SciLogi

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EDITORIAL
PONDERINGS FROM THE PANDEMIC

The RCB Science Club Team is delighted to share with you the first issue of our magazine "SciLogi". We, at the RCB Science Club, are a group of science students, researchers and administrators motivated by our common love for science and scientific communication to a wider audience. Our first public outreach endeavor, an awareness video on the pandemic in both Hindi (https://youtu.be/ifr7Y2cPl48) and English (https://www.youtube.com/watch?v=umrQiEto5aA), was warmly received and much appreciated. We thank you for your feedback and encouragement, which have motivated us to take this next step with SciLogi.

In these trying times of fake news and half-truths, made viral by social media, we aim to bring to you responsible and readily comprehensible scientific information through SciLogi. We hope to share with you opinions, perspectives and thoughts of distinguished and budding scientists, and deconstruct scientific advancements related to the pertinent issues of our times.

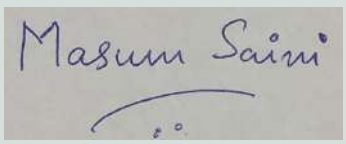
The ongoing pandemic has presented the human race with several opportunities, and challenges. Hence, this first issue of SciLogi focuses mainly on the many interesting aspects of the COVID-19 pandemic and beyond. Prof. Vrati, a renowned Virologist and our Executive Director, rightly cautions that as new viruses continue to emerge we cannot afford to lower our guards. Prof. Roy and Hiranmoy draw our attention to the unanticipated fallouts of the worldwide lockdowns such as impact on mental health and challenges of online learning, respectively. Dr. Tiwari provides a glimpse of how the pandemic has evolved, and the lessons for course correction that it has underscored for the mankind. Subham and Biplab discuss the vital role of immunoinformatics and machine learning in facilitating vaccine design to tame the virus. Dr. Saini summarizes the studies that have unraveled the scientific basis of children faring better, so far, in their battle against the virus, which might be nature's way of teaching us where to look for answers.

The articles in our magazine will also cover the length and breadth of scientific research being carried out at RCB. Sections such as 'Campus Clicks' and 'Mixed bag' in the magazine will showcase the other creative indulgences of our researchers while they engage in scientific pursuits. The 'Reminiscence' section will reproduce the experiences of our alumni, that they share with SciLogi in the form of narratives or letters, and highlight the vibrancy of Science @ RCB.

Now that we have touched base with you, and explained the overall layout and the kind of content that the magazine will feature, please feel free to send in your contributions to scienceclub@rcb.res.in. These may comprise but need not be limited to essays, short stories, opinion pieces, poems, scientific facts/trivia/quizzes, reviews of novels you may like to recommend and pictures you may have clicked on or off campus, etc. Also, we will reach out to you for write-ups on specific themes that each issue of the magazine plans to cover. We seek your active support to make this magazine successful.

In this collective endeavor, we are still very much in the process of learning and evolving. We apologize for any inadvertent omissions and errors in the compilation of the magazine and look forward to your feedback to constantly improve as we go along.

Finally, on behalf of the RCB Science Club Team, I hope that you enjoy "SciLogi", our pandemic baby, as much as we enjoyed putting it together. Please share with us (scienceclub@rcb.res.in) your views about the magazine, or a particular article/section that you found interesting, or aspects that may be improved/introduced to enhance the readership of SciLogi. Happy reading!!



SNEAK PEEK-

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New viruses will continue to emerge..... Beware!

Late in December 2019, a number of cases of the severe acute respiratory syndrome (SARS) were reported in Wuhan, China. The causative agent was not one of those usual ones known at that time. By the second week of January 2020, Chinese scientists had carried out the genome sequencing of the etiological agent that established it to be a novel coronavirus (CoV) that we now know as SARS-CoV-2. Seventeen years back in the year 2002, China had seen another outbreak of SARS that was caused by a coronavirus which was different from that seen in the year 2020. In between these two outbreaks, in 2012 another novel coronavirus (Middle East Respiratory Syndrome coronavirus, or MERS-CoV) was identified in Saudi Arabia. These incidences and reports of several other viruses suddenly appearing (for example, Ebola, H1N1, etc.) in recent years, tell us that viruses will continue to emerge and we will have to be on our guard to protect humankind from the viral onslaughts.

The emergence of novel viruses is often related to zoonosis involving the cross-species jump of a virus to humans from an animal species. With frequent travel to long distances, increasing population density, deforestation to create new human habitats bringing the population in closer conta with wild animals, the potential for the emergence of novel viruses is ever increasing.

Interestingly, the recently emerged novel viruses have RNA as the genome. RNA replication is error-prone and mutations in animal viruses may get selected that give them the advantage for infecting humans. This was evident in the cases of swine flu, and SARS and MERS coronaviruses, where animal viruses accumulated mutations allowing the virus to infect humans. The H1N1 influenza virus moved into humans from swine (pigs) and transmitted from person to person. The 2002 SARS-CoV emerged from bats and was quickly established in humans. The MERS-CoV emerged from camels. The SARS-CoV-2 showed a high sequence similarity to Bat-CoV-RaTG13 that was previously detected in horseshoe bats. The virus also showed a close genome sequence similarity to coronavirus found in pangolins. The virus has continued to accumulate new mutations that gave it a survival or replication advantage in humans.

When a novel virus appears, it poses a challenge both scientific and in terms of tight timelines to develop effective countermeasures. In the meantime, the virus continues to spread to the vulnerable population having enormous human and economic consequences. We have experienced it too well in the currently ongoing pandemic and it has convinced us that it is ever more important to understand the emergence of new viruses and establish platform technologies to swiftly develop vaccines and antivirals as countermeasures.

Mental Health and COVID-19

Every year 10th of October is celebrated as a World Mental Health Day, and as a consequence October happens to be a busy month for professionals and others (clinicians, care givers, philanthropists, researchers, educators…) who are concerned with mental health; it's the chosen time for raising awareness and bringing the mental health issues to the fore. The world federation for mental health (WFMH) announced "Mental health in an unequal world" as a theme for 2021 to highlight mental health inequality arising due to economic and socio-cultural disparities. On a more positive note, the world health organization (WHO) has declared "mental health care for all: let's make it a reality" as the theme for this year. Notwithstanding the above themes or slogans, mental health remains an overwhelming problem as reflected in a UNICEF report published this month which suggests that about 13% of the young people globally, between the age 10-19 years, live with a diagnosed mental health condition. Providing quality mental health prevention and treatment opportunities to the needy has been a challenging task for all nations.

