STATUS OF R&D MANAGEMENT AT INDIAN PUBLIC SECTOR RESEARCH LABORATORIES AND AGENCIES - REVIEW OF GOVERNMENT INITIATIVES AND CURRENT CHALLENGES AT THE ONSET OF COVID-19 PANDEMIC

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ABSTRACT

R&D Management is a crucial aspect of any Research Organization. In India the research and development at public sector organizations are being governed by various Government Research Agencies. As all the research organizations are now focus on developing vaccines and innovative solutions to fight against pandemic. In the current study, the authors attempt to decode the various initiatives by the public sector research agencies and attempt to throw lights on challenges of R&D Management by both Central & State Governments as well as various Central & State Government agencies.

Abbreviations: R&D, Research & Development; S&T, Science & Technology; GoI, Government of India; MoST, Ministry of Science & Technology

Key words: R&D Management, Public Sector, Research, COVID

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1. INTRODUCTION

As the COVID-19 crisis is still in hands, it is testing all corners of the society starting from phlebotomists to Doctors, from Hospitals to Government Establishments. At this juncture, the

policies of the government and the research management efficiency of research and development (R&D) institutes as well as Government R&D agencies are being tested, as we are expecting a solution to the disease in a record time. The Government of India's (GoI) Ministry of Science & Technology (MoST), through the Press Information Bureau recently notified that, India's Science and Technology (S&T) Institutions has raised their game against COVID-19. The Government of India and its various scientific ministries, agencies, departments has initiated a lot of efforts to combat the pandemic. In the current paper, the authors attempted to review the R&D Management initiatives at public research organizations and to identify the good approaches adopted by the public sector research organization and the Government of India and also to highlight the current challenges being faced by the stakeholders of public research organization.

2. OBJECTIVES

The objectives of the study are:

- to explore the R&D Management initiatives at public research agencies and to identify the good approaches adopted by the public sector research agencies, laboratories and the Government of India at the onset of COVID 19 Pandemic
- to highlight the current challenges being faced by the stakeholders of public research organization.

3. METHODOLOGY

In the study was carried out following a narrative or non-systematic literature review. The secondary data were collected from the reports and government portals. Secondary Data Review is a research technique used to obtain information to create a clear analytical overview. Secondary Data Review is being undertaken by taking into account multiple pieces of secondary data in order to create a coherent as possible picture on the topic. The unstructured interviews are conducted of various stakeholders of R&D laboratories like Scientists, research scholars, suppliers, vendors to understand the current challenges, they face at the organizational levels. These interviews has been analyzed to categorize the various challenges and summarized.

4. RESULT AND DISCUSSION

4.1. Recent Initiatives

A. Scientists on Mission to solve problem in hand

There is a lot of scientific research that was under process before the COVID pandemic. Starting from the Mars Mission to the Clean Ganga Project, Indian researchers are contributing to various research problems. But due to the COVID pandemic, all the public sector research agencies of India along with private R&D set up are in a mission to solve various COVID related researches (Table.01). These research are mostly led and conducted by scientists and a team of scientists. As situation is demanding a rapid response from scientific community, Indian researchers are fulfilling the demand by working with greater intent.

B. 'Make in India' Programme being activated by Government

The GoI has activated the Make in India challenge to produce various items required for combating COVID-19 as quickly as possible and in bulk. Not only basic science researches; scientists, virologists, immunologists, regulators and industry executives, all of them are

working together with the sole purpose of finding solutions and the quickest route to manufacturing essential commodities in bulk.

C. Numerous Funding Schemes by Government

To counter the COVID-19 pandemic, various funds were made available to those engaged in research. Various Government agencies has rolled out research funding schemes (Ramesh, 2020) All the GoI agencies under Ministry of Science and Technology (MoST), Department of Science and Technology (DST), National Council for Science & Technology Communication (NCSTC), Department of Science & Technology Science and Engineering Research Board (SERB), Technology Development Board (TDB), National Innovation Foundation (NSF), Department of Biotechnology (DBT) and Biotechnology Industry Research Assistance Council (BIRAC), Council of Scientific and Industrial Research (CSIR), Nano Mission, National Research Development Corporation (NRDC), as well as other funding agencies like United States–India Science & Technology Endowment Fund (USISTEF), Small Industries Development Bank of India (SIDBI) rolled out various schemes for COVID-19 research and Development. The details of the research schemes are given in Table 02.

