

Indian Journal of Science Communication

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ROLE OF SCIENTIFIC TEMPER IN MITIGATING THE COVID19 PANDEMIC

COMMUNICATION AND TECHNOLOGY INTERVENTION FOR INCLUSIVE DEVELOPMENT IN UTTARAKHAND

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- The IJSC is a peer reviewed half yearly international research journal published twice in a year in January and July.
- The IJSC is brought out and disseminated by Indian Science Communication Society (ISCOS) and Indian Science Writers' Association (ISWA); Catalyzed by NCSTC-DST.
- The ISCOS and ISWA assume no responsibility for the opinions offered by the contributors.
- Address for submission of contributions for publication: The Editor, *Indian Journal of Science Communication*, Indian Science Communication Society, Chandrika Bhawan, 577-D, Near Dandahiya Masjid, Lucknow – 226022, India; E-mail: editorijsc@gmail.com; mkp@nic.in. Refer **Instructions for Contributors**.
- Address for subscription and advertisements: The Coordinator IJSC, Indian Science Communication Society, Chandrika Bhawan, 577-D, Near Dandahiya Masjid, Lucknow – 226022, India, Phone: +91-8090907153; E-mail: info@iscos.org. Payments may be sent by demand draft/ cheque issued in favour of Indian Science Communication Society, payable at Lucknow or online bank transfer. Refer **Subscription Form**.
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- Price per copy for Individual:

Inland : ₹ 300
Overseas : US \$ 15



Indian Journal of Science Communication

Indian Science Communication Society

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Website: www.iscos.org

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BEGINNING AN ERA OF GEN-NEXT SCIENCE COMMUNICATION



India's science communication programme is largely aimed at communicating and popularizing science and technology to masses, promoting greater understanding and awareness of science and technology and stimulating scientific and technological temper amongst them. It endeavours for making that experience interactive, joyful, and relevant for diverse age groups and sections of community while striving to reach the unreached. So, it must be its touchstone that simple principles and ideas of science find appreciation in thinking, behaviour, and mindset of our countrymen to support their informed choices. The initiatives taken in the past 3-4 decades endeavour to build capacity for informed decision making and public awareness of science. It has thus been devoted towards dissemination of knowledge in interesting, informative, and innovative formats. It builds programmes with help of different media which percolate to every nook and corner of the society. The programmes are focused on outreach activities to science popularization; training in science communication; development, production and dissemination of science software; field-based projects; research, international co-operation and so on. Awards and incentives to recognize the best efforts in this challenging domain are also instituted and given annually.

The programmes and initiatives are placed in different categories, such as: i) Content Development, ii) Professional Development, iii) Promotion of Science Literacy, iv) Hands-on Science, v) Emerging Areas, and vi) International Cooperation in Science Communication. Various progressive indicators include, events, programmes, activities undertaken; trainings conducted; content, software developed; innovative activities and programmes introduced; and population and beneficiaries covered, etc. In addition, innovative programmes using leading edged technologies, i.e. drone, artificial intelligence, virtual reality, augmented virtual reality, machine learning, deep learning, metaverse, and quantum technologies, etc., are also envisaged and may be implemented in near future to begin an era of gen next science communication.

Recently, a "Report of the Third-Party Review of The Programmes and Activities of DST" has been submitted to DST for implementation. According to multilevel review and assessment mechanisms it emerged that the programmes have been able to leverage the efforts to fulfil the overarching goals of promoting science literacy and building scientific temper. It achieved a degree of qualitative change in value of everyday science, scientific information, rise in accessibility of people to fruits of scientific developments and breakthroughs, and promote a culture of informed decision making by people at large. Scientific content on STI developments through DTH and Internet TV routes was generated and enhanced to make it easily accessible to varied audience at the national platform which made a huge impact on interest in science and scientific thinking amongst students and the youth. The beneficiaries are all citizens of India and global communities, especially those interested in science and technology information in Indian languages. The Initiatives are creating an effective human resource base and growth of science communication as academic discipline, all for leveraging science literacy and building scientific temper as enshrined in Constitution of India. Provided support to stimulate, encourage and recognize outstanding efforts in science popularization and communication. The impact comprised of a thrust on reaching the unreached and promoted science literacy activities like promoting the minimum science for all, science popularization, thematic science Jathas, popular science magazines, science through digital medium, nature science communication, science through folklore, explaining science behind so called miracles, and strengthened the benefits from activities to innovate, augment, synergize and harness science communication and science media in keeping with emerging trends and applications. The initiatives reached out to country wide population, especially children, youth, women, and people at large across 600 districts, promoting science communication in regional and local languages, served the less endowed or under-stress regions and districts to make them a sensible future citizens prepared for informed decisions.

The interventions are serving students, teachers, farmers, masses in all the districts through delivery of services with enhanced scale and speed of access. Thematic outreach with high priority themes like promoting creativity and innovation mindset is yielding gains in country wide field capacity and sectoral empowerment on critical lifecycle needs. The initiative like IRIS have provided a platform to the young and talented to represent India at global science competitions like Intel International Science and Engineering Fair (Intel-ISEF) and encouraged them to come up with research-based projects. National Programme on Science, Health & Risk Communication is being promoted for helping the country in combating COVID19 pandemic. A cooperative and collaborative climate is emerging to leverage and strengthen outcomes of rest of the NCSTC programmes while providing higher visibility and collaborative avenues.

Prof. Dr. Manoj Kumar Patairiya

NEW MEDIA AS A SOURCE OF SCIENTIFIC INFORMATION FOR THE YOUTHS: A STUDY

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Science communication is an important dimension of journalism. Science news reading and viewing habits help develop scientific outlook in the society. The new or digital media is an important source of information dissemination, and the use of digital technology is continuously increasing. It can be used for dissemination of scientific information among masses. It depends on mode of receiving science related information by people. Youths, being a very important segment of our society, play a critical role in all areas of life. Good knowledge and practice of science and technology by youths can be useful for enriching scientific temperament in society. The present study is an attempt to find the mode of receiving science related news through new media among youth. It has studied mainly their reading and viewing habits on digital media. It is based on an online survey method. The findings of the study give very useful information about the science news reading and viewing habits on digital media.

Keywords: Mode of receiving, Science information, New media, Youth

Introduction

Media channels have an important role in dissemination of scientific information in society. Keeping in view the importance of science in our daily life, each section of society should become scientifically literate. (1) Science carries value due to its application in various dimensions of our life. (2) Science and technology can be correctly used when people are regularly exposed to scientific information associated with daily lives. It is possible only if they have habit of receiving science news through various media and especially digital media. When we talk about the habit of science news of youths, it includes behaviour of youths in reference to science news reading, viewing, and listening science contents through various mass media. Reading newspapers, watching TV, listening to the radio, or surfing social media is a routine. Reading itself has several benefits, like knowing information and gaining knowledge. It also inspires, entertains, and guides people besides giving knowledge on various subjects. It helps have contemporary and useful information in our life besides improving our story telling technique.

Like other news, there are several benefits of reading and viewing science news. It is a source of gaining science knowledge. It helps in learning new techniques and develops a scientific temperament, and we can distinguish between truth and false. It removes various kinds of superstitions and works as an educational tool for youths. It also develops and opens our mind. One can think critically about various aspects of life and nature. It enhances our creativity and is helpful in learning technical and other skills. It reduces gap between complex science and common persons. (3) Many problems faced by society from local to global can be solved through a very thoughtful use of science and technology. People need scientific information not only to gain knowledge and live a healthy life, but they need knowledge of science to avoid themselves from being cheated from any antisocial elements and live in the new and changing environment of the present society. Selection of food items, and use of various other kinds of items need scientific information and guidance. We also need scientific information

to make good use of various products and services. Finally, we need scientific information to live a peaceful healthy life. (4) There are a large number of science journals, and they can describe the core sources of science information. But some problems exist even with these sources. They can't be used by common people due to their complex presentation and it is very difficult for them to understand. Digital media has become a big source of various kinds of information.

Science news on digital media

Digital media has become a big source of science information. It provides many kinds of content on various dimensions of science and technology. Several science groups have also been formed on digital media. These groups are continuously increasing in size and numbers. They have become a very important platform of interaction of scientific information. Similarly, chat groups have also been formed where the members share their views about uncountable aspects of science subjects. These groups involve a variety of science subjects. Some of these groups are very active and are completely devoted to science news covering different activities. It is a new kind of platform available for all. Association with these digital groups and communities depends on one's choice. They have different kinds of interactive facilities. On the other hand, science news portals provide news about new developments in science and technology. Several science news-sites have also been created on various science subjects. Wired Science, Space.com, New Scientist, and Science News are some well-known blogs. (9) The website of the Department of Science and Technology (dst.gov.in) provides multiple content about science. (10) Many important newspapers give science news in separate pages on digital media. New media have even facilitated categorizing all these science news. Times of India, (11) Hindustan Times (12), The Hindu (13), Indian Express (14) have several hundreds of pages on science news accessible for readers on website. Similarly, there are many science YouTube channels in India. (15) Facebook has provided the facility of creating science community on its platform. (16) An online science community has also been formed on social media site. Twitter (X) also carries large number of science news accounts with different ranking, such as, @Naturenews, @newssciantist @BBC-Sciencenews, @ReuterScience, @TheScientistLLC

and alike. Instagram also gives various kinds of scientific content. Facebook has played a positive role in environment awareness. (17)

False news

Science communication is facing various kinds of challenges. (19) Several fake stories are also given in the name of science news, including digital media. The number of stories on superstition are also continuously increasing on digital platforms due to easy availability of social media. (20) The stories are presented in such a manner that create problems. So, it is necessary that people should read science news from authentic sources. People, seek solution, often tend to believe fake news. The global reach of digital technology has made the problem worse. It is also a fact that the speed of fake science news is more than real science news. So, it is significant for common people to be fully aware of scientific facts about any subject. Normally, the denial of fake news is given late and persons who have read fake news often do not get opportunity to read the clarification and real fact of the story. Various methods and tools have been developed to create and check fake news.

Discussion

The digital technology is continuously expanding. The foundation of digital infrastructure is very strong in India. It is also decreasing the digital divide in society. The Digital India is an ambitious programme of the government of India. It was launched in 2015 and now it has helped in digitally empowering Indian society. It has given enormous opportunity for the expansion of information. The users of digital media in India are increasing. It may become an effective source for the dissemination of scientific information. Several kinds of predictions have been made in reference to the expansion of digital technology. 80% of internet traffic includes social networking, video, and gaming. Global data traffic is expected to be 780 exabyte by 2026. Similarly, the industry of digital advertising and marketing is expected to be US\$780 billion by 2026. (23) The expansion of digital technology has huge opportunities for science communication. The global spread of diseases, the problem of global warming, improper utilization of technologies, and superstitions are some of the challenges faced by mankind. The ignorance of science information is creating the

situation more complex. People seek the solution of the problems without knowing the exact source of relevant knowledge. Fake news is yet another issue. Many of these problems develop mainly due to ignorance or lack of awareness about various scientific aspects. Communication systems in the health sector are widely used to improve the quality of health. Various kinds of newly developed communication systems are being used to bring desired change in health system. Telemedicine technology is growing, and wider use of this technology is expected soon. At the same time, new challenges are also developing in the health sector. Correct information about different diseases and knowledge about their prevention is necessary to avoid such kinds of health problems. It also develops awareness of the practices of good health. People need to know information about health services and prevention measures. (26)

The health care system may not work effectively without giving proper information about different kinds of health programmes and motivating people to adopt proper health rules and regulations. Health information is needed not only for the prevention of disease, but also to have proper treatment in case of suffering from any kind of disease. It is difficult to educate the masses only through a formal education system. Here comes the role of mass media and digital communication technology to help educate the masses. (27) Environment and climate are other areas where dissemination of information about different their aspects has become very important. The consequences of countless human activities over a period have left several harmful effects on ecology and it forces us to think about it in a very serious way. The twelfth edition of the UNEP emission gap report indicates a very dismaying state of the earth. (28) Digital media can play a very effective role in educating people on such issues of utmost importance. (29) Information and communication technology is another important tool for science communication among maximum people. Digital education gives detailed information about the use of digital technology in education. It is now important to know how people receive science news from digital media. Developing scientific temper among citizen has also been stressed in Indian constitution. (30) Scientific temper develops an attitude of logical thinking. Adopting a scientific approach in any kind of work includes questioning, observing, testing, hypothesizing, analyzing and communicating the

outcomes.

Literature review

The literature review of various journals reveals that there is not any recent study on science news receiving habits on digital media. Though there are several studies on newspapers and other kinds of reading habits. Several research have also been done on the content analysis. There is hardly any study about science news reading habits. The studies have been conducted to find the effects of various social media on the habits of reading by students. The study found that there was a positive impact on the habits of reading. The students used various well known social media, like Facebook, WhatsApp, YouTube, Google+, etc. (33) However, the study on the mode of receiving science related information on digital media was hardly found. In view of the above facts, the present study has been carried out.

Objectives

The main objective of the study is to find the mode of receiving science related information through digital media among youth. The following points have mainly been considered for this study:

- The study of habit of youths reading and viewing science news.
- The order of the preference in reading science news.
- The choice of language, websites in science news reading habits.
- The duration for receiving science information
- The awareness about various kinds of sources for science related information.

