

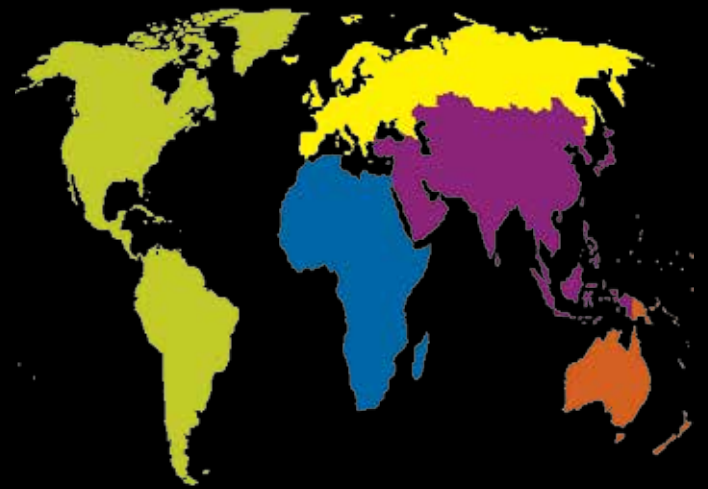
BIOTECH EXPRESS

Guest Article:

**Internet of things (IoT)
and Biotechnology (BT): A
promising technology
fusion for sustainable
development**

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- ▶ Inauguration of Nobel Prize Series India 2019 at NABI
- ▶ Women Farmer from Gorakhpur harvests highest yield from latest Wheat Variety - Karan Vandana (DBW 187)
- ▶ DBT, Govt. of India- Global AMR R&D Hub partnership
- ▶ AbbVie is terminating its Rova-T development program that cost \$5.8 billion
- ▶ GVK Bio Announces New Appointment
- ▶ WHO launches global registry on human genome editing
- ▶ Zydus Cadila receives DCGI nod to market rabies drug in India
- ▶ CSIR Young Scientist Award 2019 Announced
- ▶ Events: 16th BRSI Convention, Kerala, India



Editorial:

**Indians are behind
the Americans and
other developed
nations in Scientific
Misconduct too - the
case of biological
and medical sciences**

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September 2019

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Article submission

All queries related to article submission can be sent to biotechexpressindia@gmail.com. For more information kindly visit website: www.kashbiotech.com

Publisher : Kamal Pratap Singh

Printed at : Monex offset, B-12 SD complex, near MMG hospital, Ghaziabad- 201005.

Individual rates available to subscribers paying by personal cheque or NEFT. Order for Students, PhDs, postdoc subscription must be accompanied by a copy of student ID.



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Editorial

Indians are behind the Americans and other developed nations in Scientific Misconduct too - the case of biological and medical sciences

by Kamal Pratap Singh and Dr Seema Pavgi Upadhye
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India, the country of snake charmers has now reached to a prominent place in several global rankings, in Scientific research too, she occupies leading position. Recently, the database of retraction watch and pubpeer has got much attention worldwide, thousands of research papers and scientists' name came into attention which either found guilty or are under investigation. These series of event motivated us to do an analysis on worldwide reporting of retraction and in this article, we are looking at the scientific misconduct cases around the globe, comparing Indian misconduct cases with scientific malpractices of other worldly scientists. The basis of this study is Retraction watch.

Retraction Watch is a database of questionable scientific papers, which is apparent from their website as they directly tells about misconduct and its type(s) along with other details like scientists involved and place where it was done. This information is helping scientific community all over the world to prevent unnecessary re-

search and saving funds too, but how this whole database can be harvested is a different equation, it has many implications which we will look in this article. Many papers have already come which tells about stats of scientific misconduct, here we are trying to compile database on a global scale, emphasising India's position. The entries were taken on 20th July 2019.

1.1 R&D Spending of a country

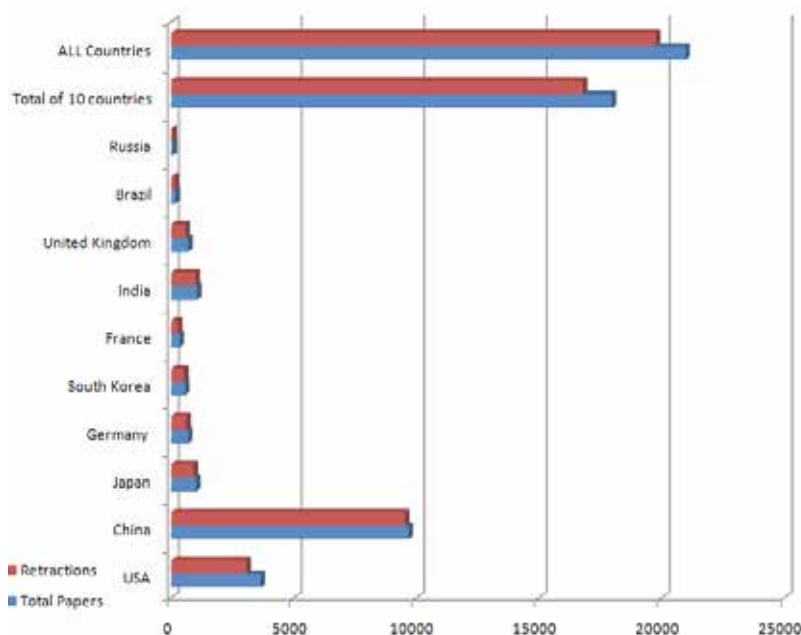
First of all, let us see how much a country is spending on R&D out of its total economic fiscal (in billion), for this, we used UNESCO's data (<http://uis.unesco.org/apps/visualisations/research-and-development-spending/>), which states that 'Global spending on R&D has reached a record high of almost US\$ 1.7 trillion. About 10 countries account for 80% of spending'. (Top 10 countries included)

1. United States
2. China
3. Japan
4. Germany
5. Korea
6. India
7. United Kingdom
8. France
9. Russia
10. Canada
11. Brazil



1.2 Total Vs Retracted Papers

S.No	Country	Total	Retractions
1	USA	3658	3082
2	China	9678	9540
3	Japan	1016	920
4	Germany	691	625
5	South Korea	565	534
6	France	345	279
7	India	1056	999
8	UK	700	590
9	Brazil	188	155
10	Russia	70	58
	Total of 10 countries	17967	16782
	ALL	20963	19767



We used these many countries for further analysis of scientific misconduct as reported by Retraction Watch. Firstly, we calculated total number of reported papers and number of papers retracted, according to the countries given in above order. The observation is given in the table:

We found no correlation between the spending and misconduct. The table shows that however USA is topmost in spending their budget but it is not no.1 in list, the pioneer position is occupied by China with close to 10,000 reported papers. Similarly, while UK has less funding, it has higher *rate* of retraction.

Since this is retraction database, we have not calculated other parameters according to the country, but the overall entries in database(which comparatively are very less). Those few other parameters are as follows:

Corrections

Expression of concern

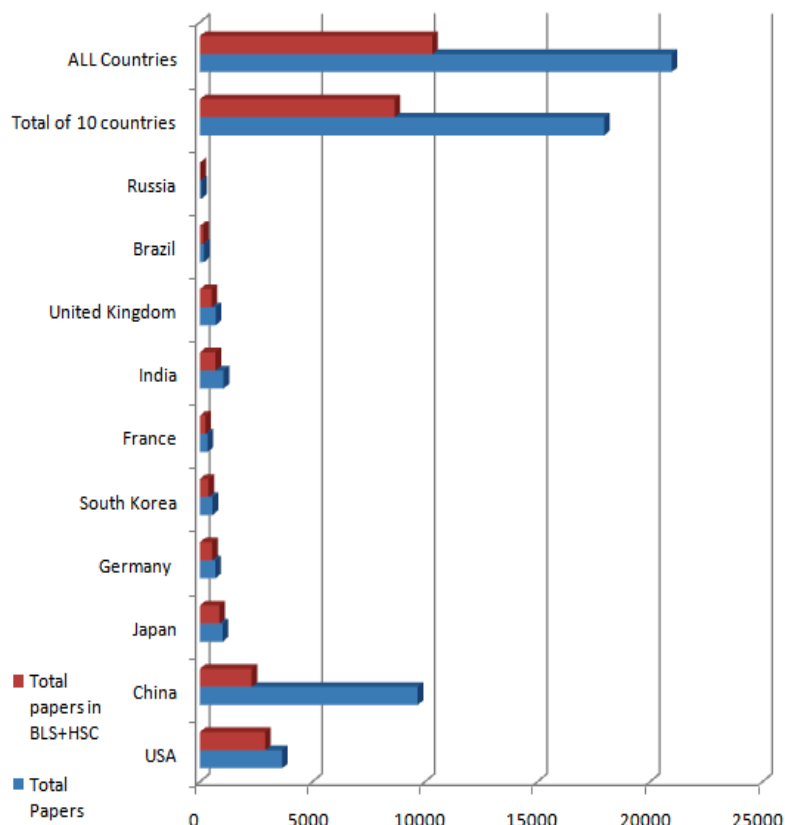
Journal Error

Publishing Ban

1.3 Contribution of Biological Science Papers

Out of all subjects, we found a much contribution of bioscience papers on retraction database, which covers medical and allied fields too(by using tag (BLS) Basic Life Sciences OR (HSC) Health Sciences in subject column), we calculated overall papers in these disciplines and continued further analysis in these fields.

	Country	Total Papers	Total papers in BLS+HSC
1	USA	3658	2901
2	China	9678	2304
3	Japan	1016	872
4	Germany	691	548
5	South Korea	565	386
6	France	345	250
7	India	1056	695
8	United Kingdom	700	522
9	Brazil	188	142
10	Russia	70	32
	Total of 10 countries	17967	8652
	ALL Countries	20963	10329



The table indicates out of total 20963 entries, 10329 or around 49.27% entries are in BLS+HSC category or we can say it is around 50%. Thus it will not be unwise to say that these fields secures prominent place in global scientific research.

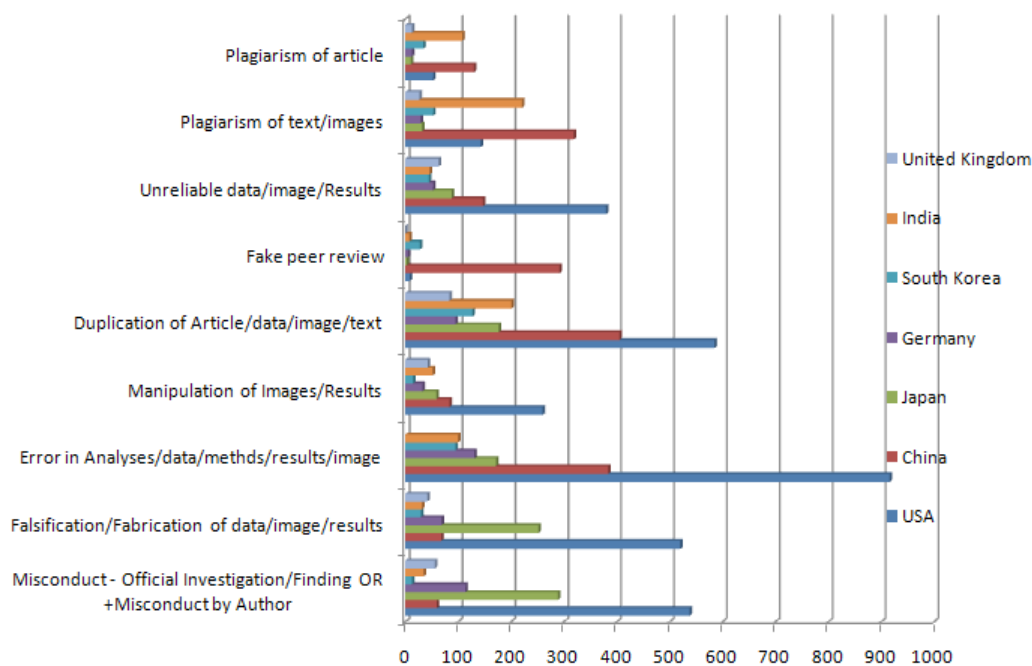
The point to notice here is about the total papers of China in chosen category, although China has highest number papers, its percent contribution in bioscience research is not matching with other countries. The 2nd position is occupied by U.S having 2nd most papers both in terms of total and in chosen categories. Next in series, India, though has more paper than Japan but Japan has more papers in bioscience, so we are placing Japan above for further analysis which makes it no.3 and India no.4, Next in the series are Germany, U.K, South Korea, France, Brazil and Russia respectively.

1.4 According to type of misconduct

(from the category (BLS) Basic Life Sciences OR (HSC) Health Sciences)

Type of misconduct	USA	China	Japan	Germany	South Korea	India	United Kingdom
Misconduct - Official Investigation/Finding OR +Misconduct by Author	538	60	289	114	13	35	56
Falsification/Fabrication of data/image/results	520	68	252	69	30	32	42
Error in Analyses/data/methods/results/image	916	384	172	131	95	100	
Manipulation of Images/Results	260	84	59	33	15	52	43
Duplication of Article/data/image/text	585	405	177	95	127	201	84
Fake peer review	9	292	3	5	28	8	0
Unreliable data/image/Results	380	147	88	53	45	46	63
Plagiarism of text/images	143	319	32	29	53	221	27
Plagiarism of article	53	130	11	13	34	108	13

Note: Bold represent highest number among countries. Note2: The table shows only few categories, for more categories kindly go to retractiondatabase.org



Following inference can be withdrawn from the above table:

1. The country with highest spending has highest rate of misconduct, we are not saying this but is apparent from the above table. USA has highest number of reported cases of scientific misconduct followed by Japan.
2. The number is almost same for falsification and fabrication too, which again is a type of misconduct. Error in analysis etc. also shows that US has highest number of scientists who makes errors frequently, it is followed by China, Japan, Germany and lastly by Indians.
3. Manipulation which must come under misconduct has impressive number of cases of USA again followed by china, Japan, Germany and then India.
4. USA is also leading in cases of Duplications, followed by China, India, Japan and South Korea
5. Chinese Scientists are making their own network of communication and leading in fake peer review, USA and other above entries has less to do with this type of misconduct.
6. US is again at the top when it comes to rely on data, followed by China and Japan.
7. Comparatively, India is leading in case of Plagiarism.

1.5 Retractions from scientists who made it to top

Retraction Watch has listed 31 researchers/scientists in their leaderboard list, which represent researchers with highest number of retractions. Some are very lucky guys to get position in this list because for some publication of these many papers is very difficult but they have published these many to retract. 183 papers by Yoshitaka Fujii of Japan who is now dismissed from research career is at top.

Name of Researcher	Total retractions	Country	Profession
1. Yoshitaka Fujii	183	Japan	Anesthesiology
2. Joachim Boldt	97	German	Anesthesiology
3. Yoshihiro Sato	84	Japan	Stem cell scientist
4. Jun Iwamoto	64	Japan	Endocrinologist
5. Diederik Stapel	58	Dutch	Social psychologist
6. Yuhji Saitoh	53	Japan	Anesthesiology
7. Adrian Maxim	48	USA	Solid-state circuits expert
8. Chen-Yuan (Peter) Chen	43	Taiwanese American	Computer scientist
9. Fazlul Sarkar	41	USA	Cancer researcher
10. Hua Zhong	41	China	Chemistry
11. Shigeaki Kato	40	Japan	Endocrinologist
12. James Hunton	37	USA	Accounting
13. Hyung-In Moon	35	South Korea	Plant researcher
14. Naoki Mori	32	Japanese	Cancer Researcher
15. Jan Hendrik Schön	32	German	Physicist
16. Soon-Gi Shin	30	South Korea	Engineer

A mere observation by looking at top 15-16 scientist revealed that most people are from Japan(6), USA(4), South Korea(2)and Germany(2), though if we go upto 31 it reveals more about origin or affiliation of these top retracters. You may access this data easily on retraction watch website.