D. COVID-19 Task Force Initiative

A ‘COVID-19 Task Force’ has been setup by Govt. of India to map the technology capabilities in R&D labs, academic institutions, start-ups, and industry. The taskforce is consists of representatives from various other Government agencies like DBT, DST, ICMR, MEIT, CSIR, AIM, MSME, Startup India and AICTE. Till now, the Task Force has already recognized several entities in the areas of drugs, diagnostics, protection gear, disinfecting systems & ventilators.

E. The new Business as usual in R&D Management at Public Research Organizations

The lockdown period has impacted all the sectors and it's not different for the organizations and its employees of public research agencies. Despite the challenges, the new schemes were rolled out by each and every scientific and research departments and agencies in record time. The importance is given to the proposals that are ready for immediate deployment. The review mechanisms of these funding agencies are working in fast track mode. The funding support will be also made available to applicants in fast track mode. These management solutions will surely pave the way for implementation of a new business as usual for the functioning of these funding agencies.

4.2. Current Challenges

The Various challenges faced by several stakeholders of R&D Management are summarized in Fig. 01. The challenges can be categorized into 2 groups. 1) Internal Challenges 2) External Challenges.

Internal Challenges

These are the challenges exists within the organization in a laboratory set up. These can be Cultural Challenges and Process challenges. The cultural challenges are Work Culture issues, Collaboration issues and Trust Issues among stakeholders as well as mental health issues of researchers and scholars. Process Challenges are administration Complexities, Bureaucracy & Red-Tapism, Operational Issues and complex processes, lack of dedicated R&D Management Offices, lack of Reward and Award process.

External Challenges

These are the challenges lies outside the laboratory set up, generally at the funding agencies, government level. These are related to policy issues. Funding challenges includes no single platform for funding application, lack of Fast Approvals mechanisms, complex paper works, duplication issues in research proposals. Scholarships challenges are irregular disbursement and infrequent Salary revision. Collaborations challenges are less Private sector participations, no Inter-organizational collaboration platform

Figure 1 Categorization of challenges faced by several stakeholders of R&D Management at public sector research laboratories in India

Source: Self Analysis by Author through literature survey and stakeholder interview

The details of challenges are described here:

A. Additional Pressure on researchers for lightning-quick contributions

All research organizations and its scientists and researchers are putting themselves at the service of the community and demonstrating their social utility at this critical juncture. Apart from the usual work pressure, currently amid COVID-19 emergency, researchers are under an additional pressure, as they need to bring out the results in quick time. The proposals need to be prepared in lightning-quick time. They need to show the rigor and innovation of research in a greater fold than in normal time. The intellectual framework preparation is the duty of research organizations but it should not take a toll on researchers.

B. Lack of One point source for all funding schemes & centralized R&D Management

As India has several ministries and departments and they are announcing funding schemes, there is no public website which is the one point source to all information related to COVID-19 research. As a researcher, one has to keep on checking multiple government and institute websites for call for proposals, the status of application and more importantly the status of the progress of the research. When India has a 'whole government' approach to fight the COVID-19 pandemic, management of funds through a central committee under MoST could have the right approach, Instead of multiple agencies announcing multiple programs. If it is

necessary due to the bureaucratic structure of Science in India, then a central portal for funding schemes would have been a probable solution where a researcher can refer.

C. The Old Business as usual of R&D Management

Everything is fast tracked for COVID-19 research. Then, the usual question is why the same is not adopted in the normal times. If grant calls can be released by agencies in record time post approval from committees; if proposals can be submitted, reviewed and supported in fast track mode; if funds can be disbursed immediately to applicant; if procurement can be done quickly in lock down situations then the same can be also happened in post COVID pandemic in normal times. The research organization and its research management groups and committees should accept this as a new normal by leaving the old processes of systems of R&D management, which is generally perceived as “slow” by both internal and external stakeholders.