Covid-19 pandemic has exacerbated the problem. Restrictions, isolations, quarantines, lock downs, topsy-turvy routines and almost nil social activity have impacted the mental well-being of vulnerable individuals. As a result, a sizable number of people with mental disorders have been added during the pandemic. The young students have been particularly affected. Closure of colleges, universities and disruption of research activities have impacted their future career prospects.

In India, one out of every seven people suffer from mild to severe mental health problem [Lancet 7: 148-161 (2020)]. A survey conducted by National Institute of Mental Health and Neurosciences (NIMHANS, Bangalore) found that about 13% of the young adults (age 13-17 years) living in an urban setting suffer from mental health conditions. It is estimated that only a small fraction (about 10-12%) of this set receives care, if any. The reason for this is not essentially the unavailability or inaccessibility to a health care system but also socio-cultural. People with mental disorder are often stigmatized and discriminated which prevents them from seeking help overtly.

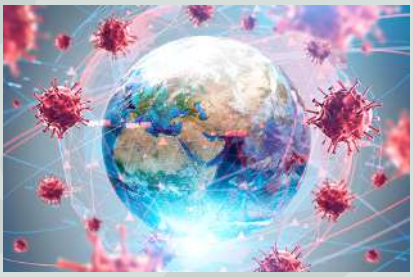
The mental health care system in India is quite fragile with its abysmal budget and extreme shortage of care givers; India has on an average, about three psychiatrists and one psychologist per million population. This problem has been acknowledged by the President of India himself. Speaking at the 22nd convocation of NIMHANS at Bangalore, President Kovind said, "India simply does not have a mental health challenge…It is facing a possible mental health epidemic". This acknowledgement by the President provides a sense of reassurance and hope that someday in the future, we shall have an inclusive, easily accessible and equitable mental health care system. Meanwhile, much can be achieved through public education and sensitization, empathy, compassion, and community help.

COVID-19 Pandemic: An Overview

The first case of COVID-19 in India was reported in Kerala on 27th January 2020. The initial trajectory of these cases lagged with the identification of fewer cases and lower fatalities. On the 24th of March, the same year, India entered a 21-day lockdown, one of the strictest globally. The entire country came to a standstill. The scene that unfolded was probably an unprecedented one when the roads were empty for such a prolonged period. The socio-psychological impact of the lockdown is probably debatable when some might claim that the lockdown brought families closer, endowing them with much-needed family time away from the rush of routine pumped-up family life. On the other hand, official data report an increase in the incidences of violence against women and children. “Man is a social being” and thus the continuous lockdown impacted people psychologically. But the economic costs of the lockdown can hardly be debated in a country where official figures report that ~80% of the working population is employed in the unorganized sector with no security of tenure, wages, or social security. Images of the mass exodus of inter-state migrants back to their native place on foot will leave a lasting impact on this nation’s psyche.

Contingent economic constraints obligated our leadership to opt for a staggered exit from the lockdown. With the exit from lockdown still in progress, cases started dropping by September after a daily maximum of 100,000 infections.

While the rest of the world, including the developed countries, was still struggling with rising infections, we had managed to flatten the curve. But the worst was yet to come. The mutated delta variant of COVID-19 came back with vengeance- the second wave. All hell broke loose when the daily infection count reached ~4 lakh cases. Glaring gaps were witnessed in the entire health infrastructure, from shortage of oxygen to hospital beds.



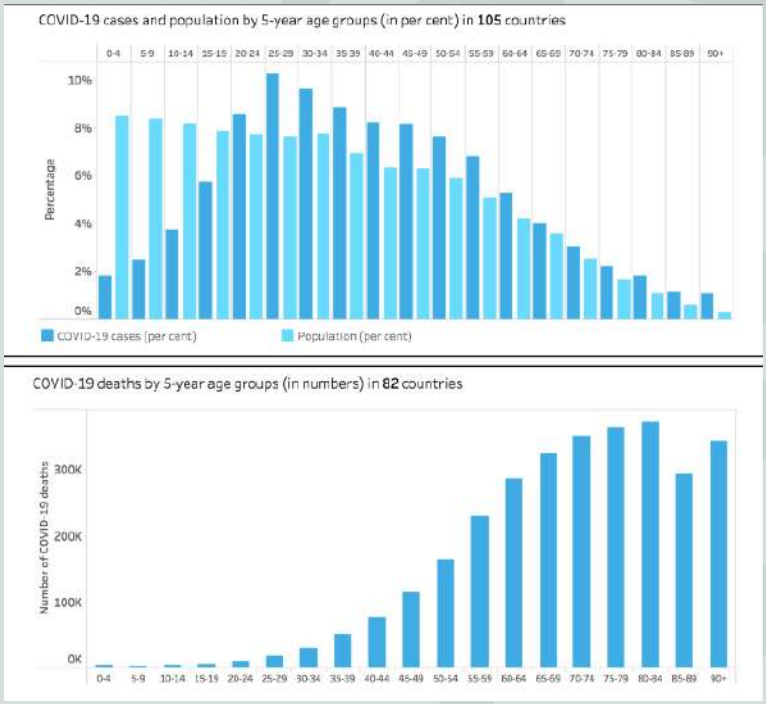
Looking for silver linings in the dark pandemic clouds, awareness of sanitization has been brought to the forefront with the normalization of sanitizers in public places. Increased usage of masks bears well for the public at large, but particularly those with breathing issues. The economic constraints imposed by the pandemic will probably encourage people to appreciate the importance of savings as well as investing in health insurance.

The pandemic has surely been an eye-opener for those involved in the governance of this country. The current national expenditure on health, amounting to ~1.2% of GDP urgently needs to be raised, when developed economies are reported to have these figures north of 9%. India, the second most populated country, needs to make healthcare its priority to capitalize on her demographic dividend.

Coping with COVID: How kids outsmart the adults?

Amid global and national efforts to curate data on COVID-19 in children, narratives from health care providers suggest that most infected children and adolescents have mild symptoms. Such anecdotal records are beginning to find validation in a global initiative by the UNICEF (United Nations Children's Fund) that aims to understand the impact of the pandemic on children and young people.

Image rendered in BioRender by Ms. Diksha Singh



For example the graphical data indicates the percentage (%) infected individuals and the rate of deaths is lower in the pediatric population (i.e. children and adolescents under 20 years of age) compared to older people.