Although not written here but two Indians are in this leaderboard, those are Rashmi Madhuri and Prashant K Sharma, who earned 26 retractions each.

We saw in all lists that US is at top but in this list Japanese researchers found prominent places and showed up at many positions. It is also to be noted that significant research area is again bioscience and/or medical sciences.

1.6 Retractions from world's topmost universities

According to the Universities rankings(QS Ranking 2018)

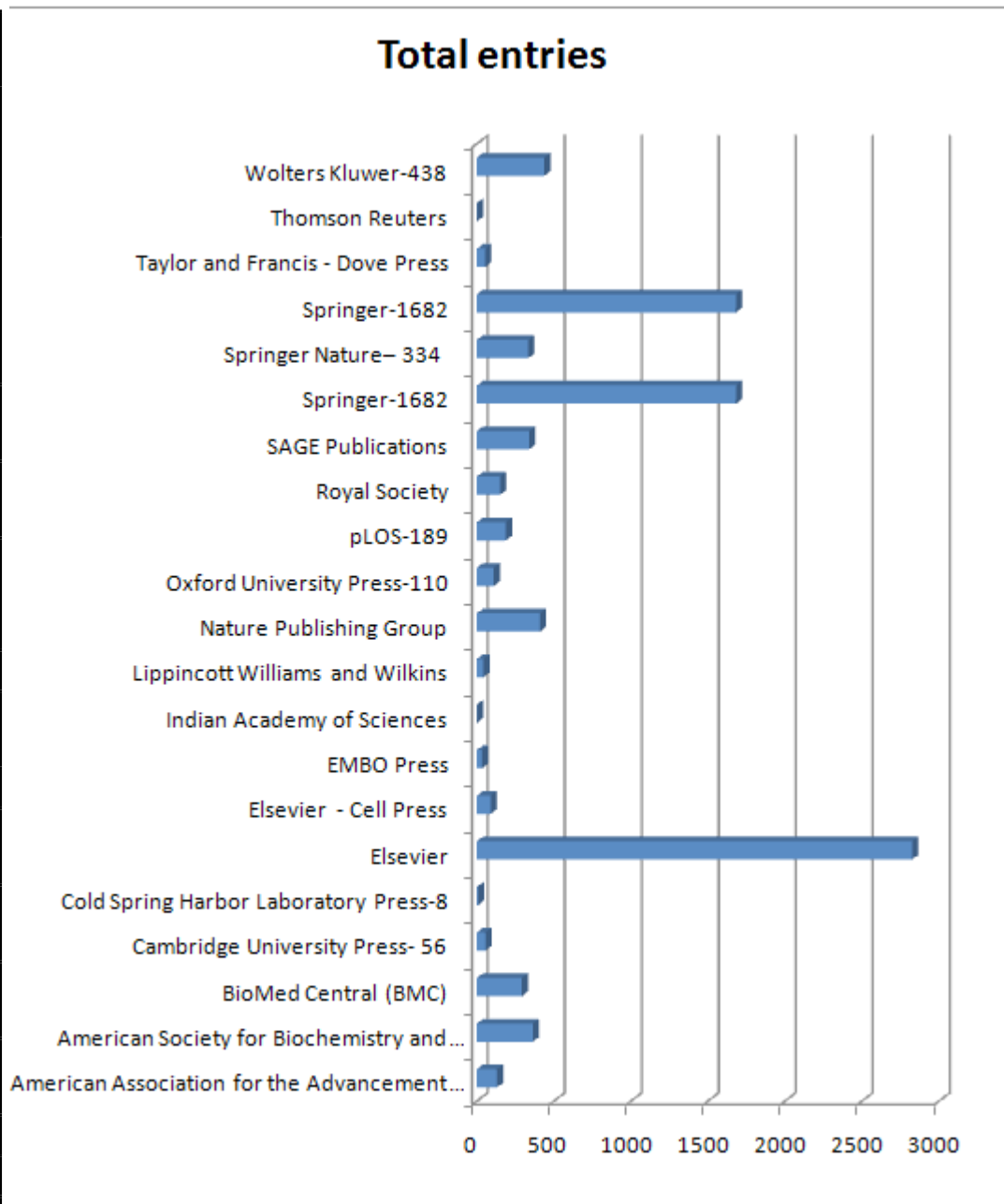
To see how World's top universities stand in terms of retraction, we analysed top 25 universities and found the following. Even top universities are home of fake scientists. Among them many are noteworthy, MIT(32), Stanford 59 UCL 45 are just some to worry.

The only exception is John Hopking which has no retraction from history or present. Though 1 or 2 retractions can be ignored because of mistake or honest mistake but large number of retractions clearly shows the need of a robust management to handle such cases of fraud.

S.No.	UNIVERSITIES	(retractions/ corrections/ others)	Country
1	Massachusetts Institute of Technology	32	United States
2	Stanford University	59	United States
3	Harvard University	31	United States
4	California Institute of Technology (Caltech)	19	United States
5	University of Cambridge	29	United Kingdom
6	University of Oxford	30	United Kingdom
7	UCL (University College London)	45	United Kingdom
8	Imperial College London	32	United Kingdom
9	University of Chicago	39	United States
10	ETH Zurich (Swiss Federal Institute of Technology)	14	Switzerland
11	Nanyang Technological University	57	Singapore
12	EPFL, SWITZERLAND	4	Switzerland
13	PRINCETON University	14	United States
14	CORNELL University	77	United States
15	National University of Singapore	68	Singapore
16	Yale University	47	United States
17	John Hopkins University	0	United States
18	Columbia University	68	United States
19	University of Pennsylvania	53	United States
20	The Australian National University	4	Australia
21	Duke University	85	United States
22	Michigan University	5	United States
23	King's College London	24	United Kingdom
24	The University of Edinburgh	2	United Kingdom
25	Tsinghua University	85	China

1.6 Retraction from World's famous Publishers

Publisher	Total entries
American Association for the Advancement of Science (AAAS)	131
American Society for Biochemistry and Molecular Biology (ASBMB)	363
BioMed Central (BMC)	292
Cambridge University Press	56
Cold Spring Harbor Laboratory Press	8
Elsevier	2826
Elsevier - Cell Press	90
EMBO Press	34
Indian Academy of Sciences	1
Lippincott Williams and Wilkins	43
Nature Publishing Group	410
Oxford University Press	110
Plos	189
Royal Society	150
SAGE Publications	340
Springer	1682
Springer Nature	334
Springer	1682
Taylor and Francis - Dove Press	53
Thomson Reuters	1
Wolters Kluwer	438



We also analysed retractions according to the publisher and found the following (in table). There are many big media houses which publishes lakhs of papers in a given year so gaining a big number is not big deal for some. But seeing retractions of Nature, AAAS (which publishes Science), ASBMB, etc. do some worry as they are known for their reputation in the market and even they have earned notable figures in this listing.

Since we were interested in Bioscience we analysed individual journals also and found hefty figures for them too, but we are not giving much information for journals because of space limitation.

Conclusion

India has long been considered a country of poors and uneducated people but in recent times she has shown his strength in many fields, for example launch of Chandrayan 2 is fresh example. Since this is a news magazine of Bioscience we are talking of bio only.

Scientific misconduct is gaining lot of attention worldwide, thanks to some whistle blowers like Retraction Watch and Pubpeer wwho are helping scientific community by dumping bad papers in a bin.

We tried to segregate Retraction watch database according to some parameters, particularly in Biological Sciences and found that though India is growing slowly but it is growing at its best. People, though are lacking skills and resources in comparison to western world but they here are still honest.

Indian Govt. is spending good amount in research, though still less but coping up and stands at number 6 position in top 10 countries.

In cases of Scientific misconduct, India is still at the bottom ranking. Total reported papers or retracted papers are much less than US, China and Japan. Like many others the main research topic in India is Biological Science research but it is again behind the US and china in numbers of reported cases of misconduct.

The very important point is what is type of misconduct whether it is intentional or unintentional. Column 1.4 talks about this and we may find that scientist from US and Japan do more intentional frauds than India, China or any other country. Fake peer review which is again a serious case of misconduct is highly prevalent among Chinese researchers.

India, though not number 1 but has good numbers in case of image dulpication and Plagiarism, which can be justified by the fact that India is still devoid of resources require to check Plagiarism. In addition, Plagiarism can be consider as seperate case of misconduct because most of such cases occurs due to honest mistake where authors were not able to check the already published papers either because they are not aware of publishing houses or if so then not able to access these papers which are behind paywalls.

As a separate branch of misconduct we strongly support negligence of Plagiarism as it is because of unavailability of softwares like Turnitin etc. in places where funding is scarce. In this line though China and USA are leading but having good numbers of Indian papers reflects the need of development of technology in Science communication.

Note: The author do not take any responsibility of any error in this article, though information made best to access. Readers are suggested to verify facts at Retraction Watch database before concluding anything.

Guest Article

Internet of things (IoT) and Biotechnology (BT): A promising technology fusion for sustainable development

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Abstract

The world has entered the era of technological overhaul and life keeps advancing by the emergence of novel technologies day-by-day. The wide insemination of technologies such as smart sensors, phones, mobile and integrated networking, miniaturization, automation and wearable's enabling the implementation of IoT in every facet of life. The rising demand for attaining the sustainability necessitates the fast research and developments in every sector including the most diversified field that is biotechnology. The Internet of Things (IoT), one of the coveted areas in technological revolution carries tremendous potential for the transformation of biotechnological research, innovation and invention. Therefore, this article forays about the current and futuristic role of IoT in advancing the innovation in biotechnological and its allied fields and confers economic up-scaling and sustainability.

Keywords: Smart sensors, Internet of things, Agriculture, Pharmaceutical biotechnology, network security

1. Introduction

The concurrent technological developments has been revoltnize the lives in current scenario. The Internet of Things (IoT), an unprecedented network platformthat connects, shares and interact data from robust and

heavy machineries and appliances to portable machines like mobile and wearable accessories with a central internet system^[1]. Therefore, IoT has enabled the connectivity throughout the universe that impacts substantially in every facet of life. Indeed, there are certain quality attributes that imparts fast acceleration of IoT in every sector that includes their size of the devices and network platforms, their ultra-fast computational efficiency and storage capacities, ability to develop intelligence, capacity to integrate, share the data through strong networking system^[2]. The prolific growth in biotechnological developments necessitates the need for the integration of IoT in this sector for enhancing the precision, reproducibility, productivity as well as entering the new horizons in the biological research invention and innovation^[3]. The rising awareness for the implementation of IoT in biotechnology sector intensifying the survey reports from Ernst and Young that reported the investment from more than 70 organizations in the biotechnological R&D sector. Therefore, this article advocates about the current role of IoT in biotechnology sector and also emphasized the current challenges and futuristic approaches that can serve as “behemoth developments” in transforming research and development^[4]. **Fig. 1** depicting role of IoT in research and development.



Fig. 1 Role of IoT in research

1. Historical background of IoT

The concept of “Internet of things” recently came into lime light and now-a-days the term has been recognized as “Internet of everything”. The idea of connected device was come into existence in 1970s but at that time the terminology has been given as “embedded internet” or “pervasive computing”. The actual term has highlighted by the pioneering work done by Kevin Ashton at Procter & Gamble in 1999 in the field of supply chain management by RFID technology. From this period onwards the technology was there but didn’t get attention from scientific communities up to 2010. From 2011 onwards, when one of the leading market research company Gartner has made the popular “hype-cycle for emerging technologies” mentioned the emerging technology “The Internet of Things”. From that time, IoT is now becoming reality and in each and every domain IoT plays significant role for the technology up-liftment^[5].

2. Components of IoT

The integration of various software and hardware technologies enables the functionality of IoT in efficient manner. The different components of IoT are described below:

- a) **Sensors & Actuators:** The sensors are designated as eyes and ears of IoT and actuators are known as muscle of IoT. The main function of the sensors and actuators is to transform energy into electrical energy in the form of data.
- b) **Transceivers** This is the hardware that enables wireless communication for data collection and transmittance. The various communication platforms are Ethernet, cellular, and Wi-Fi.
- c) **Processors & Boards** These are system on a chip devices confers intelligence to IoT systems.
- d) **Power Supplies** These are conventional thin film batteries; photovoltaic panels comprising energy harvesting modules.
- e) **Gateways & Routers** These are network connecting devices. Gateways regulate traffic between two different and non-similar network while routers controls and monitor traffic between similar networks. Together these devices help various systems to connect and integrate to the IoT.
- f) **Devices & Equipment** Products used by end users that contain IoT technologies. Examples include enabled equipment, wearables, hand-held scanners, and tracking devices.
- g) **Wearables** These are IoT enabled tiny devices and sensors that are embedded or worn on the clothing and body parts respectively.
- h) **Cloud & Fog Platforms** These are engineering architectures particularly used for carrying out extensive computation, storage and data management solutions.
- i) **Security** These are the softwares that provide security, encryption, identity protection and access control to IoT solutions. ^[6,7]

The various components of IoT have been described in **Fig. 2**.

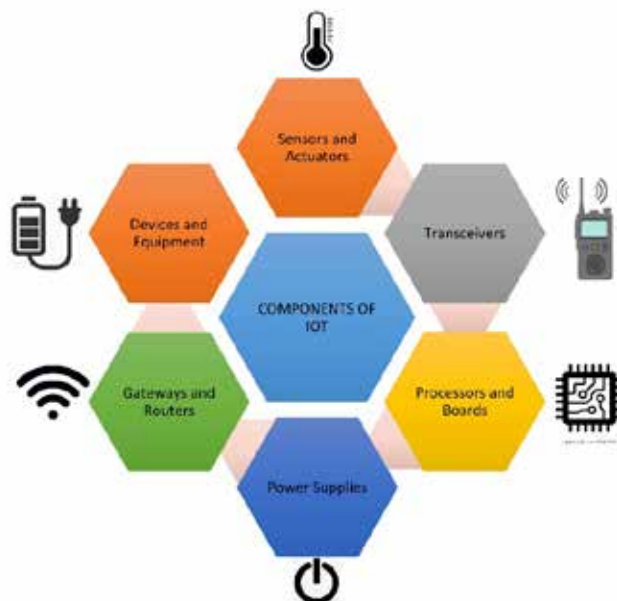


Fig. 2. Various components of IoT

3. Applications of IoT in Biotechnology

3.1. IoT in Agricultural Biotechnology

The ever growing population leads to the rising demand of food and feed for the livelihood. To achieve this livelihood and sustainability, the agriculture sector has to be improvised with latest technology that is IoT. The estimated world population in 2050 will reach by 10 billion and agriculture sector has to cope with the demand of more food with other challenges including extreme climatic and weather conditions, reducing ground water supply and associated environmental impact^[8]. Therefore, the agricultural biotechnology embracing with IoT provides a suitable alternative to transform the agricultural practices. Now-a-days, the concept of smart and precision farming paved the way for the technological inculcation for enhancing the productivity of crops in controlled and accurate manner^[9].

The development of smart sensors, automated hardware's and vehicles, robotics control systems opens the avenue of hi-tech practices of food production in hygienic and sustainable manner. Recently, various high end IoT enabled products and services have been come into limelight that provides the easy platform for the farmers to do agricultural farming in efficient way^[10]. That system includes some examples like variable rate irrigation optimizer (VRI), soil moisture probes, virtual optimizer PRO and other IoT based systems. These devices make farmers to understand the soil fertility and its composition and enhancing the efficiency of water utilization in controlled manner^[11].