D. Bureaucratic Administration in Science labs

While not disclosing the identity, both the internal and external stakeholders point out one of the challenges is that the majority of the research laboratories follows bureaucratic governance structure and the administration usually functions in a disconnected manner without keeping the needs and realities of the research project. This is one of the reasons that actual lab research and innovation rarely solve India’s immediate problem. The COVID Pandemic may act as an alarm to forget the business as usual of the current R&D management structure. The Administrative and the R&D Management modalities need a reinvention to suit the requirement of Indian researchers, largely to solve Indian problems.

E. Lack of transparent reward sharing mechanism

The science policy should address the award and reward mechanism. Once this is sorted, we can predict that there will be an evolution of sharing culture in the laboratories. Preliminary conversation of research scholars reveal that, this exists an anonymity among the neighboring lab scientists because of the trust issues, sense of fear of around credit sharing. This hampers the collaborative environment of research laboratories.

F. No inter-organizational, inter-agency platform for collaboration and communication among scientists or scholars

As in India various agencies fund, their respective laboratories, the IT infrastructures of various laboratories functions as silos. A DBT lab’s scientist current research information is not seamlessly available to a CSIR’s research scholar. By the help of personal contacts, or sometimes through luck, people do collaboration among each other. There is an unavailability of an inter-organizational, inter- finding agency platform for collaboration and communication among scientists or scholars. Researchers rely on Linkedin, Facebook, Whatsapp and other social media platforms to connect with each other apart from emails.

G. Challenges with research fellowships

From various news reports, it was evident that research scholar showed solidarity to this situation and opted to volunteer to the cause of research and COVID-19 testing, by forgetting the challenges they face from the research administration and the R&D management system like, the low pay package issue for research scholars, the timely disbursement of fellowships, the at-par salary/fellowship revision in a uniform frequency etc.

H. Duplication issues in research proposals

As given in Table 02, it is understood that the public agencies have rolled out funding schemes for various kinds of research themes. It's obvious that there may be duplication in the research proposal and the funding agencies must be surely addressing the issue. This is surely a challenging task for different agencies. The mandate and focus of different research agencies and research departments are different. To manage scientific innovation at this large scale, a centralized institute with a centralized project management office combining all the different agencies R&D management units may be a probable solution. This can be achieved by interlinking the information system of different agencies together and the cross talks between different funding agencies is needed of the hour and perhaps, need of the future.

I. Less evolved multi-disciplinary collaborations

Usually different scientists in different research organizations work on the set objectives of their choice or as per institute's mandate when they are working. But the COVID-19 is a situation, which demands implementation of evolved work culture and what established multidisciplinary research groups should have done. Though research groups work in collaborative research mode, the process of approval for getting into multi-disciplinary collaboration is less evolved in R&D Management structure.

5. CONCLUSION

Though in the article of PIB [1], It is mentioned that under the various ministries of Govt. of India a well-coordinated approach has been implemented to motivate country's scientific community. The said "well-coordinated approach", in its implementation level, is very challenging considering the short time, when the basic scientific culture is not tuned towards using sharing of best practices, when there is a lack of common platform for various scientists, scholars to understand, which research is happening in which institute? When to make a collaborative research work, scientists have to undergo a lot of bureaucratic mechanisms, When a pandemic is required to understand that India should only spend on research of need-based innovations and in avoiding duplication of research work. All this is the eye opener that India should structure its scientific policy to address all the above challenges. Do we need to restructure the R&D Management both for business as usual and for special circumstances like these pandemic? Is our crisis management system in place and strong enough for Biotechnology and human health research? How can our research ecosystem be improved in parallel to the developed economies? What best practices do they follow to quickly produce the results like vaccine development? These are few questions, both the administrators, policy makers and social science researchers need to find out. Surely, because of this crisis our grant schemes, R&D management structure will improve along with our researches.

The outcome of the literature survey as well as information gathered during telephonic interviews of various stakeholders was explained in the discussion section in a detailed manner. The conclusion of the study is summarized in Fig.02.