Data compiled by UNICEF shows the pediatric population (all age sub-groups taken together) accounts for 14% and 0.4% of the reported COVID-19 cases and deaths, respectively. UNICEF (India) also reports that no sudden spike has been noted in the overall percentage of children affected by COVID-19 in the country during the second wave of the pandemic[1] This is because, increase in number of children contracting the infection primarily reflects the increased number of people testing positive for coronavirus across the country owing to the more transmissible delta variant.

Therefore, the next obvious question is what confers better protection against COVID-19 in children? The scientists have shown that children have no difference in the viral load (i.e. number of live virus particles) in the respiratory airways as compared to adults [2]. But they have found that the difference arises from the fact that children rely on the innate (unconditioned and rapid) immune response in adults.

Studies by different groups suggest that by virtue of this innate response, children are primed to fight back the virus more effectively than the adults in more than one ways. First, nose and throat swabs from children showed they have higher levels of signaling molecules i.e. proteins such as interferons and interleukins which signal the immune system about the arrival of the

virus[2]. Second, scientists found the cells lining the respiratory tract in children have higher expression of receptors, which are structures on the cell surface that recognize the SARS-CoV-2[3]. This enables the innate immune system in children to mount stronger anti-viral response. Third, infected children have increased levels of frontline warriors such as activated neutrophil cells that ingest the unfamiliar viral particles thus limiting the replication of the virus[4]. The efficiency of these cells declines with age. Fourth, a category of cells that acts as detectors and secretors, the innate lymphoid cells, play a crucial role in children[5]. These cells detect tissue damage and secrete signaling proteins that modulate both the innate and adaptive immune responses.

Thus, scientific evidence suggests the immune state in children is poised to mount an anti-viral response of the right type and at the right time, which largely underscores the ability of children to beat the virus better than the adults. Nonetheless, given that SARS-CoV-2 continues to mutate it is important to cautiously follow the immune responses in children as they cope with the evolving virus.

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Towards COVID-19 therapy: Immunoinformatics and Machine Learning based Computational Approach in the Vaccine Designing

At the beginning of the COVID-19 pandemic, we humans were in dire need of a "bhramhastra" i.e. a vaccine to fight against it. Conventional vaccinology methods were inadequate for this pandemic because of (1) time-consuming antigen identification; (2) lack of antigenic diversity; (3) extensive pathogen cultivation in wet labs; and (4) high costs. In this moment of crisis, computer-based bioinformatics and immunoinformatics happened to accelerate vaccine designing through (i) Reverse Vaccinology (RV) and (ii) Structural Vaccinology (SV).

The causative agent of any infection contains specific epitopes which results in specific activation of the immune response. RV technology identifies these epitopes and further maps and screens them according to expression by the pathogen also to check the immunogenicity during infection. The entire genome sequence of COVID-19 was available from Dec, 2019, on computational programmes (i.e., ORFfinder, GetOrf) that identified all the open reading frames in its sequence. Then a comprehensive analysis of T-cell and B-cell epitopes prediction was done to sieve out potential VCs (vaccine candidates). For humoral response, Immune Epitope Database (IEDB) was used to identify B-cell epitopes while by screening the antigens T-cell using major histocompatibility complex (MHC) to get an idea regarding cellular responses.

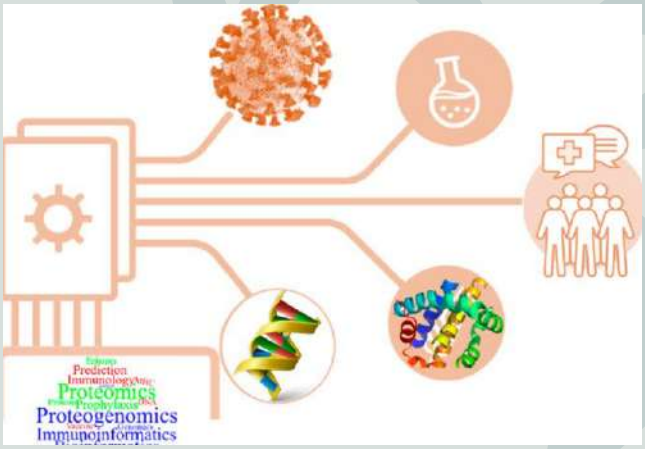
SV can be used to develop effective peptide-based vaccines by (1) assessing 3D conformational structure (i.e. X-ray crystallography, electron microscopy) of the epitope or antigen–antibody complex; (2) using molecular dynamics simulations to predict and model the epitope; (3) incorporating reengineered antigen into immunoinformatics platforms (i.e. Epitome); and (4) testing VCs for efficacy and safety in vivo. It looks into viral structure, antigen antibody complexes and their 3D structure and provides information regarding VCs and their safeties. According to a review article regarding role of immunoinformatics for VCs in COVID-19, researchers used the IEDB and virus pathogen resource to show that SARS-associated coronavirus (SARS-CoV) and SARS-CoV-2 have high gene sequence similarity and comparable B- and T-cell epitopes. Another study showed how immunoinformatics and comparative genomic methods could be used to assess a potential T-cell epitope peptide-vaccine by targeting the COVID-19 envelope protein (CoV-E). Using comparative sequencing, 10 MHC Class I and MHC Class II peptides were found that were promising VCs for COVID-19. Furthermore, some researchers used RV to analyze three COVID-19 antigenic proteins (nucleocapsid, ORF3a, and membrane protein, [NOM]) and developed a potential multi-epitope COVID-19 vaccine that can stimulate both CD4+ and CD8+ T-cell immune responses. [1,2]

Scientists also utilized the Vaxign platform, a Vaxign-ML machine-learning tool, to successfully predict a COVID-19 VC called, "Sp/Nsp cocktail." There was sequence conservation of protein nsp3

among SARS-CoV-2, SARS-CoV, and MERS-CoV and that nsp3-domain contained MHC-I T-cell, MHC-II T-cell, and B-cell epitopes [3].

As shown in another study by Yang et al. (2021), the scientists used a much more advanced platform called “DeepVacPred” which is capable of scanning all sets of epitopes from B-cell and T-cell and uses a deep neural network-based AI to pick the best possible set of epitopes for a multimeric epitope vaccine within a very short amount of time ensuring all kinds of safety for the species [4].