Methodology

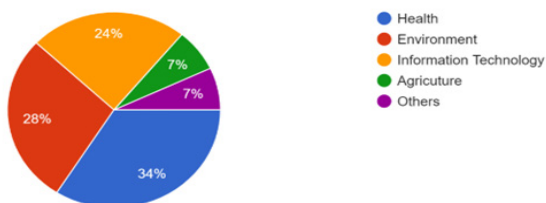
The present study has been done through an online survey method. A questionnaire contains questions related to the mode of receiving science information on digital media. The questions were framed in such a manner so that they can throw light on various modes and means of receiving science related information through digital media by youth, and accessibility of these sources. The sample size was 200. The responses collected through the survey method gave very useful and important information for the study. A detailed description of the data analysis has

been given here. The percentage of responses has been given in nearest digits. Here an analysis of responses about each question has been presented.

Q1. What kinds of science news do you often read/ view/ listen to?

Health is the most preferred subject

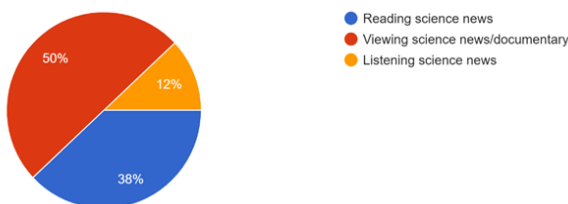
Although all subjects are important for youth but when they were asked to give preference in science subject, about 34% of the youths selected health subject as the first choice in science news receiving. 28% of the respondents selected environment as the first choice for reading science information. 24% of the respondents said information technology was their first choice. Only 7% of the respondents gave preference to agriculture while 7% preferred other subjects.



Q2. Which method is your first choice for science information on web medium?

Viewing is a popular method for science information

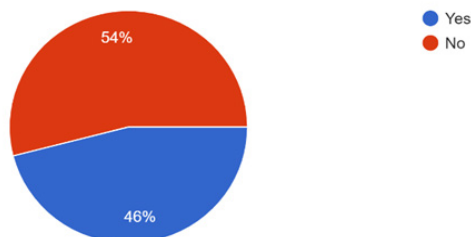
Earlier reading was the preferred style for receiving science news, but at present, the number of viewers is continuously increasing and reading methods for science information is decreasing. 50% of the total respondents preferred viewing as popular method for science news, 38% preferred reading method for getting science news and only 12% of the respondents preferred listening method for science news



Q3. Do you read/ view any science news portal?

No choice for any science news portal

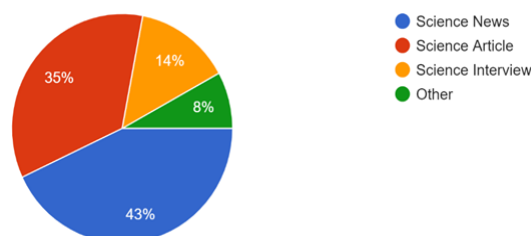
More than half of the respondents don't read any science news portal. 54% of the respondents said that they didn't read any science news portal on digital media, while 46% of the respondents said they read science news on a particular science news portal.



Q4. Which format of text in science content do you prefer the most?

News format is preferred most

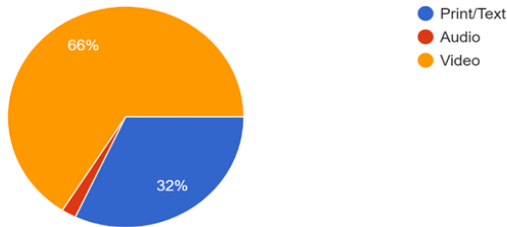
News format of the science content is still most popular. Though science information can be given in news, article and in interview formats. However, news format is most popular format and 43% of the respondents preferred it. Article is next popular format of science content, and 35% of the respondents liked it. 14% of the respondents liked interview format, while 8% liked other kinds of the formats for science information.



Q5. Which format of science news do you prefer most on web media?

Preference of format for science news

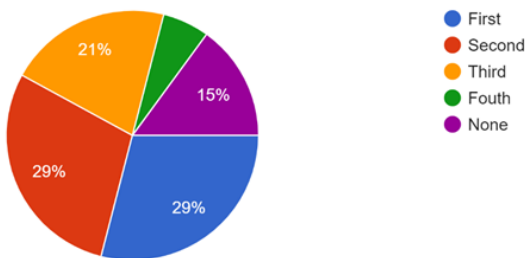
Video is most preferred format for science information. 66% of the respondents answered in favour of this medium. 32% of the respondents preferred text format for science information. Only 2% of the respondents preferred audio format of science presentation.



Q6. What is your order of preference of reading science news among all news?

Order of preference of science news

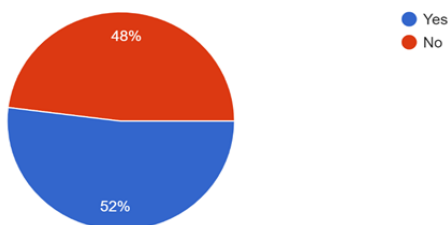
More than half of the respondents gave either first or second order of preference to science content. 29% respondents gave first preference to science information and 29% of respondents gave second preference to science information. 21% of the respondents gave third preference and 6% gave fourth preference to it. 15% of the respondents didn't give any preference to science news, it means science information is not in their choice of news.



Q7. Do you give feedback/ comment about science news on digital media sometimes?

Feedback in science news

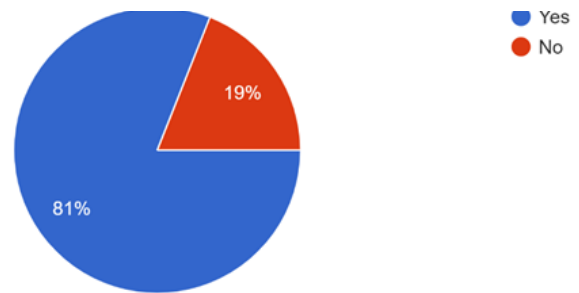
The interactive facility offered by the digital media has also motivated people to give feedback in reference to any kinds of science content. More than half, i.e., 52% of the respondents gave feedback on science content in different manner, while 48% respondents didn't give feedback on science information.



Q8. Do you cross verify science news if ever in doubt?

Verification of doubtful science content

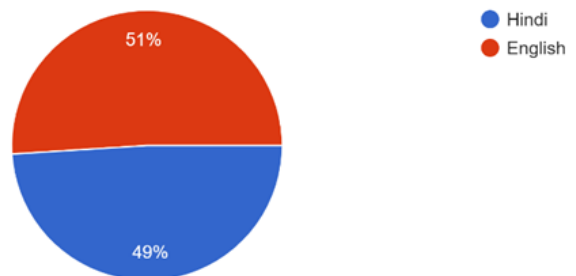
Several such stories often create confusion among audiences. However, alertness towards doubtful stories has also increased. 81% respondents said that they cross verify the science information, if they ever felt any doubt about it, while 19% of the respondents said that they didn't go to cross verify doubtful science information.



Q9. What is your normal preferred language for reading science news?

Preference of language for science news

Hindi is preferred language for reading science news for many in the north. The survey was conducted mainly among the Hindi respondents. They prefer to read science news in their mother language. 51% respondents said they prefer to read science content in Hindi language. 49% said they prefer English language for getting science information.

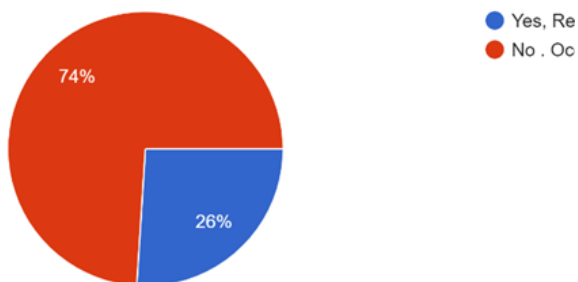


Q10. Do you read science news regularly?

Regularity in reading science news

Regularity is an important dimension for receiving science information. 26% respondents say that they read science news regularly, whereas rest of the respondents, i.e., 74% respondents said that they

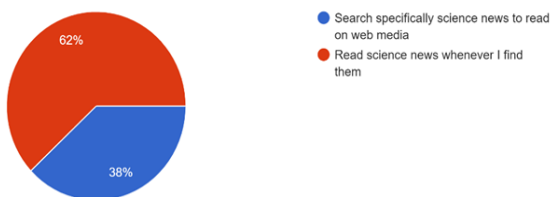
occasionally read or view science news. This is a very important indication in reference to receiving science news.



Q11. Do you perform search for specific science news?

Efforts for receiving science news

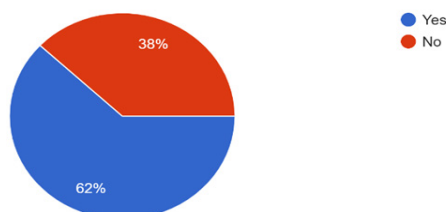
Study of science portal or searching of science news is very important for regular reading of science news. But 62 % respondents don't search science news on digital media. It is not in their habit. They read or view science content whenever on the web or other sources of science news, whereas 38% said that they search science content on web portals only.



Q12. Do you search science news on various portals on digital platforms?

Search for science news portal

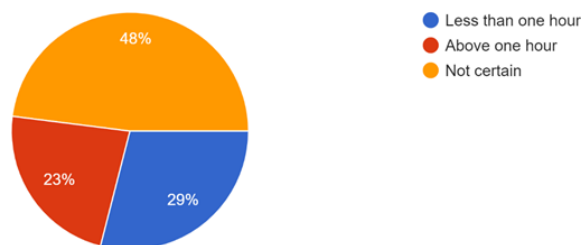
More than half of the respondents 62% do not search science news on web portals. 38 % of the respondents said that they search science news on web portal. The habit of science news reading is not homogeneous among all youths.



Q13. How much time do you give on science news reading in a week?

Duration for science news reading

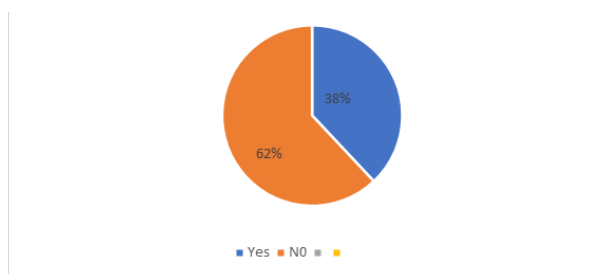
The duration of receiving science information is very important factor in dissemination of science information. The response received is not satisfactory. 48% of the respondents give less than one hour in a week for receiving science information. 29% of the respondents give less than one hour for it in a week. Only 23% respondents said that there is not any stability of time.



Q14. Do you have any favourite and well familiar science news portal/ website?

Favourite portal

There is not any favourite portal for reading science news of 62% of the respondents. 38% of the respondents have some favourite portal for science news. This response also indicates about the lack of regularity and devotion in reference to receiving science information by youth.



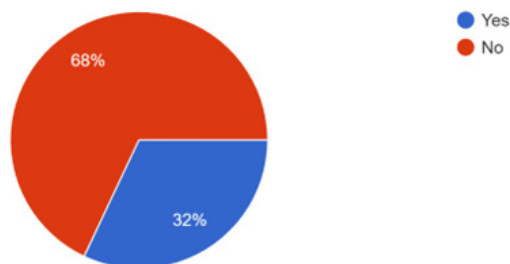
Q15. Are you associated with any science group/community on social media?

Association with science community

Most of the respondents are not associated with any group or community. 68% of the respondents said that they were not associated with any group, only 32% said that they were associated with a science

community.

This finding shows the unwillingness towards receiving science information by maximum number of youths.



Discussion and conclusions

Based on the above study, we can say that science news reading habit is not very popular in our society among the youths on digital media. At the same time, it is also not that dissatisfactory. Keeping in view the need for and importance of science in our daily life, the above situation needs to be improved substantially. Salient conclusions are summarized here:

- Health is the most popular content for readers.
- Viewing has become the most preferred style for science news among youths.
- Around half of the respondents do not read any science portal.
- News is most popular form of science information.
- Video is most popular medium for receiving science news
- Text format is at the second place in their choice.
- News is the most popular format of content among the youths.
- Half of the respondents give feedback on science news.
- Maximum number of respondents cross verify science news whenever they are in doubt.
- More than half of the respondents like to read science news in Hindi.
- Respondents don't search science news on web media.
- Respondents give less time for reading science news.
- There is not any favourite science news portal for more than half of the respondents.
- Most respondents are not associated with any

science group on social media platform.

A limited number of questions were asked about audiences' habit about reading science content. There must be several other questions related to the audiences' habit but due to limitation of the study, they were not taken. The present study can be taken as a primary study to indicate the science news reading habit. This study can be further focussed on a specific science subject or the other, such as health, environment, agriculture, energy, disasters and alike.