Figure 2 Status R&D Management at Public Research organizations at the onset of COVID-19 outbreak

Source: Self Analysis by Author through literature survey and stakeholder interview

In such a short period of time, we can hope that India will come with flying colours and one of its researchers, one of its institutes, one of its Made-in-India company will be able to develop not just new testing kits, protective equipment, respiratory devices, but also a vaccine. In a way, the COVID-19 crisis has acted as a catalyst for the Indian scientific community, which should result in betterment of Indian Science in the coming future.

Table 1 Research and Development by Indian Research Organizations at the onset of COVID-19 outbreak

Sl No	Category	Sub Category
1	Basic Sciences	<ul style="list-style-type: none"> ○ Virus morphogenesis & Development ○ Sequencing of local strain ○ Virus-host interaction ○ Genetic variants linked with virulence ○ Evolution and transmission pattern ○ Pathogenesis studies ○ Epidemiological studies ○ Immunity & Immune responses ○ Drug repurposing against key COVID-19 targets ○ Identification of metabolite biomarkers in COVID-19 infected patients enabling therapeutic target identification ○ development of antibodies against the receptor-binding domain of the spike glycoprotein of coronavirus ○ Development of disease models for respiratory viral infections
2	Development of diagnostics kits	<ul style="list-style-type: none"> ○ ELISA ○ Lateral Flow assay ○ Molecular diagnostics - PCR, Real Time PCR ○ Development of diagnostics

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		<ul style="list-style-type: none"> ○ Colorimetric tests ○ Chemiluminescence ○ Immunoassays ○ Cell culture ○ Rapid antibody based ○ Paper strip-based testing assay
3	Development of novel therapeutics	<ul style="list-style-type: none"> ○ Develop prophylaxis clinical studies ○ Evaluate existing marketed drugs under a standard protocol in patients of COVID-19
4	Development of vaccines, anti-virals	<ul style="list-style-type: none"> ○ Vaccine candidates and enabling disciplines for corona virus vaccine development ○ Novel vaccine manufacturing technologies ○ Vaccine technology platforms
5	Development of innovative solutions	<ul style="list-style-type: none"> ○ Sanitisation - machine to reduce the viral load ○ Fast-tracking the commercialization process ○ Scale-up of technologies ○ Digital X-ray detectors for screening COVID-19 patients
6	Development of IT tools & science-based IEC	<ul style="list-style-type: none"> ○ Science-based IEC (information, educational and communication) ○ Suspects tracking apps ○ Wellness apps
7	improvement of essential commodities	<ul style="list-style-type: none"> ○ Masks, sanitizers, personal protective equipment (PPEs), dress materials for frontline health workers, ○ Alcohol-based ventilators (breathing devices) for patients ○ Antiviral and virustatic surface coating of inanimate surfaces
8	Bioinformatics and computational biology	<ul style="list-style-type: none"> ○ Computational identification and validation of COVID-19 molecular targets ○ Mathematical modeling of COVID-19 spread ○ Statistical machine learning, forecasting and inferences from pandemic data ○ Bioinformatics and computational biology ○ Algorithms for infectious disease modeling ○ Quantitative social science approaches for epidemiological models ○ Data analytics for tracking, monitoring, and controlling the spread of outbreak through AI and IoT-based solutions