In this way researchers came up with a large set of epitopes for vaccine production within a very short period of time which was unimaginable using conventional vaccinology and these “formatics” researches paved the way for the final construction of the vaccine at the earliest. Successful production of the bhramhastra continues to keep the COVID infection under control at present.



Picture credit: Computational Immune Proteomics Approach to Target COVID-19Bruno Tilocca, Domenico Britti, Andrea Urbani, and Paola RoncadaJournal of Proteome Research 2020 19 (11), 4233-4241DOI: 10.1021/acs.jproteome.0c00553

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Online learning in the time of COVID-19 Pandemic - A Student's Perspective

It was 24th March 2020, we were in between our semester exam when an unexpected notice came from the Principal's office, which was an order from the state government to discontinue all the academic activities and to close the hostels immediately as the COVID-19 cases were rapidly increasing. We all were sent back to our homes and were asked to return to the college after 2days. However, none of us had seen the future; the day after that Government of India announced the nationwide complete lockdown and soon our two days holiday became almost a year long home confinement. After a month of complete lockdown, our college started an online classroom program that was completely new to all of us including our teachers. In this article, I share the findings of studies based on feedback from students, and my thoughts about online learning during these trying times.

Advantages and Opportunities

According to the UNESCO global education coalition, due to the worldwide pandemic, about 128 million learners are out of school that affected about 7.3% of the world's student population. Without online education this figure could have surged, it has cut down this number to a particular extent (1).One of the best things about online learning is that it was able to make variations from the typical classroom of blackboard and white chalk. 3D Visualisation, animation, graphics gave learning a boost and helped to understand the concepts in a much better way. Besides the conventional classes, several learning platforms like edX, Coursera, Udemy, SWAYAM, NPTEL, which offer knowledge on diverse topics, gained much more recognition and popularity. It allowed students like us to access education much more easily and learn at our own convenient time without depending on others. Studies conducted over 307 agricultural students showed that flexible time schedule and convenience are the major benefits one can derive from online learning. The advantages of a comfortable study environment and improvement of self-technical skills through such online courses were also the reasons for opting online education (2). Apart from the college or school curriculums, several new and innovative courses ranging from personality development, self-growth to creative learning like music, designing, cooking helped us to convert the monotonous life of home captivity to an interesting one.

Obstacles

Anything that becomes excess becomes toxic, same goes for online education. When it becomes the one and only mode of learning its dark side becomes more prominent to the society. The first limitation to accessing online learning is the availability of high-speed internet. According to the Digital India Report, India had a population of 1.39 billion among them only 624 million are internet users which is almost 50% of the total population.(3)

As half of the population of India is unable to access the internet, online education creates a socio-economic disparity between students. Students from rural or semi-urban areas face problem with network connectivity during online classes that disrupt the rhythm of learning. Consequently, it also increases the levels of anxiety in them. Prolonged classes sometimes become hectic since a prolonged screen time affects the health of students by triggering headache, eyestrain and mental fatigue. A study named 'The Impact of Online Teaching during the pandemic on Learning and Wellbeing' conducted by students of Lucknow-based Spring Dale College showed that over 54-58 percent students experienced several health issues (4).

As the online mode of learning is completely new, even teachers, at times, face problems with creating content and delivering lectures. Explaining tough concepts become all the more challenging. It also decreases the effectiveness of the classes. The devices used for online classes like mobile phones or laptop also contains several applications that might be used for the entertainment purpose and thus can be the cause of distraction, which hampers the active learning process. Practical, hands-on training, field visits, projects are an essential part of the coursework of subjects from science and technology COVID-19 pandemic has restricted all of those.

The ultimate goal of education is not about gaining knowledge about a particular subject but it should also be aimed at developing social skills and building character that enables a person to stand on his own feet. If you ask me about this, I would opine that online education certainly has a long way to go before it can gain the acceptance, popularity and be at par with the traditional modes of in-person teaching.

My Thoughts

Online education has undoubtedly changed the conventional way of teaching and learning which gave a new edge to the age-old education system of India. However, certain loopholes may bring imbalance in the socio-economic framework in a developing country like ours. Therefore, strong educational policies, proper infrastructure and management are required to obviate the disparities in the learning outcomes during the pandemic which have arisen owing to the limitations of online learning discussed here and will expectedly strengthen our education system in the years to come. A collaborative effort by all of us will surely help us achieve this goal in due course.

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PANDEMIC: Science under the lens of public perception

Humanity has certainly learnt a new lesson which is to respect and fear even the tiniest of things. A nanoscale virus has disrupted the normal way of life for almost everyone. The pandemic has changed them, their perspectives have changed and the way scientists are perceived has definitely improved. India has particularly lagged in recognizing the importance of science and honoring those who drive its advance.
But that all has changed with vaccines against COVID-19.

Let's recall those early months of 2020 when everyone was cooped up inside their houses. Any attempt to step out of the house was coupled with mask, gloves, sanitizers and face shields and yet people were afraid. Comparing the situation now, we have different types of vaccines as our shield. The development of COVID-19 vaccine was achieved at a pace unmatched ever before in history. The credit goes to our deserving scientists and we, as a nation, are finally giving them their due respect.

In fact, the global acceptance of science has increased at a staggering pace. There is a clear pattern of more positive attitudes towards science evident in recent research by the Wellcome Trust in the United Kingdom.

The findings reveal that the pandemic brought the public interest closer to science when results are compared to similar questions in 2015 and 2020. Pew Research and 3M reported similar trends when comparing people's response before and after the pandemic in the USA and Germany respectively.

Thus, if we weigh the average results from various polls and different nations COVID-19 has coincided with a general rise in public trust in science and scientists to various degrees ranging from as low as 8% to as high as 27%.
If anything, the pandemic has definitely taught us to respect nature and those who try to understand it and unravel the wonders it holds – our scientists.