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PREDICTING GEOLOCATION OF TWEETS: UNDERSTANDING BEHAVIOURAL AND ATTITUDINAL PATTERNS OF USERS

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Twitter is one of the most popular micro-blogging and social networking platforms where users post their opinions, preferences, activities, thoughts, views, etc., in the form of Tweets within the limit of 280 characters. To study users' social behaviour, scientific attitude, and activities across a region, it is important to know from where the Tweet has been posted. This paper aims to predict Geolocation of individual Tweets at city level by using a combination of Convolutional Neural Network (CNN) and a Bidirectional Short-Term Memory (BiLSTM) by extracting features within the Tweet and features associated with the Tweets. We have also compared our results with previous baseline models and the findings of our experiment show an improvement over baselines methods achieving 56.4% accuracy at city level prediction. Though the accuracy achieved for our top five prediction is 70.8%. All data from our experiments and analysis is available on-line on Twitter to support further investigations.

Introduction

Social media sites have the concealed potential to uncover significant bits of knowledge when a factual examination is applied to their unstructured information. The far and wide utilization of these sites which assembles colossal measures of information on our area, exercises, and inclinations give supreme chances to catch movement of individuals. A study into this pattern of human movement, considering the information from our versatile applications, frequently shows how predictable a considerable lot of our activities are; as user behaviour on social media reflects their actions in real life. Every second, on average, around 7,000 tweets are posted on Twitter, which 25 corresponds to over 4.00,000 tweets sent per minute, 500 million tweets per day and around 250 billion tweets per year [1]. With this huge and unprecedented rate of content generation, individuals are easily overwhelmed with data but find it difficult to discover content that is relevant to

their interests. So, extracting actionable patterns of the user behaviour, their movement across a region, trends from Twitter data can be called Tweet mining. Twitter allows its users to share their geolocation with the facility of GPS function yet more than half of the users choose to conceal their geo-location to maintain privacy or prevent bullying, stalking, or trolling [2]. Geographic location information of social media users can provide great assistance and insights in crime prediction and preventing Cyber stalking, Cyber bullying, Suicide, etc., if the user is exhibiting suspicious behaviour in the Tweet.

DATA SET DESCRIPTION

To access the data from Twitter, we need to have an account on Twitter. Then, Twitter requires its users to register an application. This application authenti-

ates our account and grants the user an access token and consumer key which then can be used to connect with twitter and download tweets. Crime related and Geo-tagged real-time tweets were collected from above mentioned Indian regions using Twitter Streaming Application Programming Interface (API) within a constant area of each State. Real-time Geotagged tweets were collected across 10 cities from India for a period of 30 days from 01 August 2020 to 30 August 2020 using Twitter streaming API using Bounding box Method. The Tweets were extracted in JSON format imported to a pandas Data frame in Python and were finally downloaded in CSV file format. There is lot of information associated with tweets' information such as: user ID, the screen name, number of followers, date, time, the tweet itself, device used to post the tweet (source), user Bio (age, gender, home location). Out of these features, the screen name, tweet text and user Bio have been selected to predict geolocation of Tweets. Once the tweets were collected, they need to be cleaned for further processing as real world data is prone to incompleteness and inconsistencies. NLTK

package with pip package manager in Python was used for processing text in tweets. They include removal of extra places, URL and stop words that don't change the meaning of the tweet are removed (for example and, or still, etc.). Next step is tokenization which refers to dividing the text into a sequence of words or sentences. Reducing different types of words with similar meaning with their root is also an important step. This process is called lemmatization.

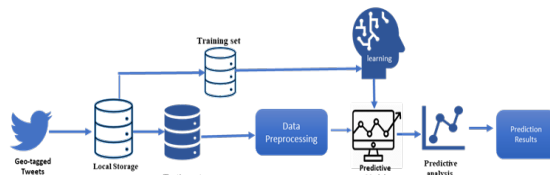


Fig. 1: Research framework

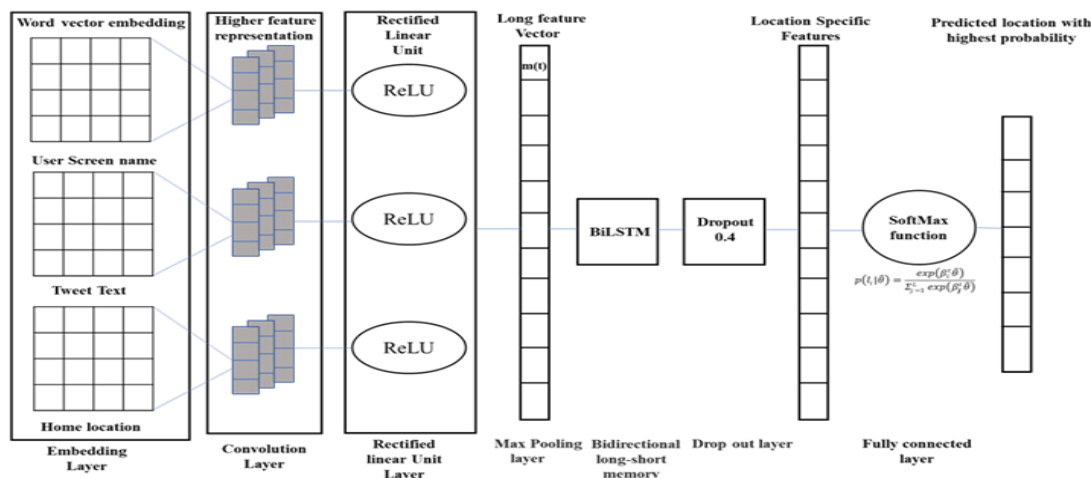
PREDICTION MODEL

We used combination of CNN and BiLSTM to extract high level features from the screen name, tweet text and user home location in profile. We have trained our model using Stochastic Gradient descent with RMSprop with learning rate 10-4 with 5-fold cross entropy loss. The data has been divided in the ratio of 80:20; former for training the model and later for testing the performance of the classifier. The architecture of the proposed approach is shown in Fig. 2. The input to our proposed prediction model is three text features extracted from Tweet. These features are then concatenated in to one text of length n and then embedded into vector form using

Table 1. Data set summary

No. of tweets	45,678
No. of users	21,544
Country	India
Cities	10
Time zone	One (GMT+5:30)
Collection technique	Twitter Streaming API

Fig. 2: Geolocation prediction model using combination of CNN and BiLSTM



word2vec vectors trained on Google GloVe which is an unsupervised learning algorithm for obtaining vector representations for words.

Hyper parameters in embedding layers

Configurable parameters

Trainable parameters

- batch size = 512
- embedded vector size(e) = 128
- sequence length = 30
- embedded matrix = v*e
- number of class = 10
- vocabulary(v) = 175409 (unique words)
- number of epochs = 10

Shape of the tensor = [batch size, Sequence length, embedded vector length] = s[512*30*128]

Output of the embedded layer is tensor reshaped to [512*30*128*1] so that each element of the word vector is itself a list of size 1, instead of a real number. Next layer is convolutional layer, we apply each of 128 filters to all word vector matrices with filter size = 3, 4 and 5 with 128 feature vector. The output shape of filter 3,4,5 when applied to a batch,

filter(3)=[512*4*1*128]

filter(4)=[512*3*1*128]

filter(5)=[512*2*1*128]

Bias 0.1 added to the output of convolution layer for each patch-filter convolution. Since there are 128 filters, 128 bias values are used. Then ReLU is applied which is a nonlinear function $x = \max(x, 0)$ where x is the output for each filter size. In pooling layer max function is applied over output of each filter to output maximum value as most representative feature m(t) generated by each filter. Features were generated in form of long vector θ .

The output of pooling layer is then fed into BiLSTM which extract location specific features from vector θ . At each step from i... n, a forward LSTM takes the word embedding of word w_i and previous state as inputs and generates the current hidden state. A backward LSTM reads the text from w_n to w_i and generates another state sequence. The hidden state h_{si} for word w_i is the concatenation of h_{si} vector forward and h_{si} vector backward. Concatenating all the hidden states, we get a semantic matrix with location specific features. Then a dropout of 0.4

is applied to the output of BiLSTM to prevent the model from overfitting and co-adaptation of hidden units. An activation function, SoftMax is then applied to long vector θ to generate the probability distribution over locations. Specifically, the probability of one tweet coming from location l_i is

$$p(l_i | \hat{\theta}) = \frac{\exp(\beta_i^T \hat{\theta})}{\sum_{j=1}^L \exp(\beta_j^T \hat{\theta})}$$

where L is the number of city locations and β_i (weight vectors, word vectors, etc.) are parameters in SoftMax layer. The output predicted location is the location with highest probability.

EVALUATION METRICS

Accuracy: The percentage of correct predicted city locations.

Acc@top5: The percentage of top five correct predicted city locations.

Median: Median is the Euclidean distance between pair of predicted coordinates

(y'lat, y'lon) and coordinates (ylat, ylon) of a city.
 Median = $\sqrt{(y'lat - ylat)^2 + (y'lon - ylon)^2}$

RESULTS AND DISCUSSIONS

The comparison results with our approach and previously baseline approach are listed in Table 2. The graphs in Fig. 3 and Fig. 4 show city level prediction result with output probability and recall and precision of each city respectively. Our approach gives 56.4% accuracy on city level prediction with median error 25.8 km. Our approach with combination of CNN and BiLSTM performs slightly better than baselines approaches [3][4][5] in terms of accuracy and median. We can further make our research effective by adding Google open street mapping.

Algorithm

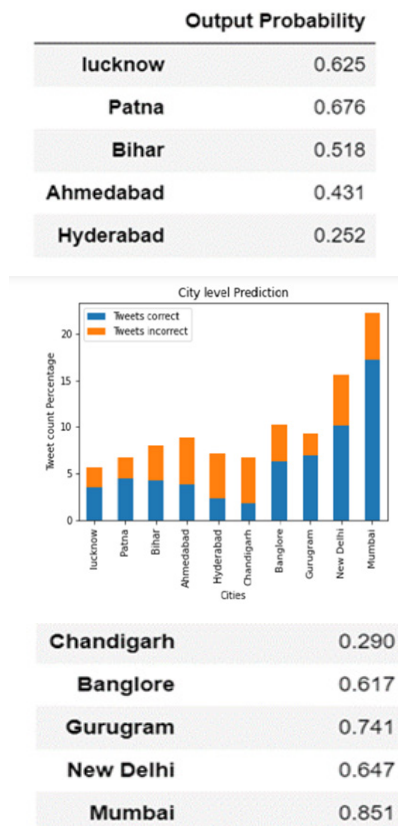


Fig. 3: City level prediction with Output Probability, the height of blue bar shows percentage of tweets whose location is correctly predicted from each city, the orange shows percentage of tweets whose location is incorrectly predicted from each city

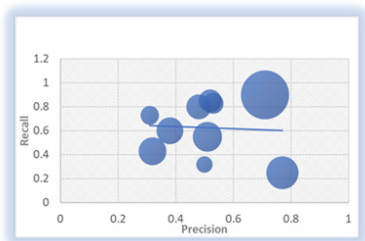


Fig. 4: Recall and precision of each city

Table 3. Comparison of our approach with previous baselines models

	Accuracy	Acc@Top5	Median (kms)
B.han et.al (2013) [3]	0.389	0.595	77.5
B.han et.al (2014) [4]	0.439	0.629	47.2
B.huang et.al (2017) [5]	0.528	0.711	28.0
Our Approach	0.564	0.708	25.8

- Step 1:** Install dependencies tweepy, tensorflow, keras
- Step 2:** Import os, json pickle, numpy, myplot
- Step 3:** Authentication with twitter using access keys and tokens
- Step 4:** Specify locations with longitude and latitude
- Step 5:** Extract Tweets using Twitter API
- Step 6:** Process the tweets using NLTK package
- Step 7:** Split the data set into training and testing set
- Step 8:** Train the model
 - Specify the hyperparameters batch size, no of epochs in embedding layer
 - Define No. of filters, kernel size, padding, activation = 'relu', strides = 1 in convolutional layer. Define max pooling layer
 - Specify loss = 'sparse categorical cross entropy', optimizer = 'rmsprop', metrics = 'accuracy'
 - Define BiLSTM with 30 units
 - Apply dropout = 0.4
 - Define activation function = 'Softmax' in soft max layer.
- Step 9:** Test the model to predict the accuracy of the model and calculate the output probability for each city.

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TELEMEDICINE REPORTING IN INDIAN MEDIA: A STUDY DURING COVID19

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The media being a primary source of information for the public has an important role in reporting and framing health promoting news updates. The news frames suggested by the media should explore solutions for existing impediments in medical and health practices to improve healthcare delivery at the time of pandemic. This study aims to show how the challenges in telemedicine were reflected in mainstream Indian print media. The results revealed that news highlighting telemedicine challenges and real-time barriers were barely reported restricting the frames to slue toward high adoption rate in telemedicine than focusing its long-standing challenges. Obstacles faced by doctors and patients who used telemedicine during this period were largely ignored. By reporting them in the prime mainstream media could have enlightened the necessity for facilitating clinical and structural reformation and in edifying workable telemedicine guidelines at this time of its increasing acceptance. We propose that by embracing 'Solutions Journalism' in health and medical news may promote a favourable environment for creating a sustainable telemedicine ecosystem in India.