More recently, the concept of smart green houses that comprises IoT based sensors that can intelligently measure and control humidity, temperature, pressure and light levels saves time, cost, energy and labor intensive process of farmers with no manual intervention and increased productivity in desired manner^[12]. Recently, advent of drones in both ground as well as aerial based systems revolutionize the agriculture by real time monitoring of irrigation, soil variability, field analysis, planting, crop health and diseases assessment^[13]. These advanced systems along with cloud computing leads to high-tech makeover in agricultural practices enabling farmers to utilize real-time data for the prediction of plant height and health, crop yield, nutritional composition of crop, canopy area mapping. Therefore, the above mentioned examples revealed the fact that IoT leads to paradigmatic shift in agriculture biotechnology sector. The wide implementation is necessary for the effective consequences of the IoT based services^[14].

Fig. 3 summarizes various applications of IoT in agricultural biotechnology.



3.2. *IoT in Pharmaceutical Biotechnology*

In the pharmaceutical industry, the discovery of novel drugs and biologics are the promising avenue for the commercialization and business. However, the pharma industries has been always challenged with the product instability and subsequent recalls, strict regulatory compliance for the adoption of GMPs and GDPs practices, operational efficiencies, and supply chain management^[15]. Therefore, its mandatory to embrace IoT in today's world of digitalization with pharma that offers surplus opportunities for the innovation, agility, consistent quality, branding and value at global scale. The significant transformation has been envisaged in the every aspect of biopharmaceutical development to clinical trials and efficient supply as per market demands.

The implementation of smart and automated equipment's and accessories provides an excellent platform for adding more precision and quality of drugs with minimal errors^[16]. The real time monitoring through smart sensing speeds up the fast regulatory reporting leads to the better adherence of regulatory compliance. The developing concept of 'Organ in a Chip' offers high-through put screening of drugs for the development of vital diagnostics with on-line monitoring. The cost of exorbitant clinical trials has been reduced by the application of IoT based sensors^[17]. The development of smart warehouses enhances the efficiency and visibility for the technicians and warehouse operators in larger extent.

The transmission of real time data for the location of products, inventory details, and maintenance of temperature for thermo-sensitive biological has drastically reduced the cost of bio-pharma by 65%. Recently, the advancements in smart packaging labels such as 2D bar-coding, RFID tags confers online tracking of the products from manufacturing to distribution^[18]. The implementation of smart serialization through Auto-ID with Automatic Information Data Collection (AIDC) in packaging materials has leads to the complete digital foot print for precise controlling of proper conditions in cold chains for the temperature-sensitive drugs during the transport.

Currently, the outburst of wearable sensing technology and the development of smart pill or ingestible pill on consumption relay the efficacy and release of drugs to the targeted regions transforms the patient health care and easy approach to trace and advice from health care professionals. Apart from that, IoT devices empower easy and fast communication of accurate and precise information of patients to doctors. Therefore, it adds on the improvement in daily lives of individuals and facilitates intensive care in home, office or social space. Therefore, based on the above discussion it is proven that IoT has immense potential to transform the pharma sector provided that pharma players could adopt this technology as soon as possible^[19]. **Fig. 4** depicting the prolific role of IoT in pharmaceutical biotechnology.

3.3. *IoT in Research and Development for Biotechnology*

The world has entered the era of "omics" by which we are acquiring and implementing the knowledge at molecular level. The high evolutionary pace of novel microbial strains, phages and other biological breakthroughs necessitates the biotechnological research more precise and agile. The acquisition of reproducibility and consistency of the results of the biotechnology research are one of the oldest and prime problems in this sector^[20]. One of the pathetic scenarios about reproducibility has highlighted in 2011, when healthcare leader Bayer has performed similar experiments for drug developmental studies published in high repute peer reviewed journals in their state-of-the-art facilities and astonishingly 25% of the results could be reproduced. In a similar line Amgen has performed experimental studies and 11% of the results could be replicated^[21]. The reproducibility can be varied in two different laboratories under same experimental conditions and infra-structural facilities^[22]. Therefore, this finicky nature of biological systems leads to early decimation of various industrial biotechnological companies such as Amyris who attempted the scale-up of the chemicals from 2 L bioreactors to 200,000-L.

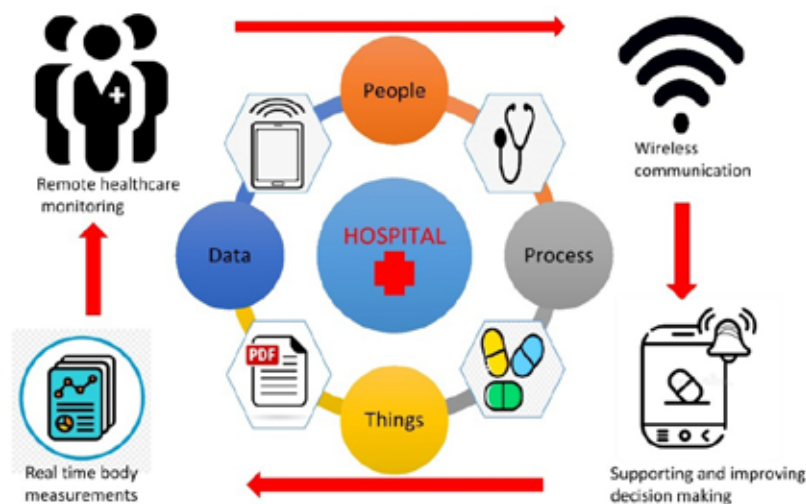


Fig. 4. Applications of IoT in pharmaceutical Biotechnology

This scenario needs to be transformed by the recent technological interventions. IoT has enabled the instruments used in biotechnological research embedded with intelligence. The interconnected communication protocols like RF and Bluetooth low energy can be used for communication with in-lab devices. The high end sophisticated sensors could be used for the collection of data with cloud servers and all the information would be digitally stored. This information could be made available by the demand of researchers after their authentication. Therefore, IoT confers promising platform for retrieving the information to the researchers belonging to any part of the world and also the information could be used for reproducing the results or taking the research at next level. Recently, among the automation laboratories in the field of biotechnology, Synbio companies have done pioneering advancements and leading name in biotech industry.

Recently, in the United States of America automated smart labs have been utilized in small scale fermentation and high-through put analytics for 15,000 operations per month for enhancing the productivity of microbial metabolites. Another classic example have been set by Ginkgo Bio-works who recently launched sophisticated automated robotic lab work flow in 18,000-square feet area. The virtual data bases have been generated and the experiments have performed with robotic arms by the identification of bar code labels. This company has involved in contract research organization for the building of novel organisms capable of synthesizing the cultured metabolites as per customers' desire and collect royalties after successful commercialization of metabolites.

Similarly, in Europe British Lab Genius is Synbio Company has rigorously involved in technological applications of artificial intelligence and automation in gene synthesis for finding and creating novel compounds and biological solutions. **Fig. 5** represented the dynamic role of IoT in biotechnological research and development. In addition to that, major IT hubs like Intel and Intrexon has also been entered in the field of service providers in the automation of R&D labs. Therefore, an immense potential has been envisaged for the application of IoT in biotechnological research in terms of enhancing productivity, accuracy and reproducibility^[23].



Fig. 5 role of IoT in biotechnological research and development

4. Current Challenges

The emergence of IoT paradigm, a global dynamic interactive network has capability of connecting everything through virtual linkage of integrated devices. They are proving their mettle in every aspect of life and biotechnology is no exception so far now-a-days. The technology is moving ahead with more innovation, invention and productivity in biotechnological research that can be clearly proven by different examples. However, IoT is embraced with sparkling glaze still facing certain challenges that need to be overcome for the successful implementation at global scale. The complex configurations of IoT devices due to utilization of diversified complex protocols laid significant impact for their acceptance in biotech industry. Apart from that, the proper authentication standards are not formulated yet therefore, the end users are not familiar with their maintenance and management of life cycle of these high-end devices. The security interfaces are very much restricted that can interact and share the security data also a barrier for their wider implementation. There are also challenges associated with their auditing and logging standards for the end users. Though, the technology has opened the window for intensifying research and development at higher pace but these challenges have to be resolved for widespread at industrial level.

5. Future perspectives

The skepticism and unpredictability of biological process, discovery of novel organisms, rising industrial demand for bio-based products and ensuring the reproducibility in biotechnological research are key players for the adoption and integration of IoT in bio-technology. Though the technology is equipped with certain challenges but there is tremendous scope for the futuristic research that can improve the efficiency of IoT in biotechnological research and development. The future work will include the establishment of network integrity in the R&D laboratory within an organization's premises that will enhance the security and trust of this technology for the expedition of innovation and invention. The technology will also improve in the development of various standards for the proper working of devices and workflow. In the future, strong networking that supports automated devices will certainly strengthen the research level in biotechnology sector.

6. Conclusion

IoT provides a window for the efficient, reproducible, fast and precise research into the biotechnology world. The IoT leads to paradigmatic developments in performing mundane tasks like automated cleaning of glass-wares and petridishes, filling multi-titer plates, dispensing cell-culture media and micro-pipetting reagents in the laboratory. The inter-connection of various laboratories is the current working domain of IoT in biotechnology research. Though the technology is embraced with certain interoperability and technical challenges but the biotechnological research is certainly on horizon by inculcation of IoT in near future.

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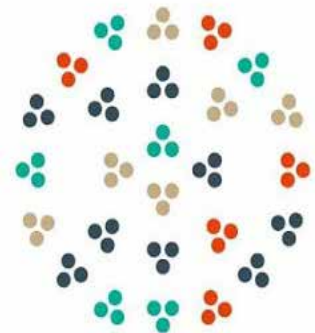
News in Focus

Department of Biotechnology, Ministry of Science & Technology, Govt. of India-Global AMR R&D Hub partnership

New, Delhi, India, 12.09.2019

The Department of Biotechnology, Ministry of Science & Technology, Government of India announce that India through Department of Biotechnology, Ministry of Science & Technology has joined the Global Antimicrobial Resistance (AMR) Research and Development (R&D) Hub as a new Member. This expands the global partnership working to address challenges and improve coordination and collaboration in global AMR R&D to 16 countries, the European Commission, two philanthropic foundations and four international organisations (as observers).

GLOBAL
AMR R&D
HUB



The Global AMR R&D Hub was launched in May 2018 in the margins of the 71st session of the World Health Assembly, following a call from G20 Leaders in 2017. The Global AMR R&D Hub supports global priority setting and evidence-based decision-making on the allocation of resources for AMR R&D through the identification of gaps, overlaps and potential for cross-sectoral collaboration and leveraging in AMR R&D. The operation of the Global AMR R&D Hub is supported through a Secretariat, established in Berlin and currently financed through grants from the German Federal Ministry of Education and Research (BMBF) and the Federal Ministry of Health (BMG).

From this year onward India will be the member of Board of members of Global AMR R&D Hub. By partnering with the Global AMR R&D Hub, India looks forward to working with all partners to leverage their existing capabilities, resources and collectively focus on new R&D intervention to address drug resistant infections. The emergence and spread of antimicrobial resistance continues unabated around the world. Given the important and interdependent human, animal, and environmental dimensions of antimicrobial resistance, it is reasonable to explore issues of antimicrobial resistance through the lens of One Health approach and should be supported by long-term commitments from all stakeholders.

Through this, all participating countries, organizations and philanthropic foundations will have a role to play to protect the efficacy of antimicrobial agents and to support the efforts of the different sectors at national, regional and global levels. Working together, AMR challenges can be well addressed and further inevitable changes can be delineated in the trajectory of health for humanity.”

The acting Chair of the Global AMR R&D Hub Board of Members, Bersabel Ephrem, Director General of the Centre for Communicable Diseases and Infection Control at the Public Health Agency of Canada said: “I am very pleased to welcome India as an important addition to our global partnership. Addressing AMR requires global action with active participation from all world regions and One Health sectors. Expanding the membership of the Hub works towards ensuring that different countries needs are incorporated when considering AMR R&D activities and actions.” In a major boost to combat one of the gravest risks to global health a dedicated special vehicle in terms of Global AMR R&D Hub may allow partners to devote expertise in order to accelerate global action against antimicrobial resistance.

For further information, please contact: Dr. Sundeep Sarin, Adviser, Department of Biotechnology, Ministry of Science and Technology, Government of India (sundeep@dbt.nic.in)

Inauguration of Nobel Prize Series India 2019 at NABI

The Nobel Prize Series is a multi-disciplinary forum featuring an exhibition, seminar, lectures, roundtables and other interactive dialogue. This year the series was conducted at the National Agri-Food Biotechnology Institute and Punjab Agricultural University in Punjab in addition to Delhi from 11 to 12 September 2019. The event was jointly inaugurated by the Dr. Renu Swarup, Secretary, DBT; Sh. Balbir Singh Sidhu, Hon’ble Minister of Health & Family Welfare Punjab, Dr. Mohd. Aslam, Advisor, DBT, Sh. Kailash Satyarthi, Nobel Laureate, Sh. Serge Haroche, Nobel Laureate and Dr. T.R. Sharma, Executive Director, NABI on 11th September 2019 at NABI, Mohali.

The theme for this year’s programme is “Teaching and Learning”. The event was attended by the Secretaries of Union Science Ministry, Vice Chancellors of the Central and State Universities and Directors of the IITs, IISERs and other National Institutes of India along with Secretaries from Punjab Govt. More than 1500 students and teachers from all across Punjab and neighbouring states took part in this mega event.



Speaking on the occasion Erika Lanner, Director of Nobel Prize Museum in Stockholm, Sweden said “Humanity today face many challenges, be it with regard to global warming, food shortages, illness or conflicts. The history of the Nobel Prize tells us that there is a way forward – science, literature and peace efforts are capable of improving and changing the world. I hope many school children and teachers in the area will be able to visit the exhibition. We want to convey a message of inspiration to the younger generation through our exhibition and show that it is possible to create a better world,”

Dr. Renu Swarup, Secretary Department of Biotechnology, New Delhi in her address said “The world premiere of Nobel Prize Museum’s new exhibition in Punjab as part of Nobel Prize Series India 2019, gives our teachers and students a unique opportunity to learn about world-changing inventions and the journey associated with them. DBT’s Partnership with Nobel Media has been very successful in inspiring thousands of students and teachers and this year the new exhibition has catalyzed a global dialogue of shared learning and experience. The young minds we inspire will be motivated to find novel and innovative ways of addressing global challenges,”

The Nobel Prize Series India 2019 brought Serge Haroche, who was awarded the Nobel Prize in Physics 2012 and Kailash Satyarthi, recipient of the 2014 Nobel Peace Prize. They were accompanied by Ms. Juleen Zierath, professor of clinical integrative physiology and a member of the Nobel Committee at Karolinska Institutet in Sweden. Nobel Laureates gave lectures and took part in roundtable discussions with experts, teachers and students. The Nobel Prize Series inspired people to seek knowledge, ask questions and contribute to improving the world. By sharing achievements and stories of Nobel Laureates with a global audience, the programme inspired engagement in science, literature and peace in line with Alfred Nobel’s vision.

Nobel Prize Museum

The Nobel Prize Museum highlights how Nobel Laureates have made the world a better place – showcasing discoveries and achievements that have saved lives, fed humanity, connected people and protected the planet. The exhibition is open to the public from 12 September 2019 – 11 October 2019, every day from 9.00 – 17.00. Based on the Nobel Prize’s unique combination of fields – natural sciences, literature and peace. The museum examines the great issues of our time and show how we can respond to them with science, humanism and cooperation. Through exhibitions, school programmes, lectures, videos, in-depth guided tours and donated artefacts, the Museum would like to generate public engagement for a better world.