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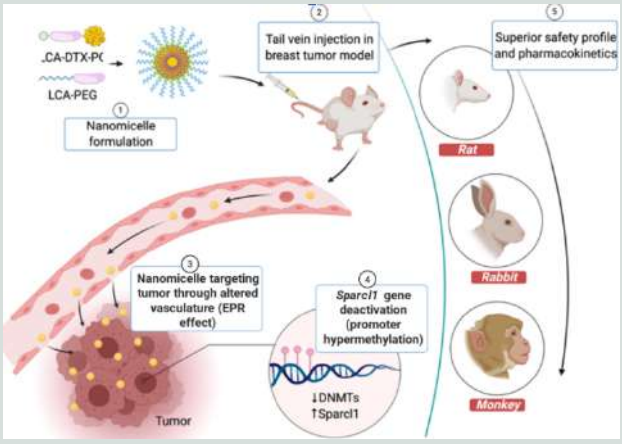
Bile Acid-tethered Docetaxel-based Nanomicelle Mitigates Tumor progression through Epigenetic Changes

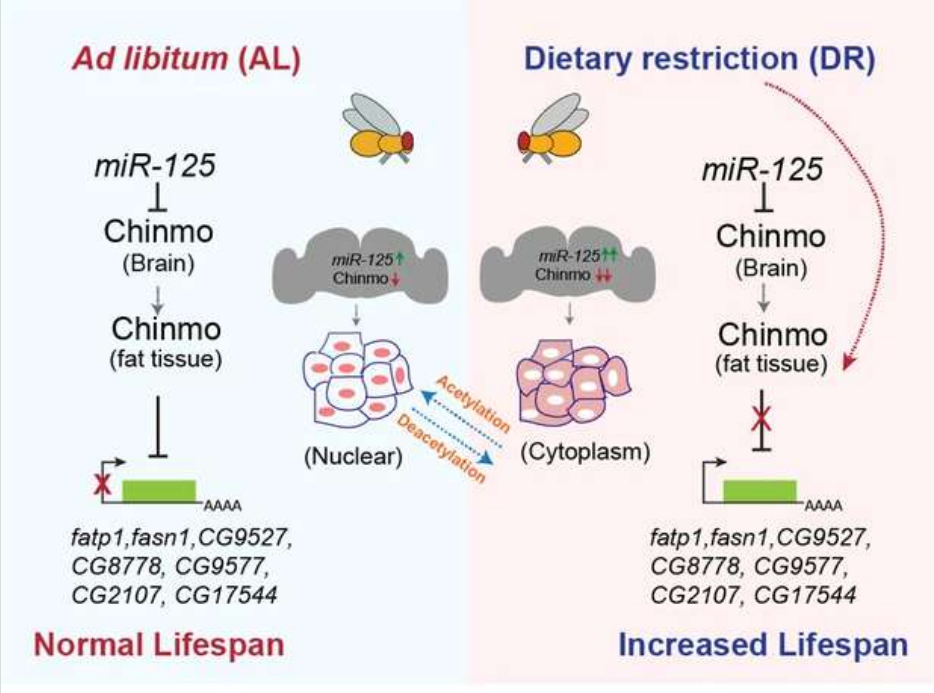


For their regular operation, every live cell in the body follows a set of instructions. When some of these instructions go awry, our cells divide fast and expand uncontrolled, eventually becoming a cancerous tumour. The optimal objective is to eliminate cancer cells selectively while avoiding damaging healthy cells. However, present chemotherapeutic medicines and formulations fall short of this ideal aim due to multi-organ toxicity. For example, formulation instability and organ toxicity are some of the problems associated with Taxotere®, a Docetaxel drug formulation licensed for the treatment of breast cancer. The chemical components employed in the formulation, and availability of the free drug in blood and important organs other than the tumour site are all responsible for these problems.

We picked a nanotechnology platform to address these issues because it has provided a ray of hope for cancer therapy during the last decade. Solid tumours, such as breast cancer, have the property of holding nanoparticles due to their altered capillaries. Surprisingly, neither the healthy organs of the body nor the circulating blood cells have altered capillaries. Through the combination of Docetaxel (DTX) with lipid molecules which are the fat molecules naturally produced in cells, we developed these microscopic nanoparticles in the size range of 100 nanometre which is 1000 times smaller than a strand of human hair. We found these nanoparticles trapping and releasing drug in the tumours relative to other organs, as well as reduced toxicity because of decreased amount of free drug in the circulation, when we tested these nanoparticles in a mouse having tumor. One of the major gaps in the study of cancer nanomedicine is a lack of understanding of how nanomedicine affects tumor cell. The growth of tumor cells depends upon the activation of several ‘genes’ which contains the instructions for various functions of cell. Therefore, we further demonstrated that these nanoparticles inhibit the tumor growth signals through deactivation of genes like Sparcl1 which is responsible for tumor growth.Several drugs/formulations have been shown to be effective in mouse models, but not in larger organisms such as monkeys or humans. Apart from the excellent tumour inhibitory potential, our nanoparticles show enhanced safety profile in many animal models, including monkeys. The superiority of our non-toxic nanoparticle formulation in monkeys gave us a lot of optimism for future research.

Our discoveries open the door to novel cancer therapeutic approaches. Because of the adaptability of our administration system, we can accommodate many chemotherapeutic drugs to boost the effectiveness of each one. One of the key goals is to decrease the economic and emotional load of cancer patients and hospitalizations by employing a single dosage of the medicine to treat tumours for an extended length of time without generating substantial effects. The short-term aim is to improve numerous aspects of our nanoparticle technology including robust production method, process, and stability factors. Our long-term objective is to improve the technology so that it may be used in clinical trials. We expect to see our medication delivery system used in clinical applications one day as a result of our ongoing research in this field.

Promoting healthy lifespan with diet and non-coding RNAs



The composition and amount of food consumed play a major role in determining how an organism will age. Research on lab animals indicate that genetic, pharmacological and dietary interventions can promote healthy lifespan. The RNA Biology laboratory is focused on identifying and characterizing evolutionary conserved microRNA-mediated networks that promote health during ageing. Interventions that extend the lifespan by reduced food intake are referred to as dietary restriction (DR). Age and nutrient-related changes in the abundance of microRNAs (miRNAs) have been linked to organismal longevity. However, the mechanisms by which they modulate lifespan and the tissue-specific role of miRNA-mediated networks in DR-dependent enhancement of lifespan remain largely unexplored. A recent publication from the RNA Biology lab shows that two neuronally enriched and highly conserved microRNAs, miR-125 and let-7 mediate the DR response in *Drosophila melanogaster*. 'Chinmo' or chronologically inappropriate morphogenesis is a direct target of miR-125 and acts both in the brain and fat body tissue to regulate fat metabolism and lifespan. miR-125 is regulated by dietary signals (DS) and represses Chinmo, thus leading to de-repression of genes involved in fat metabolism in peripheral tissues, which in turn result in the extension of lifespan. This functional analysis sets the stage for evaluation of miR-125 and other conserved miRNAs as candidates for developing therapeutics that promote healthy aging and prevent/delay diseases associated with aging. In summary, this study identifies a conserved microRNA that mediates the beneficial effects of DR by promoting communication between different tissues.