Keywords: Health and medical reporting, Print media, Telemedicine challenges, Solutions journalism

Introduction

Health promoting news disseminated through mainstream print media gains more credibility across readers of all ages. In India, with over 560 million internet users (Statista 2020) people trump their belief in traditional and mainstream newspapers and magazines which are considered as the most trusted sources of news than news broadcast on television and radio (Newman et al. 2020; Tewari 2016) like other global audiences. With this comes a huge ethos for health journalists to follow and fulfil their roles as an effective disseminator of health communication. More so, people rely on news reports presented based on realness of the situation when making important health decisions. From this standpoint, understanding what news should be gathered and reported during a global health crisis can make an important impact on the people, health-

care workers and policymakers.

A lack of evidence-based approach and not being able to critically appraise developments in healthcare delivery or examining national policy are some of the challenges health journalists face when they report news and news updates. Through tracking the right source of information, asking the right questions, and critically appraising the best and tested practices, health journalists have been deemed as adversaries to bear responsibility to execute an interpretive and facilitative role (Hinnant et al. 2016; Weaver et al. 2007). Gaps and barriers in healthcare delivery can occur at every stage in real-time practice and transparency in reporting such gaps persist, even more at the rare times of public health emergencies globally, say COVID19 pandemic. Special-

ly, news relating to public health management and covering serious gaps in its implementation while in its nascent stages are utterly crucial for policy-makers. Following the outbreak of COVID19 in March 2020, the Indian Ministry of Health and Family Welfare, along with the National Institute for Transforming India (NITI) Ayog has released Telemedicine Practice Guidelines enabling Registered Medical Practitioners and healthcare technology providers to offer medical services to the population (Telemedicine Practice Guidelines 2020). However, do the new guidelines settle existing gaps or will they lead to more new challenges to emerge at the time of pandemic, and what is yet to be ascertained! Telemedicine is similar in most aspects to other technologies for which better evidence of effectiveness is being commanded.

Many scholars have widely researched about the challenges and barriers hampering effective telemedicine practice as a form of healthcare delivery for several years. The challenges pertained to telemedicine are, access, quality of service, and cost. Access to good internet connectivity remains a larger issue, while even if there is good connectivity, there could be other dominant challenges in receiving quality services during a consultation. Cost and payment options for such distant services is also a concern as it solely depends on the practising doctor or the corporate who manage dedicated websites and smart phone applications. Besides, there are other barriers like age and educational level of the patient, preferred language for communication and patient privacy and confidentiality (Fagherazzi et al. 2020), technical design and interoperability that hamper effective telemedicine delivery (Smith et al. 2020; Kruse et al. 2018), risks in clinical decision-making and treatment and lack of trust in patient-doctor relationships (Das et al. 2020) and the greater risk of misdiagnosis (Chandwani and Dwivedi 2015).

Telemedicine in India is not something new and its presence is felt for the last two decades (Agarwal et al. 2020). Many healthcare sectors have been introducing telemedicine in various new media platforms for patients to seek consultations with registered doctors. More telemedicine platforms picked up at the time of COVID19 pandemic after new practice guidelines have cleared the air around telemedicine and made it perfectly legal for doctors to

embark upon it. The ongoing pandemic has made face-to-face consultation easily switch to virtual for non-emergency situations when movement restriction is observed in strict measures and it is the first time that India experiences a hype to its full potential ('502% spike in online consultations from people above the age of 50 in India', 2020). Telemedicine became an easy alternative means of consulting doctors when face-to-face interaction was a constraint during this health outbreak. Given the gravity of the pandemic, for many people who need consultation for symptoms like flu, bacterial infections, symptoms of coronavirus or for any other health issues, tele consults are now available at the safety of the residence of patients and doctors where they can connect through various telemedicine platforms. However, there are many impediments experienced in this process. At this decisive phase, investigating the challenges in telemedicine and resolving old ones when telemedicine has been quickly adopted and expanded to its full capacity is presumed to be most likely subject covered by the media. Given this context, the researchers' extracted a set of concerns and questions.

- a. How does challenges in telemedicine during pandemic reported in mainstream print media?
- b. Were news frames implying such challenges?
- c. Whether reporters were able to source potential solutions to distinct challenges in telemedicine practices that are suggestive to policy makers?

Materials and methods

This study uses Frame Analysis Method to qualitatively describe and interpret whether challenges in telemedicine were reflected in mainstream Indian print news media. Frames will impact readers on how the news story is investigated and presented. Journalists use this technique to deliberately guide the reader's attention and direct their focus or perspective through the reported news articles (Goffman, 1974; Tankard, 1991). The news frames serve four main purposes within the context of this research – to define problems, to diagnose a course, to make value judgments, and to suggest remedies. Such frames are vital to spot errors or gaps experienced in doctor-patient telemedicine consultation more importantly during the time of pandemic when the whole of India was under complete or partial

lockdown. The researchers assert that if the assumed frames were not focused or absent in the news then the news desk has missed the wider picture in exploring problems and solutions to cover fatal gaps in telemedicine practices owing to its quick adoption at the gruelling time of pandemic and lockdown effects. Mainstream Indian English print news were gathered from online platforms (e-paper version) for ten months between March and December 2020. A total of 24 news articles from 12 mainstream print news portals published in India appeared through web searches by following the key words - Telemedicine in India, new guidelines, challenges, gaps, barriers, hesitancy, inhibitions, and solutions were identified. However, only 10 news articles that covered telemedicine challenges (Table 1) were selected to find out the extent of reporting telemedicine challenges and to identify if any frames point such challenges or barriers in practising telemedicine during the pandemic. Five mainstream print news media covered telemedicine challenges, The Hindu; The New Indian Express, Hindustan Times, Express Healthcare, Economic Times - Health World.

Discussion and results

Slim focus on news about telemedicine challenges

During the ten-month study, news articles on telemedicine challenges and real-time barriers during pandemic were barely 'hinted out' in five mainstream print news portals between April and July 2020. Three articles were reported in the Express Healthcare, a magazine powered by The Indian Express. The first article was reported by a health and science reporter that included relevant views of major players of web-based private telehealth companies from whose excerpts a few practical challenges in current telemedicine practices were exposed. This article presents a series of telemedicine challenges that tends to focus on a broad groundbreaking gap between patients and service providers.

In rural areas, the biggest barrier is language, and an app was developed within a short span of time after the lockdown was announced; all the options are in English. While it is easy-to-use, once it is downloaded by simply clicking on the 'book an appointment' option and wait for their chance; for any rural audience, it would be a task to understand the lan-

guage and then navigate through the app. In most of the private health web-based platforms, clusters of general practitioners are more. Specialists' doctors rarely subscribe for Telemedicine. Payment options are easy through digital wallets like Google Pay and Paytm but these apps would probably be of a higher utility for tier-II and tier-III cities. With low literacy rates in rural areas, even these models of payments can be an inhibiting factor (Express Healthcare, 'Transforming Indian healthcare via telemedicine', April 9, 2020). Though, very soon, these online payment solutions were proved to be highly beneficial to small businesses and common masses at large and applicable across the globe.

Three months later, Express Healthcare reported another article written by two legal practitioners who remarked telemedicine challenges to the uncertainty surrounding the legality of prescribing drugs and the need for implementing fool proof technology to provide security and data privacy to patients. Quoting a Supreme Court judgement of 2009, the authors reclaim the uncertainty of drug prescription on how doctors can prescribe medication without physical examination. This claim was however made without referring to the recent Telemedicine Guidelines 2020 that clearly list what medication is recommended to be prescribed in its first annexure. Further, they also indicate the problems one might face with unlawful gains might made by digitising patient's data when the Digital Information Security in Healthcare Act (DISHA) has not been passed by the Indian parliament (Express Healthcare, 'Telemedicine in India: Is the time ripe?', July 10, 2020). Though certain challenges in telemedicine are voiced, the views expressed in this article do not validate them due to the prosaism of the profession of the authors.

Similarly, in its third article Express Healthcare brings the views of a Chartered Accountant who indicates the need for preparatory measures to build telehealth capacities in terms of regulation of data protection and drug pricing besides sustaining market competition. Howbeit, the article is skewed towards building a holistic business model through a sustained data protection as a key to improve telemedicine services (Express Healthcare, 'Why telemedicine and health tech providers need to improve their regulatory preparedness?', July 17, 2020). Within a coverage swath between April and July

2020, the magazine which predominantly focuses healthcare as its forte, it has fallen short of proper enlisting and detailing of these barriers in the reportage. The Hindu reports a highly enriching comment on telemedicine pitfalls by a telemedicine expert and columnist who opines that telemedicine options may go against a clinical decision. The article is timely, from a near-perfect source who has been behind the implementation of telemedicine during the early onset of pandemic in India.

Technology is the only an enabler, not an end by itself. The decision when to limit use of Telemedicine and insist on a face-to-face consult is always a clinical decision. The context, professional judgement, and the patient's interest alone matter. Some doctors may be satisfied with an ultrasound image showing a mass in the pelvis. Others may want to do a rectal examination. Patients may not be comfortable without seeing the doctor face-to-face at least for the first time (The Hindu, 'COVID19 enhances reliance on telemedicine', April 19, 2020). The COVID19 pandemic has created immense pressure on doctors to upskill their practise that allows them to contact patients from remote locations. This important observation lacks doctor's technical skills especially among experienced and senior doctors as compared to millennials were reported in Economic Times Health World as a concluding remark while the focus of the news lead was highlighting the booming telemedicine opportunities (Economic Times Health World, 'Telemedicine - Once a hard sell, now a booming demand', May 02, 2020). A similar concluding remark on lack of awareness among public hospitals to reach a wider section of population was expressed by a telemedicine healthcare expert in a December 2020 article "How digital healthcare has been a boon in 2020?", through a feature story.

A news story reported by a science and health editor of Hindustan Times pointed the progression of telemedicine in India and indicating poor internet access, illiteracy, poverty, and lack of robust Universal Health Coverage being some of the external challenges linked to telemedicine. The reporter stresses that any problems occurring in face-to-face consultations are also expected in telemedicine too (Hindustan Times, 'Telemedicine set to transform healthcare in a post COVID19 world', May 10, 2020). Although, this news was presented by a

health editor, the news aces a paucity in identifying new empirical challenges and remedies that are duly expected from the fundamental actors of health information like in this case, a science and health editor.

Only a trained medical and health reporter will be able to provide the public a balanced and objective perspective of what is being reported. Non-health journalists rarely have medical training or health-related degrees and rely heavily on experts' sources (Keshvari et al. 2018) as seen in this study that only two reporters were actual health journalists. Training journalists for health and medical beats is the key as specialist health and medical reporters have a sounder technical knowledge, networking with expert healthcare professionals and government health authorities. This will eventually improve their ability to advocate for better quality coverage of important issues in healthcare delivery (Leask et al. 2010). India is facing critical shortage of healthcare providers, so is in the newsroom indicating a dearth of trained medical and health reporters. It has been an impending wait since the time researchers and media educators have highlighted the importance to having trained health and medical journalists in the news organisations (Chaurasia, et al. 2020).

One of the news articles by The New Indian Express cites that the current telemedicine practices could favour patients who need frequent hospital visits and in the long run, but the frequency of consultation could be reduced slowly with this method (The New Indian Express, 'Dial a doctor', May 13, 2020). In its another news article, a news article indicated that any disorganised and conflicting advises experienced by patients on various consultations for a same health problem puts telemedicine in jeopardy. It also cited challenges that confront quality of services attributing to a doctor who is practising telemedicine and consider what might be the quality of consultation when doctors were overloaded with many patients waiting online, as only a few doctors opted this service.