ICAR-DMR organizes 22nd Mushroom Fair

The ICAR-Directorate of Mushroom Research, Solan organized a “National Mushroom Fair” today. The event was organized to commemorate the 22nd Year of declaration of Solan as the Mushroom City of India. The Chief Guest, Dr. A.K. Singh, Deputy Director General (Horticulture ScienB2ce), ICAR applauded the efforts made by Dr. V.P. Sharma, Director, ICAR-DMR and his team for up-scaling the laboratory studies to the level of commercial scale technologies.

The Special Guests, Dr. Parvinder Kaushal, Vice-Chancellor, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Solan; Dr. Manjit Singh, Former Director, ICAR-DMR and Dr. B.K. Pandey, Principal Scientist, Horticulture Science Division, Krishi Anusandhan Bhawan-II, Pusa, New Delhi deliberated on the mushrooms’ role in doubling the farmers’ income and its ability to fight the problem of malnourishment in the Indian population.

Dr. V.P. Sharma, briefed about the details on the Directorate's contributions in bringing the rapid transformation in the mushroom production in the country from a mere 40,000 MT in 1994 to 1,81,000 MT by the Year - 2018-19.

The Directorate showcased its latest technologies for the direct benefit of the mushroom growers during the occasion. These included the cultivation technology of the most prized medicinal mushroom *Cordyceps militaris*; bottle cultivation technology of winter mushroom and improved varieties of oyster, shiitake and paddy straw mushrooms, etc.

The Kisan Goshthi organized during the occasion provided the farmers, mushroom growers and extension workers with an opportunity to interact face-to-face with the scientists and experts of ICAR-DMR on various mushroom related problems. Around 6 farmers from the different states were honored for adopting the innovative technologies and contributions made in the mushroom production. More than 40 government and private entrepreneurs, mushroom growers and NGOs exhibited their products and around 1,200 farmers from 17 different states participated in the fair.

(Source: ICAR-Directorate of Mushroom Research, Solan)

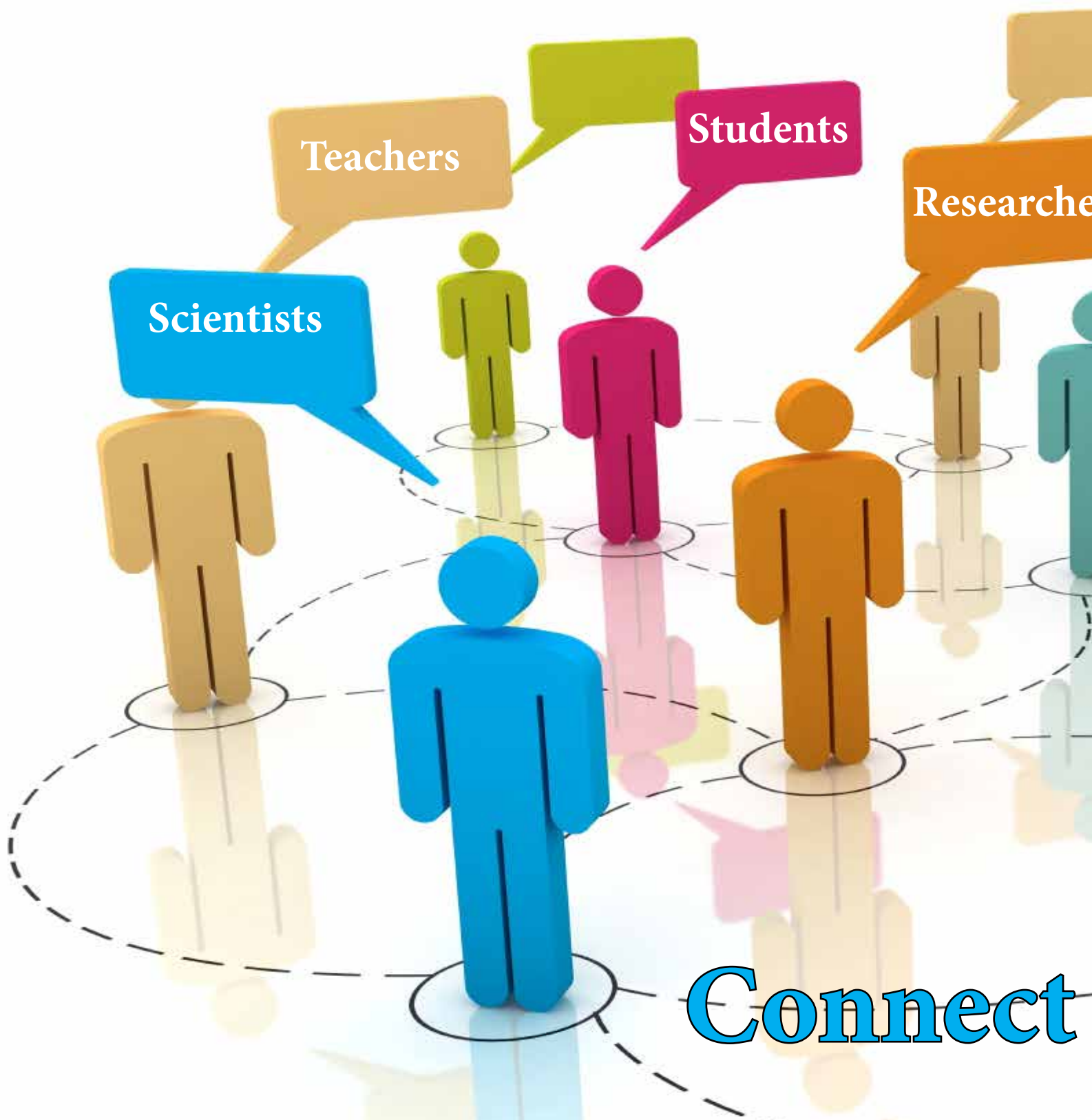


Women Farmer from Gorakhpur harvests highest yield from latest Wheat Variety - Karan Vandana (DBW 187)

The variety had significant yield advantage over the existing cultivars, viz., HD 2967, K 0307, HD 2733, K 1006 and DBW 39 of the zone. It possesses better resistance against the important diseases of the region like leaf rust and leaf blight. The Karan Vandana variety flowers in 77 days and matures in 120 days after sowing. Its average height is 100 cm and has the potential of 64.70 q per ha. The variety has better Chapatti quality with 7.7/10 score and high iron content (43.1 ppm) in the grains.

For popularizing and promoting the variety, ICAR-Indian Institute of Wheat and Barley Research, Karnal in collaboration with the Mahayogi Gorakhnath Krishi Vigyan Kendra, Gorakhpur, Uttar Pradesh organized the training programme on 16th November, 2018 for the wheat farmers of the District.

Smt. Koila Devi, W/O Shri Arjun from the village Rakhukhor, Junglekaudiya, Gorakhpur was among the 100 farmers who participated in the training programme and received the mini kit of 2.5 kg seed of Karan Vandana. She carried out the wheat sowing in line in the third week of November, 2018. Smt. Koila applied the recommended dose of fertilizers (150:60:40 kg NPK/ha) in the field and applied the irrigation two times. By carrying out the weeding manually two times during the crop season, she harvested 220 kg wheat yield from the small area of 266 m² (82.52 q/ha) on 10th April, 2019. Now, Smt. Koila Devi is the source of aspiration and motivation for the other farmers of the region.



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NEWS: Govt & Industry

After another clinical failure, AbbVie is terminating its Rova-T development program that cost the company \$5.8 billion in upfront funds three years ago

Illinois-based AbbVie announced that the Phase III MERU trial evaluating Rova-T as first-line maintenance therapy for advanced small-cell lung cancer (SCLC), failed to demonstrate a survival benefit following a pre-planned interim analysis.

While the safety profile remained the same as with other trials involving the drug, AbbVie's disappointing run with Rova-T has come to an end. The company said it was halting the MERU trial and discontinued the R&D program it had established following the 2016 acquisition of South San Francisco-based Stemcentrix. AbbVie said it will use its funds to prior-



itize other development programs within its oncology pipeline.

AbbVie halted the MERU trial following recommendation by an Independent Data Monitoring Committee (IDMC).

Rova-T is an antibody-drug conjugate designed to target cancer-stem cell-associated delta-like protein 3 (DLL3). The DLL3 protein is expressed in more than 80% of small-cell lung cancer patient tumors. It is prevalent on tumor cells, including cancer stem cells, but not present in healthy tissue, AbbVie said. When AbbVie acquired Rova-T, the company was eyeing more than just the lung cancer market. AbbVie was banking on using the drug to target other cancers where expression of DLL3 was high, such as metastatic melanoma, glioblastoma multiforme, prostate, pancreatic and colorectal cancers. In those cancers, DLL3

expression ranges from 50% to 80%.

Prior to the MERU trial, in December 2018, AbbVie halted a Phase III study of Rovalpituzumab Tesirine (Rova-T) as a second-line treatment for advanced small-cell lung cancer. That trial was halted after an IDMC called for the stoppage due to shorter overall survival in the Rova-T arm.

India-UK project to find affordable solutions to cancer

In order to promote research in affordable approaches to cancer, the government's Department of Biotechnology has joined hands with British charity, Cancer Research UK, to launch a research challenge for affordable approaches to cancer

In India, one million new cases of cancer are reported every year. Nearly 60 per cent of the cases reach hospitals in late stages when survival is difficult. For many cancers, early detection can lead to better treatment and greater chances of survival. The situation could change if affordable screening tools, cheaper diagnostic tests and more effective treatment regime become available. In order to promote research in affordable approaches to cancer, the government's Department of Biotechnology has joined hands with British charity, Cancer Research UK, to launch a research challenge for affordable approaches to cancer. The initiative will fund research projects totaling 10 million pounds over the next five years. The initiative will be managed by DBT/Wellcome Trust India Alliance.

The objective is to stimulate focused, multidisciplinary research to address important challenges in affordability in cancer prevention, diagnosis and treatment, by bringing together research strengths of India and the UK. Seven research challenges under the theme of affordable approaches to cancer have been identified.

These are prevention, early detection, early diagnosis, computational approaches, small molecule treatment, treatment and cancers of children and young people.

Besides research in affordable early detection and diagnosis, researchers will have to develop computational approaches that can reduce the cost of cancer care delivery. Research projects for identifying novel, affordable treatment approaches for hard to treat cancers using small molecules will also be funded. For cancers of children, new approaches need to be developed to improve long-term quality of life in children and young people with cancer.

The initiative is being implemented in three phases. Under the first phase, core challenges have been identified. The second phase will see establishment of new research partnerships, and projects will be funded in the last phase. DBT, Cancer Research UK and DBT/Wellcome Trust India Alliance have signed a tripartite agreement under which the India Alliance will undertake grant funded activities for second and third phases. Seed-funded teams will get awards of up to £1.5 million (approximately Rs 13.1 crores) over 4 years.

GVK Bio Announces New Appointment And Updates

GVK BIO, a leading global Contract Research and Development Organisation (CRDO), is pleased to announce the promotion of Sudhir Kumar Singh, Ph.D., to the position of Chief Operating Officer and the appointment of Ramesh Subramanian, Ph.D.,(photo) as its new Chief Commercial Officer.



Sudhir joined GVK BIO in 2013 as a Senior Vice Pres-



Manni Kantipudi • 1st

CEO, GVK BIO; Accelerating R&D and bringing partner products to marke...

now ...

Congratulations Ramesh!! A warm welcome to GVK BIO and best wishes. Looking forward to working with you as we build #GVKBIO into a trusted and preferred partner to our customers...#AcceleratingRnD #CRDO

entry into the equity markets- Jubilant Life Sciences, and XL Advisors. Ramesh also has held key leadership roles at SK Capital Partners/Ascend Performance Materials and Johnson Matthey.

ident and has been driving the Discovery Research business. He has been successful in integrating best practices in Chemistry, Biology and Chemical Development to be able to meet the key business goals.

“Sudhir, over the years has brought in a transformational change in the Discovery Research vertical and has been instrumental in sustaining GVK BIO’s leadership in the Chemistry business in terms of delivery and profitability,” commented Manni Kantipudi, Director & CEO, GVK BIO. “In his new role, Sudhir will focus on leading and building a customer-centric culture, strengthen our rapidly growing development and manufacturing footprint, while ensuring safety and compliance in the work environment.”

“Additionally, I am pleased to welcome Ramesh Subramanian to the GVK BIO management team. Ramesh brings with him deep industry knowledge in the various verticals of GVK BIO. I look forward to working with him towards our stated goal of making GVK BIO the ‘partner of choice’ for Life Science companies seeking to accelerate their R&D. In his role, Ramesh will be responsible for all Business Development, Sales, Marketing, and Corporate Development activities.”

Ramesh Subramanian brings over 20 years of global experience in building businesses across Asia, Europe, and North America, raising venture capital, implementing transformational strategies, driving M&A, and managing cross-border alliances.

Prior to joining GVK BIO, Ramesh served as the Senior Vice President and was a part of the management team at Piramal Pharma Solutions. Over his career, Ramesh has been part of management teams at Chemizon- a firm he led from start-up to a successful

Ramesh has a Ph.D. in Chemical Engineering from West Virginia University, a B.Tech. in Chemical Engineering from IIT-Varanasi, and an MBA in Finance from The Wharton School, University of Pennsylvania.

Experts disagree with ICMR, India recommendations on electronic nicotine delivery systems

Over 62 specialists in nicotine, science, policy and medicine urge ICMR to reconsider its recommendations on ENDS

The experts’ letter draws upon the findings of an elaborate Critical Appraisal of the Scientific Evidence cited in the ICMR White Paper and challenges ICMR’s



radical recommendation of complete prohibition on ENDS or e-cigarettes, claiming that these views are in contradiction of the broad consensus amongst the scientific community. The letter, signed by experts from 20 countries, including India, urges ICMR to reconsider its recommendation of banning e-cigarettes.

The experts claim that the ICMR White Paper fails to present a balanced overview of the risk-benefit ratio of ENDS vis-à-vis other combustible tobacco products and therefore, their recommendations for e-cigarette ban are not justified.

ICMR's paper claims that e-cigarettes are a gateway to "smoking and nicotine addiction", citing the 2016 US Surgeon General's report which reports a large increase in e-cigarette use among youth. However, the Critical Appraisal shows that the US Surgeon General's report does not differentiate between ever-use (even once), experimental use (in the past month) and regular use. The experts present evidence from the US' Monitoring the Future and National Youth Tobacco Survey, which shows that frequent e-cigarette use is confined almost completely to smoking youth and rate of use among never-smokers is low. The issue of addiction to nicotine from e-cigarettes, therefore, is irrelevant since its users were already addicted to nicotine from tobacco cigarettes.

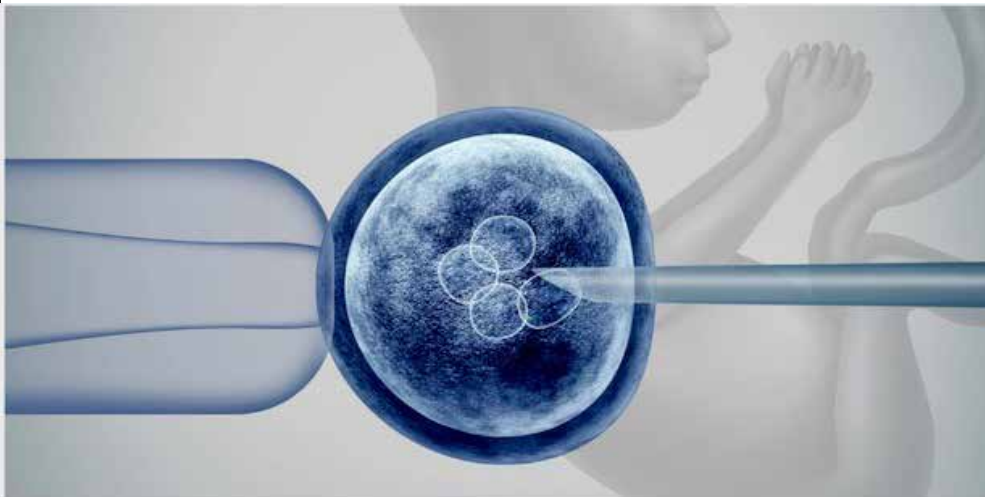
WHO launches global registry on human genome editing

A WHO expert advisory committee has approved the first phase of a new global registry to track research on human genome editing. The 18-member committee also announced an online consultation on the governance of genome editing.