Full article: https://elifesciences.org/articles/62621#content

BIODIVERSITY AT RCB

CAMPUS CLICKS

Pictures have been compiled by Ms. Anushka Das and Mr. Abhaydeep Pandey

RAVISHING RCB

CAMPUS CLICKS


Jaya Bharti Singh


Krishna Singh Bisht


Vinay Sharma


Shivam Aggarwal


Krishna Singh Bisht

Pictures have been compiled by Ms. Anushka Das and Mr. Abhaydeep Pandey

Gut Microbiome : Our Second Brain

Our brain produces chemicals called neurotransmitters which give us a feeling of energy, excitement, and happiness. These neurotransmitters also make us anxious, stressed, and low in depressed situations. Our brain controls everything that we do, feel and think. But our brain is not the only organ responsible for controlling the mental and physical functions of the body. It is a fascinating revelation that all of us possess a "second brain" in the gut which can influence the functions of our brain. The brain and gut are connected by an extensive network of neurons and a highway of metabolites and hormones which work in a bidirectional manner to direct diverse functions. The trillions of microbes present in the gut can influence our brain and therefore can regulate numerous fundamental aspects of physiology and behaviour including sleep, mood, anger, appetite, memory, and bowel motility. The gut microbiota is the most important component of the gut ecosystem, which is colonized by 1014 microbes, which are nearly ten times more than the total number of nucleated cells present in our body (Sender et al., 2016). In terms of genes, we are 99% bacteria, so we actually are a "walking bacterial colony" (Qin et al., 2010). The importance of gut bacteria can be further understood by the fact that lactose present in breast milk is mostly digested by colonic fermentation by the intestinal bacteria in new born babies (Kein CL; 1996). Apart from their role in health and disease, I am very passionate about understanding the links between our gut and the brain and in examining how our intestines and the microbes within them can influence both physical and mental health, and most importantly how our diets influence this relationship. The evidence of the relationship between the gut and the brain comes from many studies done all over the world. In a study, it is demonstrated that when mice were colonized with the bacterium Toxoplasma gondii, they lose their fear of cats (Vyas et al., 2006). They are attracted to pheromones released in cat's urine and their behaviour changes towards cats. This study suggested that the microbe takes control of its brain and changes the brain structure of the mice permanently. Humans infected by this parasite have been reported to have an increased risk of traffic accidents (Flegar J et al., 2002).

Another study reveals that Lactobacillus rhamnosus can help treat depression and stress-like emotional behaviour (Bravo et al., 2011). Bacteroids fragalis was shown to correct core abnormalities of autism-like disease in rat models with autism-like symptoms (Hsiao et al., 2013). There are many mechanisms proposed by scientists that explain how these microbes can influence our brain and behaviour. Firstly, our brain and gut are physically and biochemically connected in numerous ways. The intestine is physically linked to the brain through the vagus nerve which sends signals in both directions i.e. from gut to brain and brain to gut. Even when the vagus nerve is severed, our intestine can continue to function fully without a physical connection to the brain, suggesting they have a mind of their own. Secondly, our brain is made up of a hundred billion neurons that continuously send messages to tell our bodies how to work and behave. Our intestine also has 100 million neurons which suggest that it does much more than merely handle digestion. Third, our microbiome is the center point of our immune system which means that any disturbance down there can cause subtle immune reactions all around the body, which if prolonged can affect brain health. Fourth, most of the neurotransmitters are produced in the gut, for example, 95% of serotonin which is also called nature's antidepressant, is produced in the gut. All these studies are critical in our understanding of how these microbes can cause these changes and how the microbiome can be exploited to treat problems related to the brain. As the microbiota is easy to modify through the use of probiotics, prebiotics, and feeding habits, future strategies can be developed which will target the gut-brain axis for the treatment of idiopathic maladies and the development of the brain health. Also, if we can develop diets that will target the microbiome to support brain health at crucial stages of development, we may benefit a lot of people who are malnourished, have cognitive decline, or have developmental problems.

MIXED BAG

MS. SIDDHI PAVALE

The Story of Your Blood Group

Long long time ago the blood type A existed in the hominid ancestors of the human species.

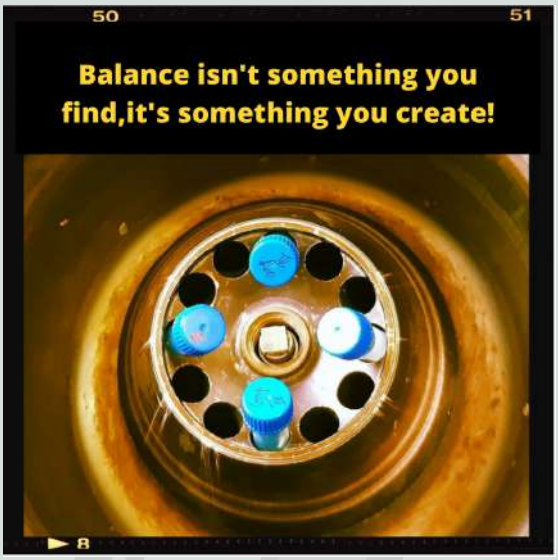
Slowly and steadily after genetic mutations over 3.5 million years,arose another blood type called the blood group B when one of the sugars that sit on the surface of red blood cells had managed to modify.

For about a million years after this only either A or B antigens happily thrived on the red bood cell surface .But then an accident of evolution occured!

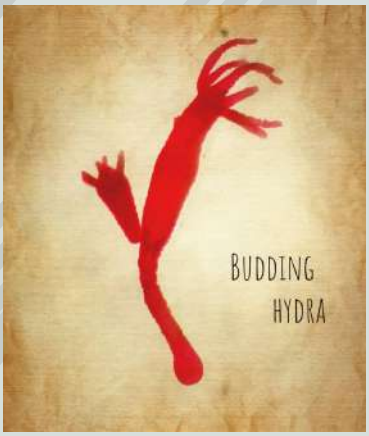
This accident affected the lives of the A and B antigens so severely that they disappeared from their lovely red homes - the RBCs. The accident - mutations had rendered the A and B sugar gene inactive, creating type O, which has neither the A or B version of the sugar.These sugars are what makes some blood types incompatible.The A and B sugar coexist since then and can also be present individually or not at all.