Though, it is not very straightforward to just hire a doctor because there are so a few of them right now available. Despite a very clear indication from the Telemedicine Guidelines (2020) as indicated in page 12 suggesting that 'services should be limited

to first-aid, life saving measures, counselling and advice on referral', there were news reports on inhibitions from the patient side that chose telemedicine to consult a dermatologist, the paper quotes a patient as, "I was not comfortable with showing the dermatologist my skin issue over the video call, because I honestly felt he wouldn't be able to diagnose much behind the screen." (The New Indian Express, 'Telemedicine is the new call for action at

the moment', May 31, 2020). Public perceive the most trusted sources on health issues from doctors. Source attribution from doctors and patients were largely ignored. It is observed that some dissatisfied patients and their close attenders freely posted their negative feedback in the 'comment' section of the mainstream news online versions. Even after this gruesome revelation, readers cannot blindly trust negative reviews or positive reviews by owners of

Table 1: List of news articles covering telemedicine challenges in 2020

No	Date of publication	Headline	Name of publication	News frames	URL
1.	April 9, 2020	Transforming Indian healthcare via telemedicine	Express Healthcare	Staggering rise in telemedicine adoption	https://www.expresshealthcare.in/covid19-updates/transforming-indian-healthcare-via-telemedicine/418106/
2.	April 19, 2020	COVID19 enhances reliance on telemedicine	The Hindu	Telemedicine opportunities	https://www.thehindu.com/news/national/tamil-nadu/covid-19-enhances-reliance-on-telemedicine/article31378946.ece
3.	May 02, 2020	Telemedicine - Once a hard sell, now a booming demand	Economic Times, Health World	Staggering rise in telemedicine adoption	https://health.economicstimes.indiatimes.com/news/health-it/telemedicine-once-a-hard-sell-now-a-booming-demand/75502115
4.	May 10, 2020	Telemedicine set to transform healthcare in a post-COVID19 world	Hindustan Times	Staggering rise in telemedicine adoption	https://www.hindustantimes.com/cities/telemedicine-set-to-transform-healthcare-in-a-post-covid-world/story-j79r1yEDFxYaE4nlcFNL31.html
5.	May 13, 2020	Dial a doctor	The New Indian Express	Telemedicine opportunities	https://www.newindianexpress.com/cities/chennai/2020/may/13/dial-a-doctor-2142535.html
6.	May 18, 2020	Telemedicine Accreditation, Certification to follow soon, says Prof (Dr) K Ganapathy	Economic Times, Health World	Staggering rise in telemedicine adoption	https://health.economicstimes.indiatimes.com/news/health-it/telemedicine-accreditation-certification-to-follow-soon-says-prof-dr-k-ganapathy/75803256
7.	May 31, 2020	Telemedicine is the new call for action at the moment	The New Indian Express	Telemedicine opportunities	https://indianexpress.com/article/lifestyle/health/in-telemedicine-virtual-healthcare-future-scope-india-mindsets-doctors-6421192/
8.	July 10, 2020	Telemedicine in India: Is the time ripe?	Express Healthcare	Telemedicine challenges	https://www.expresshealthcare.in/blogs/guest-blogs-healthcare/telemedicine-in-india-is-the-time-ripe/412528/
9.	July 17, 2020	Why telemedicine and health tech providers need to improve their regulatory preparedness?	Express Healthcare	Telemedicine challenges	https://www.expresshealthcare.in/covid19-updates/why-telemedicine-and-health-tech-providers-need-to-improve-their-regulatory-preparedness/423385/
10.	December 26, 2020	How digital healthcare has been a boon in 2020?	Economic Times, Health World	Staggering rise in telemedicine adoption	https://health.economicstimes.indiatimes.com/news/health-it/how-digital-healthcare-has-been-a-boon-in-2020/79961572

any healthcare information technology provider, specifically if reviews are posted on the healthcare agency's official websites or in their social media platforms. Reporters have neither reviewed nor addressed those convincing feedback which certainly accords for poor follow-up news articles. Rather the reporters concentrated on subjects building positive images about private telehealth platforms. The scant coverage of such challenges in telemedicine is disconcerting. There are reasons attributing to slim coverage in this context as opined by Casels (2007) which are tending to problems in any medical reporting, including sensationalism, biases and conflicts of interest, balanced reports, and lack of follow-up. Pressures from internal and external sources may prevent health journalists from enacting ideal roles.

News framing towards challenges in telemedicine

A total of three frames were identified in all the news stories. Most reported frames were arched towards the 'staggering rise in telemedicine adoption', followed by 'telemedicine opportunities', and out of the ten articles, only two articles (reported by Express Healthcare) were framed along 'telemedicine challenges', suggesting that there is a lack of balance in reporting impediments in all the news articles. The news headlines were not augmented towards hurdles or challenges in telemedicine and those reported articles were highly redundant over the ten-month period implying that there were no follow-ups on the issue.

This is clearly indicated through the news articles written by a telemedicine expert and columnists indicating the meteoric rise in telemedicine practices during lockdown with a mere passing and inconclusive remarks on telemedicine limitations (The Hindu, 'COVID19 enhances reliance on telemedicine', April 19, 2020). Again, the same expert and columnist writes in the especial edition of the Economic Times Health World ('Telemedicine Accreditation, Certification to follow soon', May 18, 2020) almost reiterating the same message. Surprisingly, the news articles by Economic Times Health World do not cover nor address any reports on how the current telemedicine structure in place is prepared to handle the challenges taking account of the fact that the same newspaper carried an article covering

extensively the pitfalls of telemedicine in India in December 2019 (Jhunjhunwala 2019) just a few months before the pandemic has occurred. During a non-emergency consultation, the new Telemedicine Guidelines 2020 state that patients may use real-time video, audio, text interaction for follow-up consultation on their ongoing treatment with the same Registered Medical Practitioner (RMP) who prescribed the treatment in an earlier in-person consultation. During the COVID-9, most of the news reports indicate that there were mounting responses from patients to privately owned telemedicine applications for a one-time subscription. In such a booming period, did the platform facilitate follow-up care systems for patients who wanted with the same RMP who gave them online-consultation for the first time? Journalists didn't report such frames, nor did they take up reports from individual RMP who treated a patient in an earlier in-person hospital consultation and later patients got connected to them either through phone or WhatsApp or video chat.

Covering fatal medical omissions or spotting wide errors in public health delivery and recording barriers will add a direct relevance to the news story if objectively placed and framed. However, editors and publishers should be equally determined not to cut favours for vested members. What is lost and untold in mainstream print media is a gain to other online news sites which has diligently exposed several barriers in telemedicine practices especially during the pandemic.

Various issues can influence how frames are created in the newsroom. Most of the news frames were merely focused on booming telemedicine sector that has witnessed a steep rise towards its use. This is because of the concerns by the government to stop the spread of the virus by social distancing and lockdowns implemented across India. A similar view was observed in a study where health journalists tend not to use controversial angles and prefer story angle that would be most likely to grab readers attention to withdraw services (Wallington et al. 2010). Conflicting reports may also usher non-adoption of telemedicine and may force patients to leave homes for a quick hospital visit at the time of strict movement control during the pandemic. Patients may stop relying on these services again even when pandemic situation return to normalcy.

Reporting Insights and solutions to telemedicine challenges

Only two news articles of Express Healthcare have solicited probable solutions for the real-time problems in telemedicine practices. The article by a health and science reporter who attributed a doctor's propositions to solve language barriers while using a common telehealth application.

The ideal model in rural areas could be having apps with local languages that people can easily understand. Maybe, people in those areas can opt to take help of NGOs who can provide them access to this app to build a sustainable telemedicine model, access to specialists' doctors should also be provided (Express Healthcare, 'Transforming Indian healthcare via telemedicine', April 19, 2020) The second article suggests preparedness in regulatory compliance and data protection, process standardisation, promoting research and building new capabilities as recommended by a financial consultant. The Indian healthcare ecosystem should build upon key focus areas, such as standardising pharma supply chains and delivery, including for e-pharma. Drug and medication delivery to patients needs to be more standardised, regularised and the scope of the same should be extended beyond tier I and II cities (Express Healthcare, 'Why telemedicine and health tech providers need to improve their regulatory preparedness', July 17, 2020).

In recent years, many health journalists are embracing 'predictiveness' in news articles to forecast, prepare and reporting responses that are working during emergencies. Leonardo Milano who leads the predictive analytics team at the United Nations OCHA Centre for Humanitarian Data, suggests that journalists should be aware of using assumptions and limitations while reporting for technologies used in all humanitarian operations (Milano 2020). This will close gaps and improve the scope for eventual advantages at the time of health emergency. Such approaches give rise to cultivating high impact 'Solutions Journalism' wherever there is truly little information available to inform new challenges.

Embracing solutions journalism in medical and health reporting

Solutions journalism is a novel approach and a rigorous form of reporting which can be functional and rewarding at this time of emergency health outbreak. Solution based news analysis can mitigate disparities in news transparency and observe how health bodies and policymakers respond to the problems. Solving existing and predicable problems through expert analysis and bringing to the forefront for public to debate and discuss is important for scaling up and embedding these new telemedicine solutions within health systems by medical and health journalists should include news reports on:

- Suitability and review of existing telemedicine system in India in terms of technical capacity, diagnostic accuracy and patient outcome.
- New telemedicine systems, standards, and protocols suitable for Indian diaspora.
- Patients' experiences in terms of timeliness, duration, physical and psychological comfort with the application they used, cost, concerns about privacy, willingness to use the telemedicine service again.
- Preparedness to mitigate limitations as stated in the technology and mode of communications by telemedicine solicitors (doctors, telehealth companies, arbitrators)
- Doctors' experiences, concerns, or overcoming limitations owing scheduling telemedicine appointments, infrastructure, technical quality and location.
- Service gaps and obstacles in terms of allotting doctors, consultation time, drug adherence, monitoring and follow-ups, speedy re-imburements, dedicated customer care support.
- Challenges in building patient's awareness and knowledge of telemedicine services

This is exactly why news needs to go beyond the headlines especially when public is inundated with redundant news about pandemics. For instance, live reports of how new technology interventions promoted telemedicine process that has reduced the limitations of an existing problem faced by doctors and patients previously must be reported. This could also involve mapping areas with newer challenges faced by telemedicine functionalist from many other countries at this time of pandemic. If many legacy news organizations and their journalist fail to adopt this approach, readers will not fail to rely on oth-

er unverified online sources diminishing the trust and credibility for what mainstream print is always looked upon.

Conclusions

The study limits the analysis to news reported only from mainstream English print news media covered between March and December 2020. However, considering that there were only 10 news articles within the territorial perspective of covering telemedicine challenges, the results should not be extrapolated to the other media that reported similar challenges during pandemic across India. Health and medical reporting can be incredibly complex, especially for journalists without a background in medical science. But for diligent and empathetic reporters, it is an opportunity to provide a two-way information leaving readers more empowered to make better health decisions. In this study, reporting differences are seen in the stances from the mainstream and special editions, though not all special editions adhered to covering the gaps or barriers in telemedicine besides the number of details in the news reports was quite limited.

Lack of news articles covering gaps in telemedicine practices by mainstream print media and by not creating an essential news frame for public discussion is debilitating and leads to mal-information or even under-reporting. This way, it may pave the way for less competent private health technology establishments, needlessly gaining strength from reporting unreasonable claims and misleading rhetoric, due to which patients might not receive enough guidance to choose a right platform for online consultation or other telemedicine services. Reporting persistent challenges faced during the pandemic will stimulate new approaches to upgrade telemedicine practices. Journalists must take a predictive approach to focus on solutions surfacing from the data facets to contextualize information for scaling up and embedding new telemedicine solutions within healthcare systems. Understanding this need will connect policymakers, and technical partners to aim high quality healthcare, access, cost and acceptance to proven telemedicine practices.

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HEALTH COMMUNICATION DURING COVID19: ANALYZING PERCEPTION AND EFFICACY AMONGST MASSES

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Providing accurate and timely health communication messages is a challenge for world leaders under normal circumstances and is especially crucial during a pandemic. The Indian government conveyed the messages regarding coronavirus through various mass media. This study explores applications of communication theory to provide insight how multiple constituencies in India perceive the effectiveness of health communication messages during the early phases of the COVID19 pandemic. This study seeks to identify perceptions of the best public health communication methods that were used during the early phase of the COVID19 in India. Health communication mainly initiates a positive dialogue between health professionals, health communicators, and media professionals to spread health awareness, health education, and health consciousness at ground level. The research methodology employed interviews with media students, media teachers, media experts, and health professionals to establish the effectiveness of health communication messages used during early stages of COVID19. Findings are presented and analyzed thematically.

Keywords: Communication theory; COVID19; Pandemic; Health communication

Introduction

Emerging infectious diseases have increased during the opening months of 2020 throughout the world. Velavan and Meyer (2020) note that the 2020 outbreak of COVID19 is an infectious disease caused by a newly discovered coronavirus. Emerging from cases in December 2019 in the capital of Hubei Province (Wuhan-China), the virus spread to various parts of the world. On 30 January 2020, the COVID19 outbreak was designated as a public health emergency of global concern (Wilder-Smith et al. 2020). The COVID19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes (Wu et al. 2020). Communication is central to our everyday functioning and can be the

essence of the human life (Berry 2006). Communication not only fulfills the social needs but also meets various physiological and survival needs of society (Varma and Verma 2017). Mass mediated communication is one of the key dimensions of the meta-narratives that explain the scholarly and practical expanse of communication. Health communication means communicating the health values and information by using effective means of communication to generate collective consensus among masses (Nishiuchi et al. 2016; Stacey et al. 2015). The key strategy of health communication is to inform the masses about health issues, challenges, and opportunities, mainly focusing on two approaches, mass media and interper-

sonal campaigning through health educators, health workers, and NGOs (Glanz and Bishop 2010; Llamas and Mayhew 2016). The objective of health communication is to disseminate health information and knowledge among individuals as well as society by improving health literacy (Sharma et al. 2019). The Centers for Disease Control and Prevention (CDC) define health communication as the study and use of public health communication strategies to inform and influence individual and community decisions that enhance health (Schiavo 2013; Thomas 2006). As health issues have become more pressing in society, the interest in health communication and the roles of health communication scholars and practitioners are certain to increase (Harrington 2014).

Health authorities should be strategic in times of health crises, such as disease outbreaks, to contain situations that can cause confusion and chaos. It is particularly important in the social media era where any citizen can be a producer and disseminator of news content, which can prove to be disastrous through the spread of misinformation, therefore, causing panic. Social media platforms are potent in terms of distribution, like WhatsApp, Facebook, Twitter, etc. Mass media not only helps the message to reach the local audience but also plays an essential role in gaining the attention of opinionmakers, politicians, government regulators, and community leaders. Mass media, also recognized as a gatekeeper, plays its part in alerting the public. This is done through media framing, by which mass media sets the tone through which the public might view the message (Malecki et al. 2020; Villar and Marsh 2019).