Addressing the second meeting of the committee on effective governance and oversight of human genome editing, Dr Tedros Adhanom Ghebreyesus, WHO's Director-General, said, "Since our last meeting, some scientists have announced their wish to edit the genome of embryos and bring them to term. This illustrates how important our work is, and how urgent. New genome editing technologies hold great promise and hope for those who suffer from diseases we once thought untreatable. But some uses of these technologies also pose unique and unprecedented challenges – ethical, social, regulatory and technical." Dr Tedros emphasized that countries should not allow any further work on human germline genome editing in human clinical applications until the technical and ethical implications have been properly considered.

Accepting the recommendation of the Committee, WHO announced plans for an initial phase of the registry using the International Clinical Trials Registry Platform (ICTRP), a WHO entity. This phase will include somatic and germline clinical trials. In order to ensure that the registry is fit for purpose and transparent, the committee will engage with a broad range of stakeholders on how it will operate. The Committee called on all relevant research and development initiatives to register their trials. To enhance the development of a global governance framework for human genome editing, the Committee will undertake online consultations and in-person engagement.

WHO's advisory committee on developing global standards for governance and oversight of human genome editing was announced by Dr Tedros in December 2018.



Zydus Cadila receives DCGI nod to market rabies drug in India

Zydus Cadila on September 3 said it has received marketing authorisation for Twinrab, used for treating rabies, from the Drug Controller General of India (DCGI).

“The novel biologic which will be marketed under the brand name, Twinrab, is indicated in combination with rabies vaccine for rabies post-exposure prophylaxis,” Zydus Cadila said in a statement.

Rabies, a viral disease which gets transmitted through the bite of a rabid animal, affects the central nervous system.

Zydus said in 2008, it had entered into an agreement with the World Health Organization (WHO) to explore opportunities in the development of a cocktail of monoclonal antibodies for the treatment of rabies.

“The use of rabies monoclonal antibodies could emerge as an innovative therapy and form a potent alternative to current blood derived rabies immunoglobulins (RIG’s) produced by vaccinating horses (ERIG) or humans (HRIG),” the company added. Zydus said it currently also manufactures and markets the rabies vaccine — VaxiRab which is a WHO pre-qualified vaccine.

Five Months After FBI Raid, uBiome Filed for Bankruptcy

In April, uBiome became the subject of an FBI investigation over allegations of illegal billing practices. The FBI raided the offic-



Photo: uBiome founder Jessica Richman (right)

es of uBiome following intense scrutiny of the lab-testing company’s billings involving Medicare.

After the FBI raid, the company’s co-founders and co-chief executive officers were placed on administrative leave and Rakow, who had been serving as general counsel, was placed at the helm of the company. However, he resigned from uBiome in July, as did the company’s two co-founders who had been on administrative leave. Founded in 2012, uBiome uses advanced technology to analyze the microbiomes on the human body. The company has four primary consumer products, SmartGut, SmartJane, Explorer and Explorer Plus.

In its announcement, uBiome did not name any of the potential new owners but stressed that any offers will be evaluated to ensure that the company’s shareholders, as well as its creditors, receive maximum benefit. While it undergoes the Chapter 11 procedure, uBiome said it obtained financing from 8VC and Silicon Valley Bank to support its ongoing operations during the sale process.

Earlier this year, uBiome was named one of the top five companies to emerge from incubators in the Bay Area. The company came out of StartX, Y Combination and 500 Startups. As of January, it had raised more than \$109 million to support its technology. Last year alone, the company raised \$83 million in Series C financing.

CSIR Young Scientist Award 2019 Announced

Two scientists were awarded CSIR Young Scientist award 2019.

1. Dr. Bidyut Purkait is working in Parasitology Division in CSIR-Central Drug Research Institute, Lucknow. His Research Area interest is in parasite biology which is driven by the desire to understand (A) RNA editing pathway and Molecular Mechanism of Drug Resistance in *Leishmania donovani*, causative agent of Visceral Leishmaniasis (VL) or Kala-azar and (B) the molecular mechanism behind the transformation of filarial parasite, *Brugia malayi*, causative agent of Lymphatic Filariasis (LF) from larval stage (resides in vector) to adult worms (resides in host) and to identify novel drug target thorough proteomic and genomic approach. (A) Visceral leishmaniasis (VL) or kala azar



2. Dr. Lipi Thukral is working in CSIR-Institute of Genomics & Integrative Biology, Delhi.

Her current areas of research include:

- Molecular motions of proteins and lipids and how their interactions lead to dynamic supra-molecular assemblies
- Mechanism of lipid-modified proteins in membrane signaling events
- Modeling approaches to identify specific motifs crucial for protein-ligand interactions



er claimed to perform a large clinical trial single-handedly



Is it possible for just one researcher to perform a clinical trial of more than 200 participants?

According to the editorial board of the European Journal of Obstetrics & Gynecology and Reproductive Biology, an Elsevier title, the answer would seem to be no. The journal has decided to retract a 2016 paper in which the author claimed to have conducted such a large trial on their own.

Here's the notice for "Calcium versus oral contraceptive pills containing drospirenone for the treatment of mild to moderate premenstrual syndrome: A double blind randomized placebo controlled trial:"

This article has been retracted at the request of the Editorial Board for the following reason: This single-author publication which reports the conducting of a large 3-arm randomised controlled trial, with no missing data from 210 recruited patients, has been questioned as implausible. The authors have been unable to provide supporting documents to provide an explanation.

The paper, by Nesreen Shehata of Beni-Suef University in Egypt, has been cited eight times, according to Clarivate Analytics' Web of Science.

"Questioned as implausible:" Journal retracts paper because a research-

A new SWIFT technology towards 3D-printed organs

Now, a new technique called SWIFT (sacrificial writing into functional tissue) created by researchers from Harvard's Wyss Institute for Biologically Inspired Engineering and John A. Paulson School of Engineering and Applied Sciences (SEAS), overcomes that major hurdle by 3D printing vascular channels into living matrices composed of stem-cell-derived organ building blocks (OBBs), yielding viable, organ-specific tissues with high cell density and function. The research is reported in *Science Advances*.



SWIFT involves a two-step process that begins with forming hundreds of thousands of stem-cell-derived aggregates into a dense, living matrix of OBBs that contains about 200 million cells per milliliter. Next, a vascular network through which oxygen and other nutrients can be delivered to the cells is embedded within the matrix by writing and removing a sacrificial ink. "Forming a dense matrix from these OBBs kills two birds with one stone: not only does it achieve a high cellular density akin to that of human organs, but the matrix's viscosity also enables printing of a pervasive network of perfusable channels within it to mimic the blood vessels that support human organs," said co-first author Sébastien Uzel, PhD., a Research Associate at the Wyss Institute and SEAS.

The cellular aggregates used in the SWIFT method are derived from adult induced pluripotent stem cells, which are mixed with a tailored extracellular matrix (ECM) solution to make a living matrix that is com-

pacted via centrifugation. At cold temperatures (0-40C), the dense matrix has the consistency of mayonnaise - soft enough to manipulate without damaging the cells, but thick enough to hold its shape - making it the perfect medium for sacrificial 3D printing. In this technique, a thin nozzle moves through this matrix depositing a strand of gelatin "ink" that pushes cells out of the way without damaging them.

When the cold matrix is heated to 37 oC, it stiffens to become more solid (like an omelet being cooked) while the gelatin ink melts and can be washed out, leaving behind a network of channels embedded within the tissue construct that can be perfused with oxygenated media to nourish the cells. The researchers were able to vary the diameter of the channels from 400 micrometers to 1 millimeter, and seamlessly connected them to form branching vascular networks within the tissues.

Organ-specific tissues that were printed with embedded vascular channels using SWIFT and perfused in this manner remained viable, while tissues grown without these channels experienced cell death in their cores within 12 hours. To see whether the tissues displayed organ-specific functions, the team printed, evacuated, and perfused a branching channel architecture into a matrix consisting of heart-derived cells and flowed media through the channels for over a week. During that time, the cardiac OBBs fused together to form a more solid cardiac tissue whose contractions became more synchronous and over 20 times stronger, mimicking key features of a human heart.

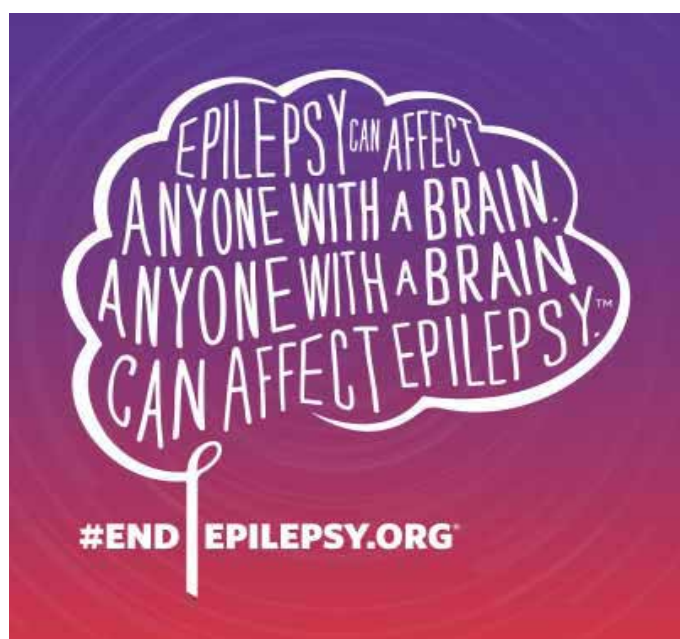
"Our SWIFT biomanufacturing method is highly effective at creating organ-specific tissues at scale from OBBs ranging from aggregates of primary cells to stem-cell-derived organoids," said corresponding author Jennifer Lewis, Sc.D., who is a Core Faculty Member at the Wyss Institute as well as the Hansjörg Wyss Professor of Biologically Inspired Engineering at SEAS. "By integrating recent advances from stem-cell researchers with the bioprinting methods developed by my lab, we believe SWIFT will greatly advance the field of organ engineering around the world."

Journal Reference:

Biomanufacturing of organ-specific tissues with high cellular density and embedded vascular channels. *Science Advances*, 2019; 5 (9): eaaw2459 DOI: 10.1126/sciadv.aaw2459

Breaching the brain's defense causes epilepsy

The study investigated epileptic seizures in zebrafish -- a widely used model organism for modelling hu-



man brain physiology. Zebrafish contains the same cell types that are present also in human brains. Two of these cell types are glia and neurons. Neurons are primarily involved in transmitting signals. The main functions of Glial cells include maintaining a balanced environment and providing support for the neurons, assisting the immune system and increasing the speed of neural signalling.

The study found that just before an epileptic seizure, nerve cells were abnormally active but only in a localized area of the brain. Instead, glial cells showed large burst of synchronous activity that are widely dispersed across the brain. During the actual seizure, the neuronal activity increased abruptly. The functional connections between the nerve cells and glial cells

became vigorous. When this happened, generalized seizure spread like a storm of electrical activity across the entire brain due to a strong increase in the level of glutamate, a chemical compound that transmits signals between neuronal cells. Glutamate was secreted by glial cells, which convert themselves from a friend to a foe.

The findings indicate that epilepsy may occur not only due to anomalies in neurons, but also in glial cells. "Our results provide a direct evidence that the interactions between glial cells and neurons change during the transition from a pre-seizure state to a generalized seizure. It will be interesting to see if this phenomenon is generalizable across different types of epilepsies," says Prof. Emre Yaksi. Normally, the glial cells absorb the excess glutamate that is excreted during the increased activity of the nerve cells. This study assumes that the secretion process of the glial cells that we observed in combination with their hyperactivity just before a seizure is a defence mechanism of the brain.

Journal Reference:

Glia-neuron interactions underlie state transitions to generalized seizures. *Nature Communications*, 2019; 10 (1) DOI: 10.1038/s41467-019-11739-z

Northwestern researcher has four more papers retracted, making five

Yashpal Kanwar, A pathologist in Chicago has lost five papers for image manipulation and other problems.

The first retraction for Yashpal Kanwar, of the Feinberg School of Medicine at Northwestern University, appeared in 2013, for a review article published earlier that year in the *American Journal of Physiology Renal Physiology*. According to the notice:

This review article contains a number of passages that are similar or identical to that of an excellent review by Mélanie Métrich et al. in *Pflügers Archiv-European*

Journal of Physiology 459(4): 535–546, 2010, and to that of other reviews. We also did not reference all of the sources for these passages.

We offer our formal apologies for this error and for any inconvenience associated [sic] with the publication of this article. The paper is therefore being retracted by the American Physiological Society, at the request of Drs. Yang and Sun, with the approval of the other coauthors.

Then, this past June, the Journal of Biological Chemistry removed four more of Kanwar's articles, including one from 2002 titled "High glucose stimulates synthesis of fibronectin via a novel protein kinase C, Rap1b, and B-Raf signaling pathway."

Kanwar in an email told to Retraction Watch that the work is solid:

JBC informed me regarding the retraction. As far as I know there are no more papers slated for retraction. The conclusions of all the four articles remains unchanged.

Biomarker identified for early beta cell death in Type 1 diabetes

Anath Shalev, M.D., and colleagues at the University of Alabama at Birmingham now have identified an early biomarker of Type 1 diabetes-associated beta-cell loss in humans -- microRNA-204, or miR-204.

"Serum miR-204," Shalev said, "may provide a much needed novel approach to assess early Type 1 diabetes-associated human beta-cell loss, even before onset of overt disease."

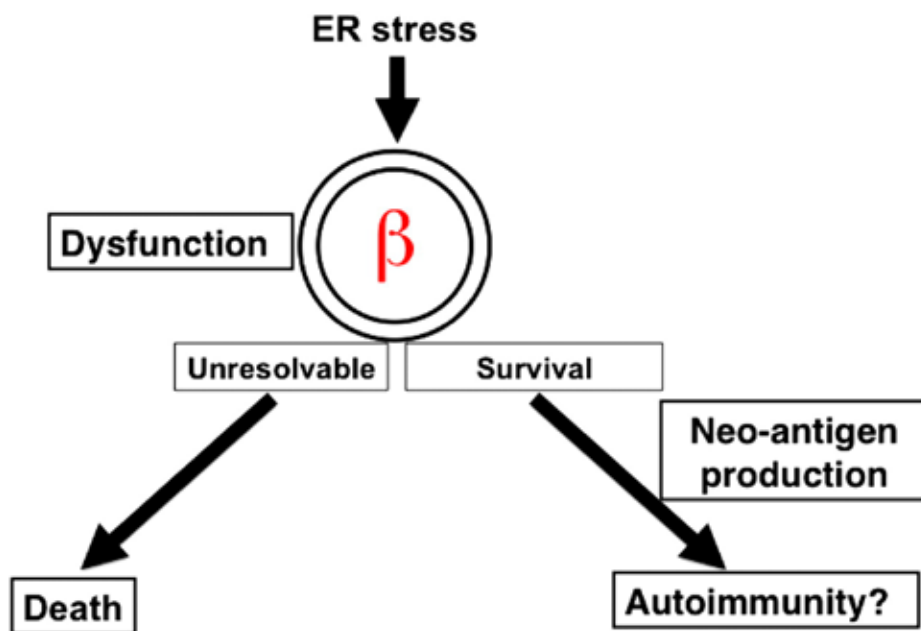
MicroRNAs are found in animal

and plant cells, where they help control gene expression. In previous work, Shalev found that miR-204 plays key roles in regulating insulin production and other critical beta-cell processes. Now, in a study published in the American Journal of Physiology-Endocrinology and Metabolism, Shalev and colleagues report that miR-204, which is highly enriched in human beta cells, is released by dying beta cells. After that release, it becomes detectable in circulating blood.