As much deterimental the accident of evolution was thought to be for the A and B blood type,it was equally benefical.The type O started being less susceptible to various infections and diseases. They are known to be less susceptible to malaria,avoiding the penetration of the malarial parasite into the RBCs.But the mutation is still called an accident as it didn't scrap off these diseases successfully.

Now, the A,B,AB,O antigens sit on our RBCs probably waiting for another mutation and we carrying them continue to explore!



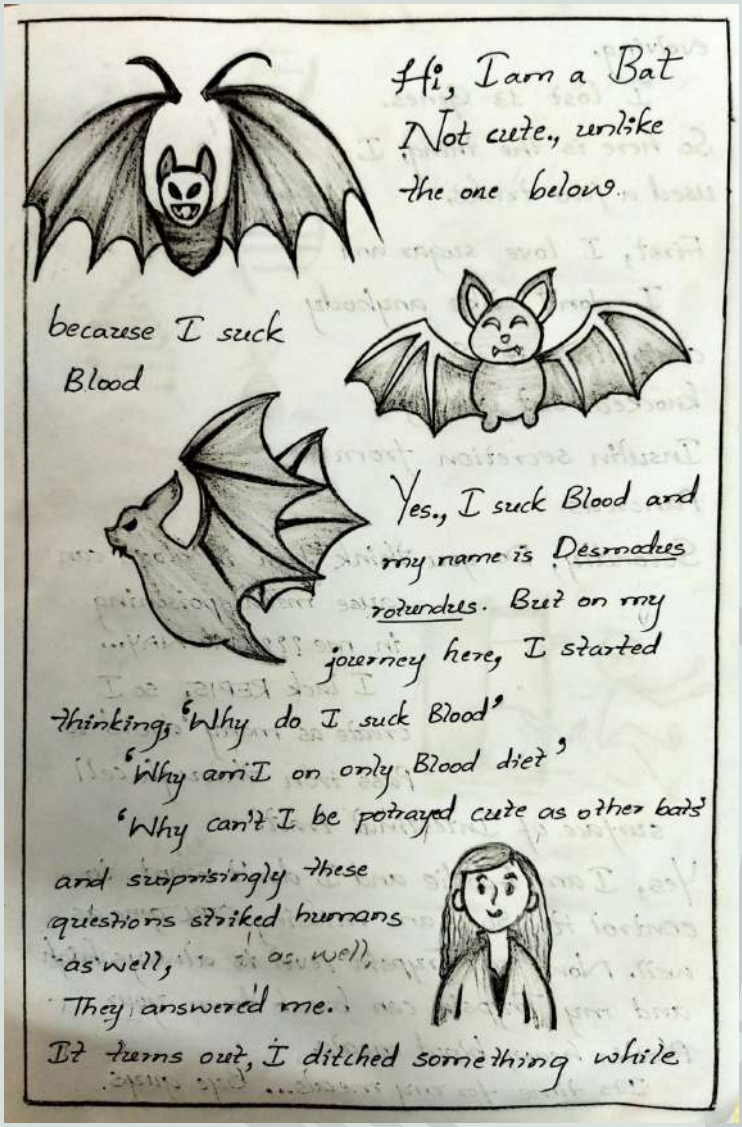
A centrifuge is one of the most frequently used machines in a laboratory . It allows the separation of contents in a sample by spinning them at high speeds, reaching up to various thousands of revolutions per minute. One of the important things to remember while using a centrifuge is to balance the weight of the samples placed in the holder opposite to each other. An unbalanced centrifuge ,operating at high speed can cause potential damage to the operator or the machine itself. This image depicts a balanced centrifuge with tubes containing samples of equal weight placed across each other.

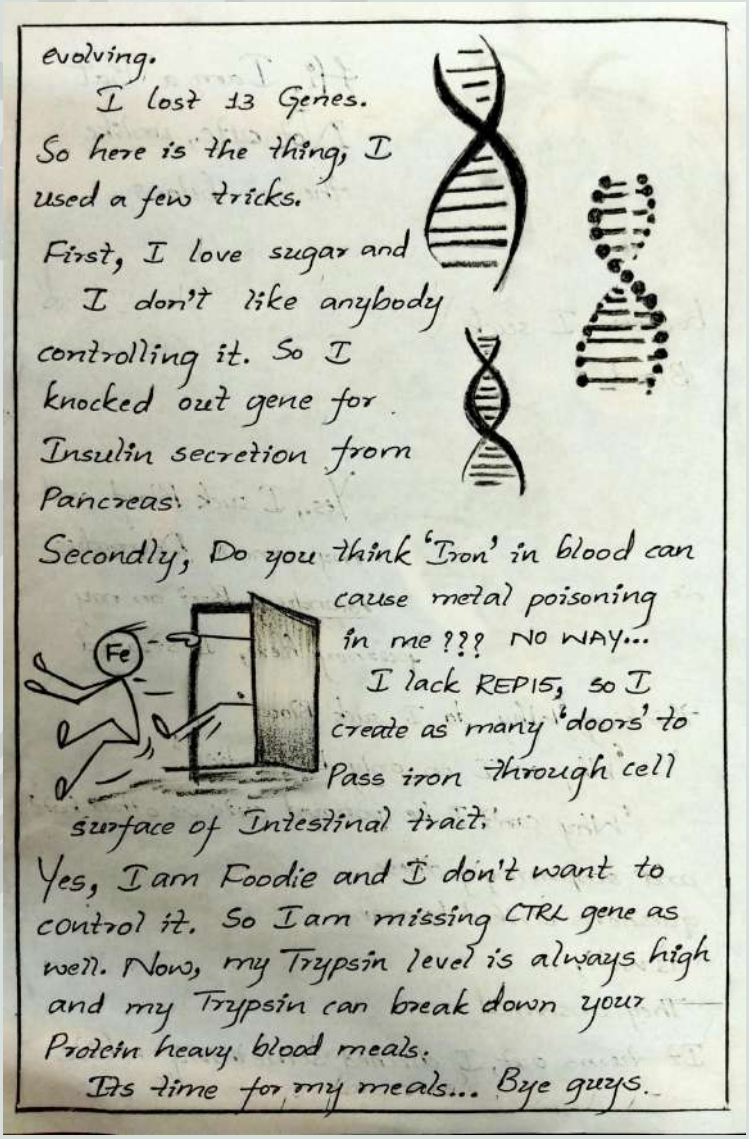


Hydra is a freshwater organism having a tube like body with a bunch of tentacles at one end. It was named 'Hydra' due to its resemblance to the immortal nine-headed water monster of the Greek Mythology .It became popular in the scientific community especially because of its regenerative capabilities, just like the water monster that could regrow its heads when cut-off! The microscopic image here depicts a hydra stained with a red dye.