Observations

At the outbreak of the COVID19 pandemic, the World Health Organization (WHO) and national governments took it seriously. They went into overdrive disseminating all requisite information about the virus. The Indian government, on 03 February 2020, set up a Group of Ministers (GoM) to monitor the situation led by Health Minister Dr. Harsh Vardhan. Even though the WHO had not declared COVID19 a pandemic, it had asked countries to remain prepared. India initiated the required preparedness and action at the field level on 17 January, much before the advice came from WHO (Seetharaman and Katiyar 2020). India's first case of COVID19 reported on 30 January 2020 from Kerala, when a university student from Wuhan traveled back to the state (Ward 2020).

India took immediate action as the Janata curfew, a 14 hour curfew (7 am-9 pm), was scheduled for 22 March 2020, before the total lockdown announced by the Prime Minister (Bhasin 2020). Everyone, except people of 'essential services' such as police, medical services, media, home delivery professionals, and firefighters were exempted from the curfew. All citizens of India were asked to stand in their doorways, balconies or windows, and clap their hands or ring their vessels in appreciation for the professionals delivering these essential services at 5 pm on 22 March 2020.

The National Cadet Corps (NCC) and National Service Scheme (NSS) were to help enforce the lockdown in the country. The Prime Minister also urged the youth to inform ten others about Janata curfew and encourage everyone to observe the curfew. Following this, while addressing the nation next time on 24 March 2020, he announced the nationwide lockdown from midnight for 21 days (India News 2020; BBC 2020). He said that the only solution to control the spread of coronavirus is breaking the cycle of transmission by social distancing. On the first day of the lockdown, nearly all services and factories were suspended (Singh et al. 2020). Education International tracks the country-wide school closures in 188 countries that impacted all learners worldwide. The learners have moved to e-learning. Vedantu supports to provide online learning in a time of COVID19 (Maichel et al. 2020). The government held meetings with e-commerce websites and vendors to ensure a seamless supply of essential goods across the nation during the lockdown period. Some voluntary and charitable organizations came forward to provide hygienically cooked food at the doorsteps of the affected individuals and families. On 14 April, the nationwide lockdown was extended till 03 May 2020, with a conditional relaxation after 20 April for the regions where the spread has been contained. India has logged 60,963 cases of Coronavirus in the last 24 hours, with 834 deaths, the Union Health Ministry said on Wednesday morning. The total number of cases in the country has now shot up to 23,29,638 with 46,091 deaths. A total of 16,39,599 COVID-19 patients have recovered from the infection, taking the recovery rate to 70.37%.

In India, the COVID19 mortality rate dropped below 2% for the first time since the first lockdown, as on 12 August 2020 and fallen to 1.99%. According to

the ICMR, a cumulative total of 2,60,15,297 samples have been tested up to 11 August 2020. The health ministry stressed that more than 70% of deaths occurred due to comorbidities (Pundir and Marwaha 2020).

This study analyses how the India has made health communication during pandemic situations of the COVID19. The study looked at how Indian authorities have handled the situation since the initial announcement of the outbreak of COVID19 in China in November 2019 by global media outlets. The study explored how effectively India has communicated this disaster and overcome it.

Literature Review

A theory explains realities based on objective and sustained observation, and it merely says why things happen in specific ways. Theories are simplified and often partial explanations of complex social reality, natural or social behavior, event, or phenomenon. The bullet theory postulates that the media injects the message into the audience's mind hence causes changes in behavior and psyche. This theory, therefore, refers to mass media audiences as a passive impact and thus depends on mass media content. It, therefore, holds that persuasive media contents achieve the desired attitudinal change from the target audience (Griffin et al. 2000).

The "Panic broadcast" incident used to support Hypodermic Needle Theory was re-evaluated and declared to show diverse reactions among listeners. H.G. Wells' play "War of the Worlds" was being broadcast as a radio drama in 1938 as a Halloween episode, directed by Orson Welles. The play was assumed as a news bulletin by the listeners, which caused a mass panic to the millions (Hypodermic Needle Theory – Communication Studies 2017). Similarly, in the Second World War, the German leaders used the movie industry to show their power in the world and unify the people for war in the 1940s. Later, the U.S. also used their own movie industry to create a negative image of the Germans and portray them as evil. They justified their actions to their own people with the help of the media. News are often bias and exaggerating, too (Bajracharya 2018).

In August 2014, a viral message on social media said that drinking or bathing with saltwater could prevent

the spread of the Ebola virus (Aliyu and Nanlong 2014). Several persons were feared dead and many more hospitalized in various hospitals in Nigeria after consuming excessive quantity of salt water and bitter kola to prevent Ebola Virus Disease (EVD). Nwabueze and Okonkwo (2018) wrote that the Federal Government had to go on air advising Nigerians to disregard the text message and postings on social media that hot water and salt may be used to prevent Ebola infection and cure infected persons. This on-air advice by worked as a magic pill to control the situation.

Health communication is defined by (Feeley and Chen 2013), citing the U.S. Department of Health and Human Services as the art and technique of informing, influencing, and motivating individual, institutional, and public audiences about important health issues. The crux of health communication is to disseminate information on disease prevention, health promotion, health care policy, and the essentials of health care and enhancement of the quality of life and health of individuals within communities. The purpose of disseminating health information is to influence personal health choices by improving health literacy. Because effective health communication must be tailored for the audience and the situation (Beato Telfer 2010), health communication research seeks to refine communication strategies to inform people about ways to enhance health or to avoid specific health risks (Health Communication Basics, Gateway to Health Communication, CDC, n.d.).

Health communication is crucial for disease prevention. Rimal and Lapinski (2009) say that communication is the core of who we are as human beings as it, apart from being our way of exchanging information, signifies our symbolic capability.

Concerning the transmission view, which this study perceives as the best suited for the communication of COVID19 information in India during 2020 health crisis, Rimal and Lapinski (2009) emphasize that careful thought ought to be invested into the channels through which intervention messages are disseminated, to whom the message is attributed, how audience members respond and the features of messages that have the greatest impact. This study investigates the effectiveness of the connection made by the Indian government regarding health communication and attempts to answer the following queries. How do

media students, media teachers, media experts, and health professionals perceive the effectiveness of the Indian government's health communication messages during March 2020?

Objectives and theoretical framework

The government of India has set up the best way to inform society on the causes and effects of COVID19 timeously and honestly so that they are engaged sufficiently to combat the spread and impact of the pandemic in India. The objective of the study is to analyze the perceptions of citizens of India about the preparation by the government and its officials to combat the situation.

Audience theory is an element of thinking that developed within academic literary theory and cultural studies. The study is framed and informed by the Magic Bullet Theory of communication. As per Berger, (1995), the intended message is directly received and wholly accepted by the receiver. The "Magic Bullet" theory assumes that the media's message is a bullet fired from the "media gun" into the viewer's "mind" (Berger 1995). Harold Lasswell introduced the magic bullet and hypodermic needle theory in 1920s. Initially, the model was set up as a counter-theory to reject what is known as the so-called hypodermic needle model or magic bullet theory, which holds that media messages are directly received and consumed by audiences (Lasswell 1972; Rensmann 2016). Wroblewski (2018), assumes that the media create messages with a specific purpose to elicit a particular response. People react in the same manner to the news. The effects of the media's "bullets" or "syringes" are immediate and powerful, often resulting in swift behavioral changes. This is a theory that can best inform the formulation of a communication model by Indian authorities that facilitated quick dissemination and quick responses to health communications in dire situations such as the outbreak of the COVID19 pandemic.

Methodology

Qualitative methods for gathering, presentation, and analysis of the findings were used. There are a variety of ways of data collection in qualitative research, including observations, textual or visual analysis, and interviews (Silverman 2017). In this study, qualitative research was adopted because it takes place in the natural setting, is interactive, humanistic, and fun-

damentally interpretive (Creswell 2007). In a qualitative interview, ethical questions should be open-ended, neutral, sensitive, and understandable (Mays and Pope 2000). The researchers have carried out interviews telephonically with different modes and means, including WhatsApp. Convenience sampling was used to select interviews. As per Gill et al. (2008), interviews can be used to explore the views, experiences, beliefs, and motivations of individual participants. Etikan (2016) explained that convenience sampling is a type of nonprobability or non-random sampling where members of the target population meet specific practical criteria, such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate, are included for the purpose of the study.

The researchers have used purposive sampling to collect the data. The media has always played a vital role in the dissemination of information. Therefore, on the basis of media and information access and its utilization, the sample of 25 undergraduate and post-graduate media students, 25 media teachers, 25 media experts, and 25 health professionals, including a psychologist, physical and mental trainers, total 100 informants have been taken. The data was collected in the initial stage of the pandemic, i.e., in March 2020. All the informants were from the different states of India. This was done to get perceptions and opinions on government communications' effectiveness on a nationwide scale.

Results and inferences

From media students:

Media students were asked their percipient for the effectiveness of the Indian government's dissemination of health communication messages during March 2020. Students opined that public health communication in India is apparently unidirectional. Students replied that the PM's address to the nation was crystal clear for the people at large. The information on the pandemic and day-to-day reports were informative and appreciable. The use of social media platforms, like Twitter, Facebook, NaMo App were more effective amongst masses. The direct dialogues of media with politicians, civil officials, and the entire government agencies were adequate. It gave the public a chance to engage back and get authentic information with facts and figures from the officials concerned.

Some students informed that the information so provided are the only reliable sources during current crisis. News channels, e-news and newsletters are the medium through which the government delivers necessary information. The Press Information Bureau has started weblink to counter fake news and disinformation regarding COVID19, which is circulated on social media. Taking note of the concern over fake news and misinformation, the Apps were created, and websites designed, with authentic news updates continuously from verified sources. Though the flow of information is almost unidirectional, information comes directly from government and mass media. The zonal helpline branches were created, where the information regarding COVID19 (symptoms, treatment, and prevention) can be available for all. A student replied, “the government communicates correct information with facts and current status at a fast pace through social media, radio, and television news channels, including print medium.”

Several students said that the government has been using all possible means of public health communication actively since the very beginning. We started receiving messages from telecom companies, news advertisements, billboards, and even text messages from the government agencies themselves. The use of social media to spread the news has been extensive, and daily health bulletins on the news channels about the condition have contributed a lot. Whereas some students said that such information has been useful on the ground.

The WHO conveys authentic facts regarding COVID19 situations worldwide, like the spread of the virus, its speed, the recovery rate of patients, etc. In a trying situation such as the present, the easy and timely availability of information to anyone and everyone is a priority. It is a commendable effort by the governments, both central and state, being able to convey the message and vital information for all stakeholders in our society. However, some students have informed that the fake news has been a challenge, where misinformation and rumours about the pandemic cause dilemma. In a continuous process until the pandemic is wiped out, the ups and downs may remain and need to be handled with a dose caution and alertness equipped with appropriate information.

From media teachers:

Media teachers said that the government is doing enough to combat the COVID19 pandemic. A teacher was astonished as how seamlessly screening of thousands of passengers for Coronavirus is carried out on arrival at Indian airports. Another praised the efforts and the directives regarding thermal screening to all passengers arriving at international airports. All passengers landing in India also had to submit two self-declaration forms with personal information and details of the countries they had traveled in the last two weeks.

An educator felt that food-related measures are to be welcomed, including doubling of food grain rations for an initial period of three months, and the addition of pulses to the public distribution system (PDS). He mentioned that many poor people are excluded from PDS as 2011 census figures were at the base, that were made realistic eventually.

Another media teacher replied that the identification of hotspots was an emerging concept which changes the way inputs and data of virus spread are gathered. These spots are effectively monitored so that the virus does not spread. Another respondent said that the emerging “hotspots” of COVID19 are regularly identified and monitored by employing a rigorous cluster containment strategy. Some of the media educators replied that closing all educational institutions, including schools, colleges, universities, and research centers due to nationwide lockdown, may be harmful in the long term. This may affect the academic year as most of the universities are having the end of the academic session, whereas some schools were busy conducting final exams.

From media experts:

A media expert from the private sector opined that a statement was issued by the Ministry of Health on the fight against COVID19 and declared a state of lockdown throughout the country, it was unfortunate that India was not ready with precautionary measures in some of the places. Although, he went on saying the lack of informative and educative public health communication on the virus leaves citizens uninformed. He also pointed out that efforts were made to train journalists on proper ways of information dissemination and that health centers and even their personnel were well informed about the virus. A journalist said that the Indian government was doing enough to com-

municate on different aspects of the pandemic. She said that the response by the government was timely and adequate otherwise unnecessary panic situation would have been caused. She praised the preparations for quarantine and conversion of railway coaches as isolation wards.

A journalist replied that India had started screening travelers coming in from Corona affected countries at airports long before we had even a single case of corona. India had made 14-day isolation mandatory for all international passengers much before the number of corona patients reached 100. All the malls, clubs, and gyms were shut down in many places.