Measurements using human blood samples showed that serum miR-204 was elevated in children and adults with early Type 1 diabetes, and in people with autoantibodies who are at risk for Type 1 diabetes, but it was not elevated in Type 2 diabetes or another autoimmune disease. Furthermore, serum miR-204 levels were inversely correlated with remaining beta-cell function in recent-onset Type 1 diabetes.

"Having a non-invasive, straightforward method sensitive enough to detect early beta-cell loss -- especially prior to the diagnosis of Type 1 diabetes -- is critical in order to allow for any therapeutic intervention to be started as early as possible in the disease process and ideally before the majority of beta cells has been destroyed," Shalev said.

Discovery of the biomarker was a step-by-step, hypothesis-driven process, starting from the observation that miR-204 had 108-fold higher expression in



pancreatic islet beta cells as compared to pancreatic alpha cells.

The researchers first showed that miR-204 was released by cultured rat beta cells after induction of cell death by streptozotocin. Then they showed that killing of beta cells in mice given streptozotocin led both to diabetes, as expected, and to a massive increase in serum miR-204 levels.

Next, they showed that Type 1 diabetes-associated inflammatory cytokines, which induce beta cell death, caused release of miR-204 from both cultured rat beta cells and primary human pancreatic islets.

To test miR-204 in humans, they looked at serum from people receiving autologous pancreatic islet transplantations. It is known that islet transplantation is associated with massive beta-cell death shortly after the transplantation. The researchers found that miR-204 levels in serum rose sharply, 20 to 40 minutes after islet infusion.

The researchers next found that serum miR-204 was significantly elevated in children with recent-onset Type 1 diabetes. It was also elevated nearly threefold in adults with recent onset Type 1 diabetes and more than twofold in people with autoantibodies that put them at risk for Type 1 diabetes.

In contrast, it was not significantly elevated in people with Type 2 diabetes or people with the autoimmune disease rheumatoid arthritis. It was not significantly elevated in people who have had Type 1 diabetes for a long time and have lost most of their beta cells.

Serum miR-204, Shalev and colleagues found, correlated with remaining beta-cell function, as measured by the “gold standard” of mixed-meal stimulated C-peptide area under the curve. Serum miR-204 also showed good predictive diagnostic power in the context of early Type 1 diabetes, including the ability to differentiate adult recent-onset Type 1 diabetes from Type 2 diabetes. That is useful because adults with Type 1 diabetes are often misdiagnosed when first found to have diabetes.

Journal Reference:

Serum miR-204 is an early biomarker of type 1 diabetes-associated pancreatic beta-cell loss. *American Journal of Physiology-Endocrinology and Metabolism*, 2019; DOI: 10.1152/ajpendo.00122.2019

Scientists shows how mutations in two different genes coordinate to drive the development of malignant lung tumors



The study in novel genetically engineered mice looked at the characteristics of lung tumors from when they are invisibly small to when they are larger and potentially deadly. The results shed new light on the mechanisms of tumor progression and will help researchers currently developing drugs for lung tumors.

There are many types of lung cancer: non-small cell lung cancer (NSCLC) is the leading cause of cancer-related death globally, and lung adenocarcinoma is the most common subtype of NSCLC. Around 75% of lung adenocarcinomas have mutations that affect two important control mechanisms for cell growth -- the MAP kinase pathway, and the PI3'-kinase pathway. Each pathway alone is not sufficient to cause lung cancer; they need to coordinate to make this happen.

“We knew that mutations in the MAP kinase path-

way promote the growth of benign lung tumors, but that PI3'-kinase mutations alone do not kickstart tumor formation in the same cells," explains lead author Ed van Veen, former Postdoctoral Fellow in senior author Martin McMahon's laboratory at Huntsman Cancer Institute (HCI) at the University of Utah (U of U), Salt Lake City, US. "The pathways instead cooperate to drive the growth of malignant tumors, but we didn't know what molecular changes occurred as a result of this cooperation and how the lung cells lose their characteristics as cancer develops."

The team studied mice with mutations that were only active in lung cells called Type 2 pneumocytes. They analyzed the effects of these mutations on the genes and protein molecules in individual cells at different stages of tumor development. When they looked at the gene expression of the MAP and PI3'-kinase-driven tumors, they found that the tumor cells had reduced levels of genes that are hallmarks of a Type 2 pneumocyte, suggesting that these lung cells had lost their identity.

Next, the team looked at which molecules were responsible for coordinating the MAP and PI3'-kinase pathways together. Fluorescent labeling of molecules already known to be involved in lung cell specialization showed some surprising results -- these molecules did not play a role in the loss of lung cell identity that contributes to tumor progression. Rather, a molecule called PGC1? appeared to be involved.

To investigate if PGC1? directly controls the loss of Type 2 pneumocyte identity during lung tumor development, the team studied mice with a silenced version of the molecule, alongside mutations in the MAP kinase pathway. They found that silencing PGC1? causes lung cells to lose their specialized characteristics by cooperating with two other molecules that are required for this specialization.

"Taken together, our results shed light on the mechanisms by which pathways involved in lung tumor development also cooperate to influence the specialization of tumor cells," explains senior author Martin McMahon, Senior Director of Preclinical Translation at HCI and Professor of Dermatology at the U of U, Salt Lake City. "Since both MAP kinase and

the PI3'-kinase pathways are targets for drug development, this study may influence the deployment of drugs currently in clinical trials, the interpretation of trial results and the process of novel lung cancer drug discovery."

How gonorrhea develops resistance to antibiotics



Davies' team has just published a paper showing how cephalosporins bind and inactivate a gonococcal protein dubbed penicillin-binding protein 2 (PBP2). Led by postdoctoral fellow Avinash Singh, Ph.D., the researchers showed the protein undergoes key structural changes, including twisting and rolling of a loop to bind the antibiotic, that enhance the reaction with cephalosporins. Without these changes, the protein would react much more slowly with the antibiotic.

Davies explained that all antibiotics work by targeting essential functions in a particular bug. Cephalosporins work by attacking the bacterial cell wall.

Normally, PBP2 moves along the bacterial cell's cytoplasmic membrane, reaching out into the space between the cytoplasmic membrane and the outer membrane, looking for peptides to bind to. The protein joins peptides together to create a mesh -- just like an onion bag at the grocery store, Davies said. But antibiotics jump in to bind to the protein before it can get to a peptide.

“The protein is walking around the membrane layer as normal, but its active site is blocked by antibiotic, so all those potential interactions with the peptide substrate are fruitless,” Davies said.

With the protein out of commission and not building the mesh, holes start to appear in the cell wall. Cytoplasm starts to leak out, and the cell bursts and dies, Davies said.

Yet the resistant strains, which have been identified in Japan, France, Spain and most recently in Canada, evade the lethal action of cephalosporins by preventing the antibiotic from binding to the protein target. How they achieve this is a major focus of Davies’ research.

There are 60-some mutations on the PBP2 protein in the resistant strains of gonorrhea. Davies’ team has identified six mutations that are at the root of the resistance and is looking at how the mutations change the way the protein reacts to antibiotics.

Once researchers understand how the mutations are preventing antibiotics from doing their work, new drugs can be developed, Davies said. Knowing which mutations are important may also allow a diagnostic test to be developed to tell doctors whether a particular patient has a resistant strain and, therefore, which drugs to prescribe.

Davies said it appears that the mutations restrict the protein’s flexibility, preventing the structural changes needed to bind the antibiotic. That triggers a new mystery. If those movements are critical to its job of binding to peptides and building the mesh that keeps the cell wall intact, how can the mutations block the antibiotic but still allow the normal reaction? “This is the most fascinating aspect of our research,” Davies said.

“It’s an essential function, so the mutations can’t change the protein too much. It must be able to discriminate. Discriminating against an antibiotic while still retaining the normal binding and reaction with their substrate is a delicate balancing act they have to negotiate,” he said.

This balancing act might be the reason that antibiot-

ic-resistant gonorrhea hasn’t spread as quickly as anticipated.

“There’s a fitness cost. They don’t function quite as well as their susceptible counterparts, and it’s probably for that reason they’re not spreading as fast as people feared they would,” Davies said.

Although the resistant-type gonorrhea isn’t spreading as quickly as public health officials feared, there have been increases in the number of cases of susceptible gonorrhea, as well as other sexually transmitted diseases.

Gonorrhea diagnoses increased by 67% between 2013 and 2017, according to the CDC.

“We expect gonorrhea will eventually wear down our last highly effective antibiotic, and additional treatment options are urgently needed,” said Gail Bolan, M.D., director of the CDC’s Division of STD Prevention, when it released those figures.

South Carolina has the fourth highest rate of gonorrhea, according to an analysis of CDC numbers by Health Testing Centers, a lab testing service.

MUSC infectious disease specialist Eric Meissner, M.D., Ph.D., said it’s not entirely clear why the rates of STDs are increasing.

“We know that there are proven interventions that individuals can use, including regular use of condoms, that markedly reduce the odds of acquiring a sexually transmitted disease. So the rise in STD rates suggests there’s a need for more public health interventions and education,” he said.

Although gonorrhea isn’t fatal, it can cause lifelong problems if left untreated, including infertility and susceptibility to other sexually transmitted diseases, like HIV.

“An important thing for people to know is you can have gonorrhea and not have symptoms, so you can’t rely upon the absence of symptoms alone to provide reassurance that you or your sexual partner do not have gonorrhea,” Meissner said. “Sexually active peo-

ple at risk for gonorrhoea exposure should get regular testing.”

Meanwhile, Davies and his team are continuing their work in the lab. The next step is understanding how the protein can still perform its normal essential function while eluding the antibiotics. The group has some ideas that it will put to the test, he said. “Even though the specific strain Dr. Davies is studying is rare, it is important to note that the emergence of resistance in gonorrhoea is a real concern,” Meissner said.



Plant research could benefit wastewater treatment, biofuels and antibiotics

The researchers used a new DNA sequencing approach to study the genome of *Spirodela polyrhiza*, one of 37 species of duckweed, which are small, fast-growing aquatic plants found worldwide.

The scientists discovered how the immune system of *Spirodela polyrhiza* adapts to a polluted environment in a way that differs from land plants. They identified the species’ powerful genes that protect against a wide range of harmful microbes and pests, including water-borne fungi and bacteria. The study could help lead to the use of duckweed strains for bioreactors that recycle wastes, and to make drugs and other products, treat agricultural and industrial wastewater and make biofuels such as ethanol for automobiles. Duckweed could also be used to generate electricity.

“The new gene sequencing approach is a major step forward for the analysis of entire genomes in plants and could lead to many societal benefits,” said co-author Joachim Messing, Distinguished University Professor and director of the Waksman Institute of Microbiology at Rutgers University-New Brunswick.

Duckweed can also serve as protein- and mineral-rich food for people, farmed fish, chickens and livestock, especially in developing countries, according to Eric Lam, a Distinguished Professor in Rutgers’ School of Environmental and Biological Sciences who was not part of this study. Lam’s lab is at the vanguard of duckweed farming research and development. His team houses the world’s largest collection of duckweed species and their 900-plus strains.

Journal Reference:

Plant evolution and environmental adaptation unveiled by long-read whole-genome sequencing of *Spirodela*. Proceedings of the National Academy of Sciences, 2019; 201910401 DOI: 10.1073/pnas.1910401116

Albino lizards are the world’s first gene-edited reptiles

The way gene editing is performed in most model systems is to inject CRISPR-Cas9 gene-editing reagents into freshly fertilized eggs or single-cell zygotes. But this technique cannot be used in reptiles, Menke says, because lizards have internal fertilization and the time of fertilization cannot be predicted. An isolated single-cell embryo from a female lizard also cannot be easily transferred, making it almost impossible to manipulate outside of the lizard.



But Menke and his research team noticed that the transparent membrane over the ovary allowed them to see all of the developing eggs, including which eggs were going to be ovulated and fertilized next. They decided to inject the CRISPR reagents into the unfertilized eggs within the ovaries and see if the CRISPR would still work.

“Because we are injecting unfertilized eggs, we thought that we would only be able to perform gene editing on the alleles inherited from the mother. Paternal DNA isn’t in these unfertilized oocytes,” Menke says. “We had to wait three months for the lizards to hatch, so it’s a bit like slow-motion gene editing. But it turns out that when we did this procedure, about half of the mutant lizards that we generated had gene-editing events on the maternal allele and the paternal allele.”

This suggests that the CRISPR components remain active for several days, or even weeks, within the unfertilized eggs. After screening the offspring, the researchers found that about 6% to 9% of the oocytes, depending on their size, produced offspring with gene-editing events.

“Relative to the very established model systems that can have efficiencies up to 80% or higher, 6% seems low, but no one has been able to do these sorts of manipulations in any reptile before,” Menke says. “There’s not a large community of developmental geneticists that are studying reptiles, so we’re hoping to tap into exciting functional biology that has been unexplored.”

Menke says that his team had two reasons for making the lizards albino, as opposed to editing other traits. First, when the tyrosinase albinism gene is knocked out, it results in a loss of pigmentation without being lethal to the animal. Second, since humans with albinism often have vision problems, the researchers hope to use the lizards as a model to study how the loss of this gene impacts retina development.

“Humans and other primates have a feature in the eye called the fovea, which is a pit-like structure in the retina that’s critical for high-acuity vision. The fovea is absent in major model systems, but is present in anole lizards, as they rely on high-acuity vision to prey on insects,” Menke says.

Studying gene functions in reptiles offers new opportunities for exploring aspects of development that are best studied in non-established animal models, Menke says. And ultimately, this gene-editing technique could be translated for use in other animals.

“We never know where the next major insights are going to come from, and if we can’t even study how genes work in a huge group of animals, then there’s no way to know if we’ve explored everything there is to explore in the realm of gene function in animals,” Menke says. “Each species undoubtedly has things to tell us, if we take the time to develop the methods to perform gene editing.”

Journal Reference:

CRISPR-Cas9 Gene Editing in Lizards through Microinjection of Unfertilized Oocytes. *Cell Reports*, 2019; 28 (9): 2288 DOI: 10.1016/j.celrep.2019.07.089

Commonly used antibiotics may lead to heart problems

Scientists have shown for the first time a link between two types of heart problems

and one of the most commonly prescribed classes of antibiotics.



In a study published today in the *Journal of the American College of Cardiology*, researchers at the University of British Columbia (UBC) in partnership with the Provincial Health Services Authority's (PHSA) Therapeutic Evaluation Unit found that current users of fluoroquinolone antibiotics, such as Ciprofloxacin or Cipro, face a 2.4 times greater risk of developing aortic and mitral regurgitation, where the blood backflows into the heart, compared to patients who take amoxicillin, a different type of antibiotic. The greatest risk is within 30 days of use.

Recent studies have also linked the same class of antibiotics to other heart problems.

Some physicians favour fluoroquinolones over other antibiotics for their broad spectrum of antibacterial activity and high oral absorption, which is as effective as intravenous, or IV, treatment.