MIXED BAG

MS. KUSUMA B





Awe-'struc' by Structural Biology

Mary Johnson, PhD
Lab: Laboratory of Genomic Integrity and Evolution, headed by Dr. Deepak T. Nair

Witnessing empty rooms getting filled up with a pool of amazingly talented budding scientists and extraordinary infrastructure, from borrowing and sharing facilities from other NCR institutes to setting things into pace by tapping into our own powers and potential and overcoming the pain-staking growth, RCB has come to be a name, worthy of mention. Alongside housing all the world class facilities, RCB looks after the well-being of its students and staff with great hostels, homely food and transportation facilities, all of which were up and running in no time. The able mentorship of my supervisor Dr. Deepak T. Nair and co-mentor Dr. Deepti Jain, a strong sense of support from my colleagues, and unconditional love from my wonderful friends have shaped me to the professional that I currently am. I am a postdoctoral researcher based at the very promising centres, the NCI/NIH, Maryland, USA where I work to elucidate the detailed structural mechanism of type 3 secretory system (T3SS) in gram negative bacteria.

NIH NATIONAL CANCER INSTITUTE

DID YOU KNOW?
The type III secretion system (T3SS) is also known as the injectisome because its structure resembles a needle and syringe and acts in a similar fashion.

Narrowing down to all things nano

Nihal Medatwal, PhD
Lab: Laboratory of Nanotechnology and Chemical Biology, headed by Dr. Avinash Bajaj

The journey of my transformation into a researcher began in 2014 when I was selected to join RCB as a PhD candidate, under the able guidance of my supervisor Dr. Avinash Bajaj and co-mentor, Dr. Ujjaini Dasgupta. My career has been through dramatic progresses where, through collaboration in different projects, I have built up on my keen interest in the field of science. Mass spectrometry, for me has to be the finest jewel of the crown that I now adorn as a successful graduate of the lab that has shaped me up into the researcher that I am today. Currently, I am a postdoctoral fellow based in Ian A Blair's lab at the Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, USA. Now I am an independent researcher working on a project of national importance at UPenn.

Perelman School of Medicine University of Pennsylvania

DID YOU KNOW?
The most common contaminant in a mass spectrometry experiment is keratin! Make sure to cover up!

Pivotal Proteomics

Sanjay Kumar, PhD
Lab: Laboratory of Functional Proteomics, headed by Dr. Tushar Kanti Maiti

I graduated in 2020 from Dr. Maiti's lab, after a six-year journey. Under his able mentorship and with the helping hands of my favourite seniors who were were always ready to train junior students on fundamental aspects of scientific assays and techniques, I happened to pursue a research topic that was challenging yet oh so interesting. The amalgamation of professionalism and caring attitude of the faculties, scientists and staff at RCB has created an open, friendly atmosphere at the institute, which is very conducive to exploratory research. Currently, I am working as a Research Fellow in Department of Neuroscience, Mayo Clinic Florida Campus where we work on dissecting the role of mitochondrial as well as autophagic lysosomal dysfunction in aging process and the pathophysiology of several age-related human diseases, including Parkinson's disease, Alzheimer's disease, amyotrophic lateral sclerosis (ALS), fronto-temporal dementias, lysosomal storage disorders and mitochondrial diseases. To end this on a positive note, I sincerely hope and believe that one day we all will bring glory to our alma mater.

DID YOU KNOW?
Proteomics research permits the discovery of new protein markers for diagnostic purposes and the study of novel molecular targets for drug discovery.

Towards a happy tummy and blister-free skin

Salman Ahmad Mustafa, PhD
Lab: Laboratory of gut infection and Inflammation Biology, headed by Dr. Chittur V. Srikanth

I graduated with a PhD in 2019 from the laboratory of Dr. C.V. Srikanth where my work was primarily focused on understanding the involvement of PTMs mainly SUMOylation in controlling intestinal infections and inflammation associated disorders. RCB's challenging yet scholarly environment helped me gain extensive research experience and unique perspectives in molecular biology, cellular biology, immunology and gene therapy. In the course of my jounrney, I have received immense help from my RCB family that has aided me in my professional and personal growth. Currently, I am working as a Postdoctoral Research Associate in Chiappini Lab at King's College, London where we specialize on Nanomaterials and Biointerfaces where my project involves developing minimally invasive, porous silicon nanoneedles to deliver therapeutics in patients battling recessive dystrophic epidermolysis bullosa (RDEB). I have also held the position of a postdoctoral research associate at at Yale University, USA where I was focused on understanding involvement of innate immune signaling in controlling autophagy mechanisms in macrophages during infection induced inflammation in the gut.

DID YOU KNOW?
Recessive Dystrophic Epidermolysis Bullosa, RDEB is a potentially fatal fragile skin disease that leads to excessive skin blistering due to a genetic lack of collagen

Long-distance relationships (at the cellular level!)

Sunayana Dagar, PhD
Lab: Laboratory of Cellular Dynamics, headed by Dr. Sivaram V S Mylavarapu

Yale University
School of Medicine

Seeing is believing and with this thought I was always curious to explore the inner world of a human cell through microscopy. I joined Dr. Sivaram's lab at RCB because of intriguing science being done in the lab and for my passion to learn high-end microscopy. My research experience at RCB has helped me leverage skills like project designing and handling, data analysis and interpretation, scientific writing and definitely teamwork. I have worked in multiple projects in the lab and that has widened my horizons of expertise and taught me adaptability. My research project was focused on understanding the mechanisms involved in biogenesis of tunneling nanotubes, which can be considered as a long-distance communication mechanism between two cells, primarily formed under stress conditions. Now how cool is that! My research training at RCB helped me in getting a Postdoctoral associate position at Yale School of medicine, USA. During my postdoctoral research, I would be exploring how filamins influence extracellular matrix remodeling, and how filamin mutations cause disease.

DID YOU KNOW?
Confocal microscopy, most frequently confocal laser scanning microscopy (CLSM) or laser confocal scanning microscopy (LCSM), is an optical imaging technique.

This section has been compiled by Ms. Anushka Das and Dr. Masum Saini.

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