A media expert replied that the press conference by the Ministry of Health and Family Welfare with Press Information Bureau daily, had been a commendable task. It is the health communication made based on the daily report, hosted mostly in the evenings. He added that the Prime Minister has been organizing virtual meetings to strategize ahead to tackling COVID19. He has conducted virtual conferences with chief ministers, scientists, doctors, cricketers, ministers, and leaders of opposition parties and others. A journalist told that the Indian government had launched a coronavirus tracking application namely Aarogya Setu, which translates as 'a bridge of health.' This has been designed to provide citizens with information about the pandemic and has been used by more than 50 million people till 25th March 2020. The application uses AI and Bluetooth to assess whether the user is within six feet of a person infected with COVID19. The application is available in 11 languages, and the it is hoped that it will help limit the spread of viruses.

From health professionals:

Health professionals were asked their percipient for the effectiveness of the Indian government's dissemination of health communication messages during March 2020. The government communicates about various symptoms of coronavirus infection and how it can be prevented and cured. As per the instructions of mayors of municipal corporations, garbage collectors are also taking precautions. It has been insisted to wear masks, wash hands frequently at least for 20 seconds, and to stay inside the home. This has helped all health professionals to fight against COVID19 effectively. The information regarding social distancing and use of hand-sanitizer has reached the masses

effectively and efficiently by the official announcements. Self-protection and precautionary measures have been disseminated through different media. A health professional said that information for self-protection, to clean hands with soap and water, or an alcohol-based hand rub, maintaining a safe distance from anyone specially who is coughing or sneezing, not to touch own eyes, nose or mouth, to cover nose and mouth with a bent elbow or tissue while coughing or sneezing and to stay at home. A doctor replied since the breakout of coronavirus, the public communication systems have been very effective, making sure the information is accessible to everyone. The idea of making sure that test kits, masks, and gloves are not being wasted is something new to spread awareness via platforms where a person can make sure to detect if they are affected or not. Under 'make in India', people started making reusable masks at home.

Another health professional replied that regular updates regarding the number of active, deceased, and recovered people through the web, requesting celebrities to communicate to masses, and many efforts alike proved significant during this crucial situation. The positivity spread across the nation through excellent public communication using various mass media, has helped the people at large to remain COVID19 negative.

Many of the professionals appreciated the sufficient supply of anti-malarial drug hydroxychloroquine; though India banned its export after the corona outbreak; however, the ban was lifted nearly after two weeks, due to its global demand that India decided to fulfil in view of her humanitarian policy.

Discussion and conclusion

The pandemics, crises and disasters are not pre-informed. The COVID19 pandemic has proved the communication strategies for handling it effectively by the country's leadership and official channels of command. The combined use of social media, the use of AI enabled mobile applications, including electronic, print, and digital media help disseminate the authentic official information to the masses. The firm resolution of the leadership has motivated the people of the nation to stand together. National applause for coronavirus health workers was exemplary. The communities that do not have access to newspapers, radio, television, or the internet are also being served with

necessary food and healthcare support adequately by the local bodies.

The data was collected through the questionnaire via online medium due to the lockdown in the country. The researchers couldn't get more informants due to the nature of data collection being a limitation to the study. The study has attempted to get the perception of health communication in the initial stage of the pandemic and lockdowns. The study has contributed to understanding the general awareness of health communication in society. The study established the reporting perceptions of efficacy that various groups in India have access and benefitted from transmission of health communication information. The research found that health communication's focus has been on educating and informing society on health-related issues in general and corona in particular over the period of the study. The study suggests the best communication theory could be the Magic Bullet Theory to strategies communication plans to combat COVID19 and to channelize useful information to the entire country.

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MODALS AS PERSONAL STANCE MARKERS IN EDITORIALS: A STUDY OF TWO PAKISTANI ENGLISH NEWSPAPERS

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This study investigates the use of modals as personal stance markers in Pakistani English newspapers' editorials. A corpus of 500 editorials has been developed published in 'The News' and 'The Dawn' (250 editorials each) and analyzed using AntConc 3.4.4.0. Results reveal that prediction is a characteristic feature of the Pakistani English newspaper editorials. In addition, Pakistani English newspaper editorialists use modality to mark personal stance while commenting, reporting, or informing about the situation. Based on these results, the study cautions the readers of editorial writers' stance as it might affect their opinions. Results also reveal that there is a difference in the use of modal adverbs in the editorials of both newspapers. The results reveal that the editorialists of The Dawn make less use of prediction markers as compared to the editorialists of The News. Though modals are commonly used in mainstream newspapers, their usage in science news and science editorials may lead to irreparable misunderstandings of scientific facts, ideas, and opinions. Therefore, the readers must be extra careful and vigilant to understand the true science between the lines.

Keywords: Editorials; Modality; Modal verbs; Stance markers; English newspaper

Introduction

In recent years, 'stance' has emerged as a significant concern for researchers within cognitive, functional, interactional, pragmatic, and socio-linguistic domains of linguistics. It can be marked by morphological, prosodic, and lexical devices, etc. Similarly, stance can also be achieved through interactional patterns in different speech situations or through skillful use of specific linguistic signs by the speakers of a language.

In fact, stance means something which the speakers

take toward different concepts, ideas, objects, and people depending on their personal beliefs, knowledge state, sociocultural norms, and identity (Iwasaki and Yap 2015; Orta 2010). Major drive for the researches on stance as a prominent linguistic category traces back to a number of studies on subjectivity and modality in language (Benveniste 1971; Biber and Finegan 1988; Biber, Johansson, Leech, Conrad and Finegan 1999; Du Bois and Kärkkäinen 2012; Englebretson 2007; Halliday 1994; Hunston & Thompson 2000; Hyland 1999, 2005; Kärkkäinen 2006; Iwasaki and Yap 2015; Lyons and John

1995; Traugott 2012; White 2001). The notion of stance is very broad, therefore, different researchers have attributed different terms to it. Jaffe (2009) has listed several terms related to stance, i.e. affect, attitude, commitment, epistemic state, evaluation, evidentiality, feeling, inter-subjectivity, judgment, perspective, point-of-view, subjectivity, and voice (pp. 6). Similarly, some other researchers have also contributed to the terminology of stance. For example, Halliday (1994) called it 'modality', Hunston and Thompson (2000) called it 'evaluation' and White (2001) called it 'appraisal'. Biber et al (1999) combined a few terms to define stance as 'personal feelings, attitudes, value judgments, or assessments' (pp. 966). All these terms are inseparable from one another and provide useful entry points into the complex system of stance marking (Iwasaki and Yap 2015).

Stance taking or stance marking is a fundamental human activity which is carried out using language devices. Human beings express their beliefs, desires, and feelings, assess the world around them, and agree or disagree with other humans in social interactions (Ahmad, Mahmood and Mahmood 2019; Orta 2010). Mostly, people, particularly writers make use of modal verbs to express their stance, conveying either the degree of certainty of propositions (epistemic modality), or meanings such as obligation, permission, or necessity (deontic modality). Mostly, stance markers precede the structure presenting the propositions. Modal verbs also come before the main lexical verbs and in this way present new information in the clauses. This arrangement of the constituents depicts the chief function of stance markers as frames (Fillmore 1982) for the interpretation of the propositional information. In most cases, the writers, first of all, establish their personal viewpoints and then encourage the readers to process the following information from the same perspective (Orta 2010).

Stance marking by the writers with the help of modal verbs is very common. Different researchers have observed the use of modal verbs as personal stance markers in different types of writing. Such as Hyland (1996) found its use in scientific writing, Holmes (1988) and Hyland (1994) observed its use in textbooks, He and Wang (2012), Mirahayuni (2002) and Panacova (2008) noted its use in non-na-

tive speakers academic writing. Ngula (2017) and Orta (2010) discovered its use in research articles, Bista (2009) investigated its use in political discourse and Narthey and Yankson (2014) discovers the use of modal verbs in political manifestos.

This study presents an analysis of personal stance marking in newspapers, with a special focus on the texts of the editorials selected for this study. It involves the major principles in the study of stance marking through modal verbs as well as the main terminologies linked with it. For, several studies (e.g. Bonyadi 2011; Fowler 2013; Halliday 1994; Hayat and Juliana 2016; Khalid 2013; Lawal 2015; Ntsane 2015) have also highlighted modality in world renowned English newspaper editorials and there is a possibility that Pakistani English newspapers might also be presenting personal as well as institutional stance through the editorials. Therefore, the study aims to find the answers, whether Pakistani newspaper editorial writers make use of modal verbs for personal stance marking, and the mostly used modal verbs in Pakistani English newspaper editorials.

Literature review

Different studies have been conducted around the world to examine the presence of personal stance in newspaper editorials. One of those studies was conducted by Le (2004) who analyzed newspaper editorials as written varieties of language and observed that, compared to academic texts, the editorial texts were 'much shorter in length, have a content that can be exposed with less complexity and they benefit from a much larger and less specialized audience'.

Moreover, the editorials texts contained such opinions as conveyed in much more personal ways. She added further that for that reason they might naturally contain some textual markers and be more inter-personal. Therefore, she suggests since knowledge is more personal in editorials, it needs to be diminished to be acceptable for a wider group of readers. Qun (2010) conducted research based on corpus analysis techniques to study the features of modality in scientific papers as well as newspaper editorials. The results of his research indicated that the authors of academic papers evaded such epistemic modals as 'surely' and 'I think' because of

their focus on presenting an unbiased view of the news events. Apart from being objective, the authors of scientific papers justified their findings in reasonable, consistent, and assertive ways. Therefore, the occurrence frequency of 'often' was higher than 'sometimes' and 'usually'. As far as the newspaper editorials were concerned, 'could' and 'should' were found to be the most distinguished features of the editorials. A reason behind this preference, according to Qun (2010), might be because most of the editorialists try to remark on events which had previously happened. Hence, the past tense has been preferred. On the other hand, the editorialists have tried to mark their stance in an unclear way. It might be due to the reason, in view of the researcher, that they do not intend to offend their readers. Thus, they preferably used mitigating modals, i.e. 'might' and 'could'. Bonyadi (2011), in his study based on comparative textual analysis of editorials published in American and Persian English newspapers, noticed that the mentioned editorial writers used auxiliaries of prediction, i.e. 'will' or 'would' in their editorials. The study also reported a difference that prediction modals were used most frequently by American newspaper editorial writers as compared to Iranian writers who used the modals of necessity with greater frequency. The study called modality as a linguistic property which the language users could use to create favourable or unfavourable bias or to manipulate the opinion of the readers.

Trajkova (2011) examined linguistic functions and forms of hedges in Macedonian and English newspaper editorials. He observed that hedges worked as interpersonal meta-discourse markers and helped editorialists tone their statements down and present uncertainty in their factuality thus making them acceptable for the readers. Based on these observations, he cautions the editorial readers of the editorialists' persuasive power and style. Khalid (2013) conducted research to examine the presence of authorial subjectivity in Scottish English newspaper articles. The examination results that the modal verbs work as the indicators of ability, permission, possibility, and the Scottish newspaper article writers depend on the use of modals to infuse their voice into the text, to maintain authorial presence in the text and to establish contact with their readers. According to Lawal (2015) press makes use of modality as a method to report news. The reason for

it, as he states, is that modality involves the claim of a person assuming the position of authority and claiming or asserting to have knowledge of what will happen in future. He regards 'must' crucial for editorial text writers to exercise the right to claim of knowing about future happenings. He adds that editors must follow the ideology of the newspaper. Therefore, they make use of modals subjectively. Hence, the editorial writers may not be committed to truth of propositions. Ntsane (2015) investigated the management of contact between editorial writers and their readers with an aim to explore how an editorialist involves a reader as a participant in his discourse while maintaining his persona as an author. Still another aim of his study was to know about how the reader of an editorial is aligned or disaligned with the views of an editorial writer. Thus, applying the Engagement System of the Appraisal Framework, he explored that contractive means were used slightly more than the expansive means. The slight differentiation means that the writer of an editorial tries to maintain a balance between maintenance of his authority as an author and bringing in his readers in communicative events. The results of his study also indicated that the different newspapers used engagement means were used in the same way. In addition, he found the tones to be conversational and the arguments to be somewhat subjective.