"You can send patients home with a once-a-day pill," said Mahyar Etminan, lead author and associate professor of ophthalmology and visual sciences in the faculty of medicine at UBC. "This class of antibiotics is very convenient, but for the majority of cases, especially community-related infections, they're not really needed. The inappropriate prescribing may cause both antibiotic resistance as well as serious heart problems."

The researchers hope their study helps inform the public and physicians that if patients present with cardiac issues, where no other cause has been discovered, fluoroquinolone antibiotics could potentially be a cause.

"One of the key objectives of the Therapeutic Evaluation Unit is to evaluate different drugs and health technologies to determine whether they enhance the quality of care delivered by our programs or improve patient outcomes," said Dr. Bruce Carleton, director of the unit and research investigator at BC Children's Hospital, a program of PHSA. "This study highlights the need to be thoughtful when prescribing antibiotics, which can sometimes cause harm. As a result of this work, we will continue working with the BC Antimicrobial Stewardship Committee to ensure the appropriate prescribing of this class of antibiotics to patients across British Columbia, and reduce inappropriate prescribing."

For the study, scientists analyzed data from the U.S. Food and Drug Administration's adverse reporting system. They also analyzed a massive private insurance health claims database in the U.S. that captures demographics, drug identification, dose prescribed and treatment duration. Researchers identified 12,505 cases of valvular regurgitation with 125,020 case-control subjects in a random sample of more than nine million patients. They defined current fluoroquinolone exposure as an active prescription or 30 days prior to the adverse event, recent exposure as within days 31 to 60, and past exposure as within 61 to 365 days prior to an incident. Scientists compared fluoroquinolone use with amoxicillin and azithromycin.

The results showed that the risk of aortic and mitral regurgitation, blood backflow into the heart, is highest with current use, followed by recent use. They saw no increased risk aortic and mitral regurgitation with past use.

Etminan hopes that if other studies confirm these findings, regulatory agencies would add the risk of aortic and mitral regurgitation to their alerts as potential side effects and that the results would prompt physicians to use other classes of antibiotics as the

first line of defense for uncomplicated infections.

Journal Reference:

Oral Fluoroquinolones and Risk of Mitral and Aortic Regurgitation. *Journal of the American College of Cardiology*, 2019; 74 (11): 1444 DOI: 10.1016/j.jacc.2019.07.035

Scientists identify gene as master regulator in schizophrenia

Using computational tools to investigate gene transcription networks in large collections of brain tissues, a scientific team has identified a gene that acts as a master regulator of schizophrenia during early human brain development. The findings may lay the groundwork for future treatments for the highly complex neuropsychiatric disorder.

The study appeared online today in *Science Advances*. Wang co-lead the research with Jubao Duan, PhD, the Charles R. Walgreen Research Chair and an associate professor at the Center for Psychiatric Genetics of North Shore University HealthSystem (NorthShore) and the University of Chicago, Evanston, Ill. The first author was Abolfazi Doostparast Torshizi, PhD, of the CCMT at CHOP.

Although schizophrenia affects about 1 in 100

adults, and is highly heritable, the genetic architecture of the neuropsychiatric disorder is notoriously complex, with many unsolved questions. Wang and colleagues contrast the current state of knowledge to recent advances in cancer research. Oncology researchers have identified many gene pathways and networks that when perturbed, result in specific types of cancer. That knowledge has permitted fine distinctions in diagnosing subsets among types of cancer, and has led to individualized treatments based on a patient's genetic profile.

The study team used computational systems biology approaches to discern a disease-relevant core pathway in schizophrenia and to discover a master regulator in that pathway that affects hundreds of downstream genes.

Wang and colleagues analyzed two independent datasets of biological samples from schizophrenia patients and control subjects. One dataset, the CommonMind Consortium (CMC), is a public-private partnership with well-curated brain collections. The other was a collection of primary cultured neuronal cells derived from olfactory epithelium (CNON), generated by study co-authors at the University of Southern California and SUNY Downstate. The CMC dataset contained adult postmortem brain tissue, while the CNON dataset, used to validate findings from the CMC study, represented cell cultures that contain neu-



ronal cells from nasal biopsies. Applying an algorithm developed at Columbia University to reconstruct gene transcription networks, the study team identified the gene TCF4 as a master regulator for schizophrenia.

Previous genome-wide association studies (GWAS) had indicated that TCF4 was a locus for schizophrenia risk, said Wang, but little was known of the gene's functional effects. The study team investigated those effects by knocking down, or decreasing, the gene's expression in neural progenitor cells and glutamatergic neurons derived from induced pluripotent stem cells in Duan's lab at NorthShore.

Observations on three different cell lines showed that, when knocked down, the predicted TCF4 regulatory networks were enriched for genes showing transcriptomic changes, as well as for genes involved in neuronal activity, schizophrenia risk genes having genome-wide significance, and schizophrenia-associated de novo mutations. Although some of the cellular effects of TCF4 dysregulation were previously shown in mice, Duan noted that the results from perturbing TCF4 gene networks in human stem cell models may be more relevant to the neurodevelopmental aspects of neuropsychiatric disorders.

The current study, said the researchers, sets the stage for further investigations. One direction, said Wang, is to use expanded datasets to explore whether other master regulators in addition to TCF4 may act in schizophrenia. If so, it may eventually be possible to classify patients with schizophrenia into subgroups more responsive to specific treatments, as is occurring in many cancers, to assist in implementing precision medicine in psychiatric diseases.

Other approaches, added Doostparast, may involve pursuing functional genomics at the level of single cells, to assess the cell types that are most influenced by dysregulating gene expression.

Journal Reference:

Deconvolution of transcriptional networks identifies TCF4 as a master regulator in schizophrenia. *Science Advances*, 2019; 5 (9): eaau4139 DOI: 10.1126/sciadv.aau4139

A publisher just retracted 22 articles

SAGE Publishing is retracting 22 articles by a materials science researcher who published in two of their journals — but the anonymous reader who brought the problems to their attention says the author's duplication affects more than 100 articles.

Ali Nazari, now of Swinburne University of Technology in Australia, had five papers retracted earlier this year from an Elsevier journal. His total of now 27 retractions — the others from the *International Journal of Damage Mechanics* and the *Journal of Composite Mechanics* — came following emails in January of this year from an anonymous reader to several publishers raising concerns that Nazari had duplicated his work in more than 100 articles.

Whistleblower 'relieved'

The anonymous reader who brought the issues to publishers' attention told Retraction Watch that "the retraction notice is accurate, but incomplete." The reader said that he or she had also flagged potential inconsistencies in the data, inconsistent authorship lists, and what the reader called "clear falsification of data."

In addition to the five articles Elsevier has already retracted, the publisher is investigating others, the reader said. Springer Nature, which had investigated the issue in 2012 and decided not to retract any of Nazari's articles, is investigating again. At the time of this writing, Taylor and Francis has not responded to the reader's correspondence of last week.

NOTIFICATIONS

**Indian Academy of Sciences, Bengaluru
Indian National Science Academy, New Delhi
The National Academy of Sciences, India,
Prayagraj**

**Science Academies' Summer Research Fellowship Programme
for Students and Teachers – 2020**

Applications are invited from interested students and teachers from all universities and colleges affiliated to UGC/AICTE/MCI/Accredited Institutions of State Universities for these Fellowships. The application should include: (a) the application form in the prescribed format; (b) scanned copies of marks sheets from class X till the last examination; (c) a write-up (about 150–250 words) as to what the applicant wants to learn and achieve. Student applicants should provide the e-mail id of one of their teachers or HoD familiar with their work. The Academy will approach them for a recommendation letter in the prescribed format. The selected candidate should work with the assigned guide for two months any time during the calendar year, preferably during the summer.

Applications should be submitted by logging onto one of our websites (www.ias.ac.in; www.insaindia.res.in or www.nasi.org.in). The registration number assigned soon after online submission must be quoted in all future correspondence.

The last date for receipt of applications online is 30 November 2019.

Information of selection along with concurrence of the guide will be despatched around February–March 2020. The selected students/teachers will be provided appropriate round trip train fare and a monthly fellowship to meet their living expenses at the place of work.

Professor M R N Murthy Chairman, Joint Science Education Panel Indian Academy of Sciences, Bengaluru

Notice

Indian Institute of Technology (Banaras Hindu University)

Advertisement No. IIT(BHU)/FA/Conventional Ad/2019

IIT (BHU) Varanasi invite online applications from well qualified and meritorious Indian Nationals for faculty positions at the level of Professor, Associate Professor and Assistant Professor in its various Science & Engineering Departments, Interdisciplinary Schools. Persons of Indian Origin (PIO) and Foreign Nationals can also apply for faculty positions..

Schools: Biochemical Engineering, Biomedical Engineering and Materials Science & Technology.

The applications for the above mentioned positions will be received through online portal. The link is as under: <https://facultyrecruitment.iitbhu.ac.in>.

The last date for submission of online applications is 15.10.2019.



UNDER AEGIS OF SILVER JUBILEE CELEBRATION OF IAPS-2019

2019 BioMilaap

NATIONAL CONFERENCE on RECENT ADVANCES IN AGRICULTURE, FOOD TECH AND HUMAN HEALTH NOVEMBER 05-06TH, 2019

Organized by:
Department of Molecular and Cellular Engineering,
Jacob Institute of Biotechnology and Bioengineering,
Sam Higginbottom University of Agriculture,
Technology and Sciences,
Prayagraj.



Registration OPEN | Abstracts are invited for Oral/Poster Presentation | Submit Full Length Article for YSA Category
Last Date of Registration : 30th September, 2019 | Last Date of Abstract/Full Length Paper Submission : 10th October, 2019

Contact
Prof. (Dr.) Ir. Jonathan A. Lal | Dr. Vijay Tripathi
Convener | Organizing Secretary

9721840883, 7499339697, 7782981381 | biomilaap2019@gmail.com | www.biomilaap.in

In Collaboration with

Call for Nominations/Applications for ICMR Awards & Prizes- 2019

The Indian Council of Medical Research (ICMR) invites Nominations/Applications from Indian scientists for ICMR Awards & Prizes for the year 2019 (list given below) in various fields of biomedical sciences. Last date of receipt of Nominations/Applications is 30th November, 2019

List of ICMR Awards/Prizes for the year 2019

Dr. B.R. Ambedkar Centenary Award for excellence in Biomedical Research (Biomedical Research)
 Dr. Subhas Mukherjee Award (Assisted Reproductive Technology, Reproductive Biology & Endocrinology and Reproductive Health in General)
 Basanti Devi Amir Chand Prize (Biomedical Sciences)
 Shakuntala Amir Chand Prize (Clinical Research) - Age below 40 years (Number of prizes – four)
 Amrut Mody Unichem Prize (Gastroenterology)
 Dr. H.B. Dingley Memorial Award (Paediatrics) – Age below 40 years.
 ICMR Kshanika Oration Award (Biomedical Sciences) – for Indian women scientists
 ICMR Prize for Biomedical Research for Scientists belonging to underprivileged communities (Biomedical Sciences)
 ICMR Prize for Biomedical Research conducted underdeveloped areas – (Biomedical Sciences)
 ICMR Tilak Venkoba Rao Award (Psychological Medicine) - Age below 40 years
 JALMA Trust Fund Oration Award (Leprosy and other mycobacterial diseases)
 Major General Saheb Singh Sokhey Award (Communicable Diseases) – Age below 40 years
 Smt. Kamal Satbir Award (Non-tuberculosis Chest Diseases, especially Respiratory Allergy and Chronic Obstructive Lung Diseases) - Age below 40 years
 Dr. D.N. Prasad Memorial Oration Award (Pharmacology)
 Dr. J.B. Srivastav Oration Award (Virology)
 Dr. M.O.T. Iyengar Memorial Award (Malaria, Filariasis, Plague or Medical Entomology)
 Dr. Prem Nath Wahi Award (Basic and/or Clinical Cytology and/or Preventive Oncology)
 ICMR Chaturvedi Ghanshyam Das Jaigopal Memorial Award (Immunology)
 ICMR Chaturvedi Kalawati Jaghmohan Das Memorial Award (Cardiovascular Diseases) – Preferably a medical person
 ICMR Smt. Swaran Kanta Dingley Oration Award (Reproductive Biology)
 ICMR-CNMC STS Excellence Award (for medical undergraduate student who has been awarded ICMR STS)

Address for correspondence:

The Director General, [Kind Attention: Dr. N. C. Jain, Scientist-G & Head, Division of Human Resource Planning and Development (HRD)], Indian Council of Medical Research, V. Ramalingaswami Bhawan, Ansari Nagar, Post Box No. – 4911, New Delhi-110029 Telephone: 011-26589258, email: drencejain@gmail.com



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19 - 21 December, 2019



XLIII ALL INDIA CELL BIOLOGY CONFERENCE

VENUE:

IISER Mohali

ORGANIZERS:

Sudip Mandal
Lolitika Mandal
IISER Mohali

REGISTRATION:

Registration opens:

September 1, 2019

Last Date for Registration:

October 10, 2019

CONTACT:

aicbc2019@gmail.com

SPEAKERS:

Sumantra Chattarji

NCBS, Bangalore

Anuradha Ratnaparkhi

ARI, Pune

Biman B Mandal

IIT Guwahati

Chandrima Das

SINP, Kolkata

Chetana Sachidanandan

IGIB, New Delhi

Deepa Subramanyam

NCCS, Pune

Gitanjali Yadav

NIPGR, New Delhi

Jonaki Sen

IIT, Kanpur

Kalika Prasad

IISER Thiruvananthapuram

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Raj Ladher

NCBS, Bangalore

Ram Kishore Yadav

IISER Mohali

Rashna Bhandari

CDFD, Hyderabad

Ravi Manjithaya

JNCASR, Bangalore

Sandhya Koushika

TIFR, Mumbai

Sanjeev Shukla

IISER Bhopal

Siddharta Jana

IACS, Kolkata

Surajit Sarkar

DU South Campus, New Delhi

www.aicbc2019.org

Indian Society of Cell Biology

Indian Institute of Science Education & Research (IISER) Mohali





INTERNATIONAL CONFERENCE OF CARDIOVASCULAR SCIENCES-2020 (ICCS-2020)

Incorporating Annual Conferences of International Academy of
Cardiovascular Sciences (IACS)-India Section &
International Society of Heart Research (ISHR)-India Section
(February 21–23, 2020)

THEME

Convergence of Clinicians and Scientists for Cardiovascular Health

CO-SPONSORS

All India Institute of Medical Sciences (AIIMS), New Delhi, India
Society for Promotion and Research in Cardiovascular Sciences (SPARCS),
Academy of Cardiovascular Sciences (ACS)

ORGANIZING SECRETARY

Prof. Harvinder Popli

Off. Registrar & Dean, DPSRU

ORGANIZING SECRETARY

Prof. Nitish Naik

Department of Cardiology, AIIMS

CHAIRPERSON, LOC

Prof. Ramesh K. Goyal

Vice Chancellor, DPSRU

CHAIRPERSON, LOC

Prof. Vinay Kumar Bahl

Dean, AIIMS

VENUE

DELHI PHARMACEUTICAL SCIENCES AND RESEARCH UNIVERSITY

M.B. Road, Pushp Vihar Sector-III, Opp. Sainik Farm, New Delhi – 110 017, India

E-mail: iccsdelhi2020@gmail.com



Mini-symposium on 'Genetics and Evolution: Intertwined Strands'

By Indian Academy of Sciences and Ashoka University

30th September – 1st October, 2019 (Monday and Tuesday)

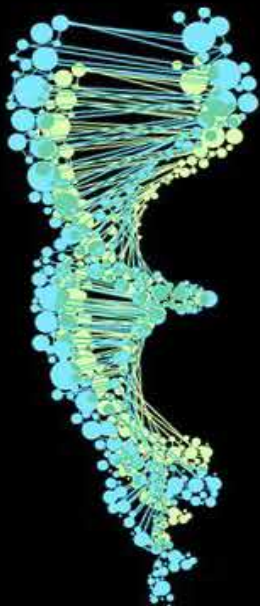
The historical development of the fields of genetics and evolution has been intertwined, at least since the time of Darwin in the mid-nineteenth century. Both fields, by virtue of the domains they address, also impact upon how we humans conceive of ourselves. Consequently, advances in understanding in genetics and evolution are answering age-old mysteries about how we came to be the way we are, even as advances in genetic technologies are raising ever-new ethical issues for societies to grapple with. This mini-symposium will explore some of these aspects in a manner accessible to students and non-specialists in the fields.