Source: Self Analysis by Author through literature survey

Table 2 List of Research Schemes by Government of India Agencies

Sl No	Department	Efforts	Refer ence
1	Department of Science and Technology (DST)	<ul style="list-style-type: none"> ● Leading the coordinated effort supporting R&D, mapping entities, products which are viable, facilitating, providing seed support and also for scale up 	[1]
2		<ul style="list-style-type: none"> ● CAWACH - Centre for Augmenting WAR with COVID-19 Health Crisis for evaluating and supporting entities addressing challenges of COVID-19. ● Supporting at various steps for fast-tracking the process of commercialization and technology scale up. 	[1]
3		<ul style="list-style-type: none"> ● SATYAM - Science and Technology of Yoga and Meditation with broad theme ● immunity improvement, respiratory system improvement and interventions to overcome respiratory disorders 	[1]
4	National Council for Science & Technology Communication (NCSTC)	<ul style="list-style-type: none"> ● YASH - Year of Awareness on Science & Health with Focus on COVID-19 ● development of science, health, and risk communication software in terms of publications, audio-visual, digital platforms, folk performances, trained communicators, especially in regional languages to cater to various cross sections of the society in the country 	[8]
5	Science and Engineering Research Board (SERB)	<ul style="list-style-type: none"> ● IRPHA - Intensification of Research in High Priority Area Scheme, for epidemiological, immune response and immunity during respiratory viral infections, new anti-virals, vaccines, and affordable diagnostics. 	[1]
6		<ul style="list-style-type: none"> ● ‘Core Research Grant Special Call on COVID-19’ to meet the current requirements of the health workers such as kits or tools, computational identification and validation of COVID-19 molecular targets, and drug repurposing against key COVID-19 targets and in-vitro/clinical dose testing of nutritional supplements for immunity. 	[1]
7		<ul style="list-style-type: none"> ● Project on mathematical modeling of COVID-19 spread ● statistical machine learning, ● forecasting and inferences from pandemic data; ● focused algorithms for infectious disease modeling and ● quantitative social science approaches for epidemiological models. 	[1]

8	Technology Development Board (TDB)	<ul style="list-style-type: none"> Soft loans for research addressing protection and home-based respiratory interventions for COVID 19 patients. 	[12]
9	National Innovation Foundation (NSF)	<ul style="list-style-type: none"> ‘Challenge COVID-19 Competition (C3)’ supporting grassroots innovations for healthy food for nutrition and boosting immunity; reducing transmission and rethinking "contactless" devices for post-corona implementation needs 	[13]
10	Department of Biotechnology (DBT) and Biotechnology Industry Research Assistance Council (BIRAC),	<ul style="list-style-type: none"> COVID-19 Research Consortium Program seeking proposals from industry, academia, industry-academia partnership with a focus on affordable diagnostics, vaccines, novel therapeutics, repurposing of drugs or any other intervention for control of COVID-19. 	[11]
12	Council of Scientific and Industrial Research (CSIR)	<ul style="list-style-type: none"> NMITLI - New Millennium Indian Technology Leadership Initiative, seeking proposals from industries for effective containment interventions, assistive devices such as affordable ventilators, innovative diagnostics (rapid, affordable, cutting edge), novel drugs or repurposed drugs, new vaccines or repurposed vaccine, and track-and-trace technologies. Core Strategy Group (CSG) has been set up in CSIR and the five verticals have been identified under which the COVID-19-related activities are being carried out. These include: Digital and Molecular Surveillance; Rapid and Economical Diagnostics; New Drugs / Repurposing of Drugs and associated production processes; Hospital Assistive Devices and PPEs; and Supply Chain and Logistics 	[14]
13	NANO MISSION (DST & SERB)	<ul style="list-style-type: none"> Special call for Nano Coating COVID-19 for Antiviral Nano-coatings 	[9]
14	Small Industries Development Bank of India (SIDBI)	<ul style="list-style-type: none"> COVID-19 Startup Assistance Scheme (‘CSAS’) for providing assistance to innovative startups that have demonstrated ability to adapt to economic impact from COVID-19 and ensured its employees’ safety and financial stability. 	[5]
15	United States–India Science & Technology Endowment Fund (USISTEF)	<ul style="list-style-type: none"> United States-India Science and Technology Endowment Fund COVID-19 Ignition Grants for development and implementation of new technologies, tools, and systems to address COVID-19 related challenges including monitoring, diagnosis, health and safety, public outreach, information and communication 	[6]
16	National Research Development Corporation (NRDC)	<ul style="list-style-type: none"> Proposals related to scaling up, prototype development, market testing of the prototype, generating data required by regulatory authorities and certification 	[7]

FUTURE SCOPE

The current work is based on the literature survey and the telephonic interviews conducted with the various stakeholders during the lockdown period and the statements given in this paper must be validated by conducting systematic surveys in future.

Conflict of Interest: The author does not have any Conflict of interest.

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