CONVENER: H A RANGANATH, CENTRE FOR HUMAN GENETICS BANGALORE
(EDITOR-IN-CHIEF, *JOURNAL OF GENETICS*)

Speakers

Day 1 (2pm–4pm)

Amitabh Joshi, JNCASR
Umesh Varshney, IISc
S Ganesh, IIT Kanpur
Arun Kumar Joshi, CIMMYT & BISA



VENUE: AC 01 LT 106
OLD ACADEMIC BLOCK
ASHOKA UNIVERSITY, SONEPAT
INDIA



Day 2 (10am–4pm)

LS Shashidhara, Ashoka University
TNC Vidya, JNCASR
Punyasloke Bhadury, IISER Kolkata
NG Prasad, IISER Mohali
BK Thelma, University of Delhi

6th International Conference

INVERTIS
UNIVERSITY BAREILLY

**“Translational Approaches in Clinical,
Environmental & Biotechnological Research”**

GenoPro-2019

October 11th-12th, 2019 (Friday & Saturday)

Invertis University, Bareilly invites you to participate in **GenoPro2019**, the **6th International Conference** to address emerging research & new challenges in multi disciplinary areas of biotechnology. The motto of this conference is to bring together leading academicians, scientists, researchers, medical practitioners and various industry professionals from around the world to a common platform and have scientific discussion on the latest advancements in interlinked domains of Translational research. This conference helps in enabling the life science industries to make new or better products, often with greater speed, efficiency and flexibility.

THRUST AREAS

The scientific program of the GenoPro2019 is designed to discuss the major fields such as; Drug discovery and development, Cancer biology, Diagnostics & medical devices, Pharmaceutical Science, Agriculture, Microbiology, Immunology, Cell Culture, Renewable Energy Technology, Nanotechnology, Ancient DNA & Palaeogenomics, Bioprocess and Food Processing Technology, Industrial Biotechnology, Environmental Biotechnology, Cell Biology, Genetic Engineering, Molecular Biology, Biosensor, Bioinformatics and Computational Biology and many more.

TECHNICAL SESSION

GenoPro2019 will commence with an introductory Keynote session, parallel plenary sessions of different thrust areas and award sessions for –

- Novel Research Award
- Young Scientist Award
- Oral Presentation Award I, II and III
- Poster Presentation Award I, II and III

CALL FOR ABSTRACT

Research papers are invited on any of the given thrust area in any one of the award category. All abstracts should be submitted by e-mail before **September 15, 2019** on genomics@invertis.org. Peer reviewed abstracts will be published in special issue of indexed journal. The authors will be intimated by September 30, 2019 regarding the acceptance of the abstract.

REGISTRATION

	India	Abroad
Research Scholars & Students	INR 1500	USD 100
Faculty Members	INR 2000	USD 150
Industry Personnel	INR 2500	USD 200
On Spot Registration*	INR 2500	USD 200

* Only for Faculty, Research Scholars and Students

For more details: www.genopro2019.in

Important Dates

Abstract Submission	September 30, 2019
Confirmation of Acceptance	September 30, 2019
Registration	September 30, 2019
Conference	October 11-12, 2019

Venue: Main Auditorium and Seminar Hall I & II, Invertis University, Bareilly

Organizing Committee:

Dr. Sanjeev Kr. Maurya
Convener
+91 9105000858

Dr. Shashank Upadhyay
Co-Convener
+91 9307756983

Dr. Pankaj Kumar Rai
Organizing Secretary
+91 9452550100

Organized by :

Department of Biotechnology

Invertis University, Bareilly-Lucknow National Highway-24, Bareilly, 243123 UP INDIA, Phone: (0581)- 24600454
Url: www.invertisuniversity.ac.in | E-mail: genomics@invertis.org

JAM 2020

JOINT ADMISSION TEST for M.Sc.



ORGANIZING INSTITUTE: IIT KANPUR

About JAM: National test for admission to M.Sc.

(Two years), Joint M.Sc.-Ph.D., M.Sc.-Ph.D. Dual Degree, M.Sc.-M.S. (Research)/Ph.D. Dual Degree and other Post-Bachelor Degree programmes at IITs (Bhilai, Bhubaneswar, Bombay, Delhi, (ISM) Dhanbad, Gandhinagar, Guwahati, Hyderabad, Indore, Jodhpur, Kanpur, Kharagpur, Madras, Mandi, Palakkad, Patna, Roorkee, Ropar, Tirupati and (BHU) Varanasi) for the Academic Session 2020-21. JAM score will be used by IISc Bangalore for admission to Integrated Ph.D. programmes. JAM score will also be used by other centrally funded technical institutions like NITs, IEST Shibpur, SLIET Punjab and IISERs for admission to their programmes.

STRUCTURE AND MODE OF JAM 2020

JAM 2020 examination will be conducted ONLINE only. A candidate can appear in either one Test Paper or two Test Papers by paying an additional fee for the second test paper. Candidates opting to appear in two Test Papers must ensure that the opted Test Papers are not scheduled in the same session.

IMPORTANT DATES FOR JAM 2020

05 September 2019	Start of ONLINE Registration and Application Process
08 October 2019	Closure of ONLINE Application Process
09 February 2020	JAM 2020 Examination
20 March 2020	Announcement of JAM 2020 Result

EXAMINATION CITIES AND TOWNS

Agartala, Agra, Ahmedabad, Asansol-Durgapur, Bareilly, Bengaluru, Bhopal, Bhubaneswar, Chennai, Coimbatore, Dehradun, Dhanbad, Dibrugarh, Ernakulam, Faridabad, Ghaziabad, Goa, Greater Noida, Gurugram, Guwahati, Hisar, Hubli, Hyderabad, Indore, Jaipur, Jalandhar, Jammu, Jind, Jodhpur, Jorhat, Kalyani, Kannur, Kanpur, Kharagpur, Kolkata, Kollam, Kottayam, Kozhikode, Kurukshetra, Lucknow, Madurai, Mangalore, Mohali, Moradabad, Mumbai, Nagpur, Nanded, Nasik, New Delhi, Noida, Palakkad, Patna, Prayagraj (Allahabad), Pune, Raipur, Ranchi, Roorkee, Shillong, Siliguri, Thiruvananthapuram, Thrissur, Tiruchirapalli, Tirunelveli, Tirupati, Vadodara, Varanasi, Vijayawada, Visakhapatnam and Warangal.

Note: The JAM 2020 Committee may add or drop any place as an examination city/town at its discretion.

INFORMATION BROCHURE AND APPLICATION PROCEDURE

Refer to <http://jam.iitk.ac.in> for downloading the Information Brochure and the details of application procedure.



GROUP/CATEGORY	FEE DETAILS	
	One Test Paper	Two Test Papers
Female (All Categories)/SC/ST/PwD	₹ 750/-	₹ 1050/-
All Others	₹ 1500/-	₹ 2100/-

PATTERN OF TEST PAPERS

JAM 2020 Test papers will be fully objective type, with three patterns of questions: (i) Multiple Choice Questions (MCQ), (ii) Multiple Select Questions (MSQ) and (iii) Numerical Answer Type (NAT) questions.

Joint Admission Procedure: Admissions to

various academic programmes at IITs for the Academic Session 2020-21 shall be made based on the All India merit list of JAM 2020. Candidates who qualify in any test paper of JAM 2020 will be eligible to apply for admission to all the academic programmes corresponding to that test paper, provided they also satisfy the minimum educational qualifications and the eligibility requirements as specified by the institute(s) in which admission is sought. Admission shall be given in the order of merit depending on the number of seats available at the admitting institute(s). After the declaration of JAM 2020 result, qualified candidates should apply online at common admission portal (JOAPS) through the Organizing Institute (IIT Kanpur) specifying preferences for the programmes of their interest. Further details regarding admission, prescribed fees, etc. are available on the JAM 2020 website. Reservation policy is applicable as per the Government of India norms.

ELIGIBILITY REQUIREMENT AND MINIMUM EDUCATIONAL QUALIFICATIONS (MEQ) FOR ADMISSION

In the qualifying degree, the aggregate marks or CGPA/CPI without rounding-off (taking into account all subjects, including languages and subsidiaries, all years combined) should be at least 55% or 5.5 out of 10 for General/OBC (NCL)/EWS category candidates and 50% or 5.0 out of 10 for SC/ST and PwD category candidates (If CGPA/CPI is on a different scale, it would be linearly mapped to a scale on 10).

Refer to <http://jam.iitk.ac.in> for MEQ and other details. Proof of having passed the qualifying degree with the required eligibility as specified by the admitting institute should be submitted by September 30, 2020.

JAM 2020 SCHEDULE

EXAM DATE	SESSION and TIME	TEST PAPERS
09 February 2020 (Sunday)	SESSION - I 9:30 am to 12:30 pm	Biotechnology (BT), Mathematical Statistics (MS) and Physics (PH)
	SESSION - II 2:30 pm to 5:30 pm	Chemistry (CY), Geology (GG) and Mathematics (MA)

CONTACT DETAILS of JAM OFFICES

Institute	Website	E-Mail
IISc Bangalore	http://gate.iisc.ac.in	jam@gate.iisc.ac.in
IIT Bombay	http://gate.iitb.ac.in/jam	jam@iitb.ac.in
IIT Delhi	http://jam.iitd.ac.in	jam@admin.iitd.ac.in
IIT Guwahati	http://iitg.ac.in/gate-jam	jam@iitg.ac.in
IIT Kanpur	http://jam.iitk.ac.in	jam@iitk.ac.in
IIT Kharagpur	http://jam.iitkgp.ac.in	jam@adm.iitkgp.ac.in
IIT Madras	http://jam.iitm.ac.in	jam@iitm.ac.in
IIT Roorkee	http://iitr.ac.in/jam	jam@iitr.ac.in

Augmenting Writing Skills for Articulating Research (AWSAR)

Call for Entries

“Augmenting Writing Skills for Articulating Research (AWSAR)” is an initiative of Department of Science and Technology (DST), Government of India. It endeavors to disseminate Indian research stories of Science, Technology & Innovation being pursued in the country in a format that is easy to understand and interesting for all the stakeholders.

DST invites lucid stories from PhD scholars and Post Doctoral Fellows (PDF) with an aim to strengthen the ecosystem of science communication and inculcate scientific temperament in society.



My
Research



*Come,
Join the new breed
of science storytellers!*



Who can apply

Indian citizen pursuing PhD or PDF in any stream of Science and Technology (S&T), within the tenancy period of her/his research, can submit the entry. The story must relate to research being pursued by him/her.



Award categories

A. For PhD Scholars

- 1st prize : ₹1,00,000 (one)
- 2nd prize : ₹50,000 (one)
- 3rd prize : ₹25,000 (one)
- 100 selected entries : ₹10,000 each

B. For Post Doctoral Fellows

- One Outstanding story : ₹1,00,000
- 20 selected entries : ₹10,000 each



Selection criteria

A panel consisting of eminent scientists and science communicators, constituted by DST, will evaluate the entries.

Entries can be submitted from **15 August 2019 till 30 September 2019**

For more information please visit www.awsar-dst.in

Unleash the Spirit of Science Communication

GATE 2020

GRADUATE APTITUDE TEST IN ENGINEERING



Organising Institute

GATE qualification is required for admissions to Postgraduate Programmes (Master's and Doctoral) with MHRD and other Government Scholarships/Assistantships in Engineering/Technology/Architecture/Science. The GATE score is also used by some PSUs for their recruitment and by several universities in India & abroad for admissions.

GATE 2020 score will be valid for THREE YEARS from the date of announcement of results.

Eligibility

The following candidates are eligible to appear in GATE 2020:

Bachelor's degree holders in Engineering/Technology (4 years after 10+2 or 3 years after B.Sc./Diploma in Engineering/Technology) and those who are in the final year of such programmes.

Bachelor's degree holders in Architecture (Five years course)/Naval Architecture (Four years course) and those who are in the final year of such programmes.

Bachelor's degree holders of Four-year programme in science (B.S.) and those who are in the final year of such programmes.

Master's degree holders in any branch of Science/Mathematics/Statistics/Computer Applications or equivalent and those who are in the final year of such programmes.

Holders of Four-year Integrated Master's degree (Post B.Sc.) in Engineering/Technology and those who are in the second or higher year of such programmes.

Holders of Five-year Integrated Master's degree or Dual Degree in Engineering/Technology and those who are in the fourth or higher year of such programmes.

Holders of Five-year Integrated M.Sc. or Five-year integrated B.Sc./M.Sc. Dual Degree and those who are in the final year of such programmes.

Candidates with qualifications obtained through examinations conducted by professional societies recognized by UPSC/AICTE as equivalent to B.E./B.Tech. Those who have completed section A of AMIE or equivalent of such professional courses are also eligible.

All Candidates must apply online.
For application, visit the following URL:

<http://gate.iitd.ac.in>

Further details can be obtained by accessing any of the GATE/JAM zonal website.



Important Dates

September 03, 2019	Opening of Online Registration & Application Form
September 24, 2019	Closing of Online Application Form
October 01, 2019	End of Extended Period for Online Application
February 01, 02, 08 & 09, 2020	Examination Dates
March 16, 2020	Announcement of Results

Examination Centres

GATE 2020 examination will be conducted in select cities & towns in India as well as in Six cities abroad.

Examination Pattern

Examination for all the papers will be Computer Based Tests (CBT).

Application Fee

Examination Centres in India	On or before 24 th Sep 2019	During the Extended Period
SC/ST/PwD/Female Candidates	₹750	₹1250
All other Candidates	₹1500	₹2000
Examination Centres outside India (All Candidates)		
Addis Ababa, Colombo, Dhaka & Kathmandu	US\$50	US\$70
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#BIOTWEET19

2ND TWITTER CONFERENCE

#Biotweet19 Twitter International Poster Conference is an online event held entirely over Twitter to bring members of the biotechnology scientific and academic community together to share their work. After the success of first Twitter Conference #Biotweet18, Amity Institute of Biotechnology, Amity University Mumbai is excited to announce the event to be held from 27th to 28th September, 2019. We are pleased to share that Amity Institute of Biotechnology, Amity University Uttar Pradesh, Lucknow is also supporting the second edition of this event.

WHEN ?

September 27th & 28th, 2019

WHERE ?

Online Over Twitter



ORGANIZING INSTITUTE

**Amity Institute of Biotechnology Amity University,
Mumbai**

Mumbai - Pune Expressway, Bhatan, Post – Somathne, Panvel, Mumbai, Maharashtra 410206

&

**Amity Institute of Biotechnology Amity University Uttar
Pradesh, Lucknow Campus**

Malhour (Near Railway station) Gominagar Extension, Lucknow 227105

CATEGORIES • Environment and Renewable Energy

**VIRTUAL CONFERENCE
FOLLOW US: @BIO_TWEET19**

**FREE REGISTRATION
<http://tiny.cc/9yuubz>**

**Upto 27th September, 2019,
18:00 (IST)**

FIRST CALL

#HASHTAGS TO BE USED

- ⇒ #biotweet19
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