Ahmad, Mahmood, and Mahmood (2019) examined the use of modal verbs as editors' personal stance markers in the editorials of a noted Pakistani English newspaper and observed that the modals of prediction, i.e. 'will' and 'would' were most frequently used in the newspaper's editorials. Based on this observation, they concluded that prediction was the main feature of the said editorials. In addition, they found that Pakistani editorialists had been reporting information about news events with personal as well as institutional judgements which had been realized by different modal verbs. They suggested the readers of Pakistani English newspaper editorials to be conscious of the fact that the said editorials might be biased and affect their opinion. Thus, realizing the significance of modal verbs to manipulate social reality, this study aims to spotlight linguistic manifestations of the idea in selected editorials of 'The Dawn' and 'The News' as representatives of Pakistani English newspapers. It is important to mention here that both newspapers are highly esteemed

amongst readers. Particularly, these newspapers are read by government officers, politicians, policymakers, and other highly educated persons. Therefore, these newspapers are called elite newspapers and have a significant influence on policymaking in Pakistan. The rationale for this venture has been based on the arguments given by eminent researchers. Fowler (2013) says that what is true about newspaper editorials is that they make use of textual strategies which foreground speech acts presenting beliefs and values. It is through these textual strategies the editorial writers present their stance. Media houses in Pakistan play an important role in public opinion building and decision-making by military as well as political leadership (Hayat and Juliana 2016). Thus, media seems to have the power to bring a change in the perceptions of knowledgeable people. Hall and Smith go further to claim that the media has the power to change the world by propagating its philosophy to the public. Therefore, the media arguments are important (1975). Generally, newspapers are considered as the most authentic and responsible tool of media (Hassam, Ali, Iqbal and Raza 2013). Pakistani English newspapers are regarded as having greater importance for their coverage and functions throughout the country (Rafiq 2007). Writers of newspaper articles help create ideas among their readers (Hall & Smith, 1975). The central role of the writers is to convey and persuade through their personal opinions (Van Dijk 1996). In fact, the writers of newspaper editorials adopt the ideological stance of the managers or the owners of newspapers (Henry and Tator 2002). The reason behind is that newspapers are affected commercially. 'The News' and 'The Dawn' are private media groups' newspapers and rely on government for advertisements to some extent (Tawab 2000). Therefore, the writers are trying to convince the readers in the light of newspaper policies (Shoeb 2008).

Methodology

Corpus of the study:

This study employs purposeful sampling to develop and select the corpus. Let it be clear that this study is not corpus based, rather it is corpus driven. Major reason is that the study focuses on the use of modality as the stance marking in Pakistani newspaper editorials. Hence, to assist to a new research, 500

English newspaper editorials have been driven from a bigger sample in a previous study, (250 editorials from 'The Dawn' and 250 from 'The News'), published during the months of March-April 2017. Both newspapers are ranked among top broadsheets on newspapers' official websites.

Editorial classifications:

According to Hall (2003), newspaper editorials can be classified into the editorials of attack, of criticism, of defense, of entertainment and of praise. This study involves all these classes of editorials. The reason behind is that the corpus included all editorials published from March-April 2016.

Criteria for corpus driving/ selection:

The corpus was selected based on following parameters, i.e. relativity with different newspaper networks, daily/ weekly issues, signed/ unsigned manuscripts written by editorial writers representing an editorial board, online availability, written/ published in English (Siddique 2017).

Corpus retrieval:

As mentioned earlier, the corpus for this study was retrieved from a previous study by Siddique (2017) to support to new research.

The retrieval process went through these stages:

(1) receiving data in electronic form with prior consent and permission of the researcher, (2) recording of the corpus in Microsoft Excel marking file number, token types, word types, sources, publication dates, etc., (2) renaming of editorials, (4) removing editorial titles, publication dates and author names, (5) conversion of the corpus files into notepad for processing in Antconc 3.4.4.0 processor and (6) collecting/ gathering the editorials in one folder namely, 'Compiled up files 1 to 500', which was further set/ named as, 'All Editorials (1-500)'

Distribution and length of corpus:

As it has already been mentioned, the corpus of this study comprises of 500 editorials published in Pakistani highly esteemed English newspapers, i.e. 250

Table 1: Corpus length

Name of newspaper	No. of editorials	Word types	Word tokens
The News	250	09,633	103,860
The Dawn	250	10,053	103,596
Total	500	19,686	207,456

editorials from The Dawn and 250 from The News. The length of the corpus is given here.

Corpus analysis:

Analysis of the corpus of this study has been carried out through the following procedure: i) Model: The corpus of the study has been analyzed in the light of functional approach by Halliday (2004) which helps analyze the relationship between the types of modality, i.e. (1) deontic, and (2) epistemic, and the degrees of modality, i.e. low, medium and high, as being the

ideology/ stance markers; ii) Tuning procedure: A tuning procedure for modal expression was devised to find the frequency of the modal expressions in the corpus using Antconc3.4.4.0, (2014). The said expressions are given here.

Results

Results of the study are as follows:

The results showed that the editorial writers used modal verbs in their editorials which were published

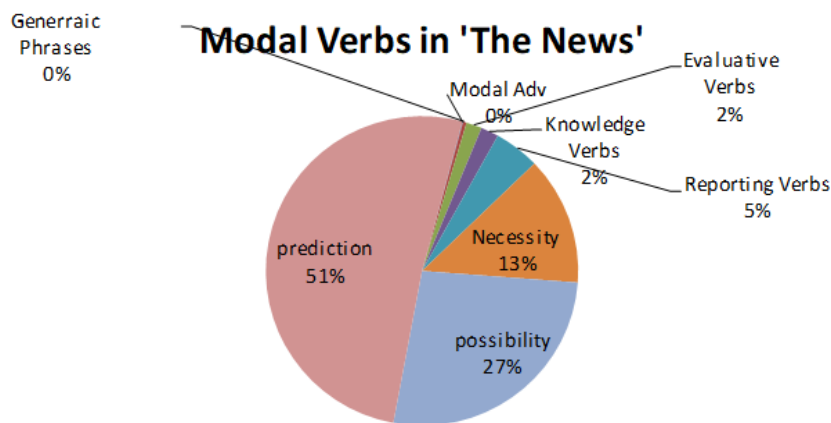
Table 2: Tuning procedure of modal verbs

Function/ expression	Modality/ modal verb
Prediction	will would
Possibility	can could may might
Necessity	must should
Model adverbs	unlikely undeniably apparently clearly truly accurately un-acceptedly grandly surely genuinely less likely
Evaluative adverbs	woefully substantionally seriously painfully deadly badly -sadly cynically cheifly not surprisingly unfortunately fright-eningly ruthlessly efficiently uncritically rapidly under-standably
Reporting verbs	claim voice warn declare admit specu- late hope doubt concede predict announce charge
Knowledge verbs	seem appear believe
Generic phrases	It seems that there is no doubt that it is never accept- able it makes us wonder doubts have now arisen it is clear that it is obvious that

Table 3: Modal expressions in 'The News'

No.	Modals	Frequency
1	Modal adverbs	1
2	Generic phrases	5
3	Evaluative verbs	22
4	Knowledge verbs	25
5	Reporting verbs	64
6	Necessity	182
7	Possibility	363
9	Prediction	695
Total		1357

Table 3: Modal expressions in 'The News'



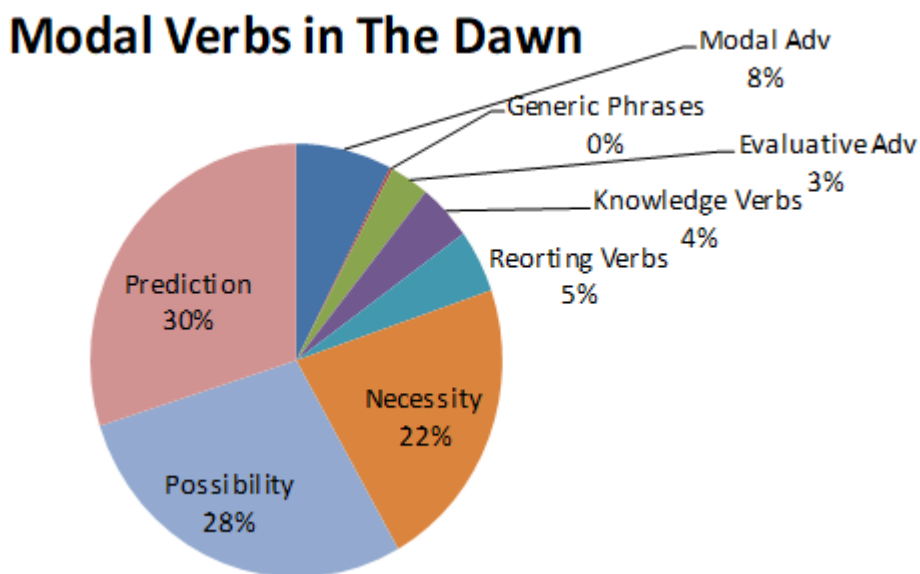
in The News. Frequency of the use of different modal verbs in the editorials published in the said newspaper is that the frequency of modal adverb (like clearly, unlikely, truly, less likely, genuinely, apparently, accurately, unacceptably, surely, etc.) is 1, of generic phrases (like It is obvious that, It is never acceptable, There is no doubt that, It makes us wonder, It seems that, Doubts have now arisen that, It is clear that) is 5, of evaluative adverbs like (badly, chiefly, deadly, woefully, painfully, seriously, sadly, unfortunately, and understandably etc.) is 22, of

knowledge verbs like (appear, believe, seem etc.) is 25, of reporting verbs like (warn, claim, admit, voice, hope, doubt, declare, announce, etc.) is 64, of necessity (like should, must) is 182, of possibility (like can, could, may and might) is 363 and finally of prediction (like will, would) is 695. In this way, the use of modal adverbs seems to be minimum whereas the use of prediction expressions seems to be maximum in the editorials written by Pakistani editorialists for The News. The results show that the editorial writers used modality in their editorials which

Table 4: Modal expressions in 'The Dawn'

No.	Modals	Frequency
1	Modal Adverbs	133
2	Generic phrases	4
3	Evaluative verbs	54
4	Knowledge verbs	75
5	Reporting verbs	83
6	Necessity	389
7	Possibility	501
9	Prediction	528
Total		1767

Table 4: Modal expressions in 'The Dawn'



were published in The Dawn. Frequency of the use of different modal verbs in the editorials published in the said newspaper is that the frequency of modal adverb (like clearly, unlikely, truly, less likely, genuinely, apparently, accurately, unacceptably, surely, etc.) is 133, of generic phrases (like It is obvious

that, It is never acceptable, There is no doubt that, It makes us wonder, It seems that, Doubts have now arisen that, It is clear that) is 4, of evaluative adverbs like (badly, chiefly, deadly, woefully, painfully, seriously, sadly, unfortunately, and understandably etc.) is 54, of knowledge verbs likes (appear, believe,

seem, etc.) is 75, of reporting verbs like (warn, claim, admit, voice, hope, doubt, declare, announce etc.) is 83, of necessity (like should must) is 389, of possibility (like can, could, may and might) is 501, and finally of prediction (like will, would) is 528.

In this way, the use of generic phrases seems to be minimum, and the use of prediction expressions

seems to be maximum in the editorials written by editorialists for The Dawn. It is evident from the above table that there are certain differences and certain similarities in the use of modal verbs in the editorials of The News and The Dawn newspapers. A difference is that the frequency of the modal adverb in The News is 1 but the frequency of the same in The Dawn is 133. However, the most frequently

Table 4: Modal expressions in ‘The Dawn’

Modality	Frequency in The News	Frequency in The Dawn
Modal Adverbs	1	133
Generic phrases	5	4
Evaluative verbs	22	54
Knowledge verbs	25	75
Reporting verbs	64	83
Necessity	182	389
Possibility	363	501
Prediction	695	528
Total	1357	1767

used modality in both of the newspaper editorials is the same, i.e. prediction modal verbs have been found in maximum use.

Discussion

It is important to make the readers aware of the fact that editorialists might make use of the said verbs to establish either a favourable or unfavourable bias throughout the text to influence their opinion. It is evident that the said editorialists made a frequent use of the different types of modals including modal auxiliaries, modal adjectives, evaluative adverbs, knowledge verbs, reporting verbs, etc. This means that the editorial writers have reported the events, under their discussion in editorials, with their own attitude. To increase the degree of modality, the

writers of editorials have made an excessive use of modal adverbs like surely, truly, unlikely, etc. to subjectively define the situations. Similarly, they have also made evaluative adverbs to mark desirability towards the situation. The writers of editorials have also made use of reporting verbs like, claim, hope, doubt, etc., which is the clear indication that the said editorialists have injected their attitude and opinion into truth value of the content reported in the editorials (Ntsane 2015).

Modality is taken as a speaker’s attitude or opinion towards a proposition, or a situation described in the proposition (Lyon 1977; Quirk, Greenbaum, Leech and Svartvik 1985). Meaning thereby is that the speakers or writers make use of modality to mark their attitude or opinion in the texts or talk. Similar-

ly, a characteristic of modality is that it is judgmental in nature (Palmer 2001) and involves the manifestation of judgments or evidence about the actual condition of the situations (Chafe and Nichols 1986; Palmer 2001). As modality expresses the opinion of the speakers and writers, it does not have any assurance of truth of the propositions (Papafragou 2005). Hence, no person can find even a single entirely objective, unbiased and value free text. In fact, it is the writers' authorial interest, viewpoint, and vision, which defines the essence of the style of a story and gives the story a particular 'feel' and 'color' (Simpson, 1993: 5). This feel or colour develops a particular stance of the writer in an editorial. According to Tawab (2000) the stance of a newspaper is affected commercially. Lawal (2015) adds that editors must follow the ideology of the newspaper and in the view of Henry and Tator (2002) the authors create a larger ideological position of the owners and managers of each newspaper. Therefore, they make use of modals subjectively.

Additionally, in the opinion of Hayat and Juliana (2016), the stance of a newspaper is affected by the proprietary structure, newspapers' policy, and the political condition in which the specific newspaper is being published. The article writers depend on the use of modals to infuse their voice into the text, to maintain authorial presence in the text and to establish contact with their readers. Hence, it is evident that modal verbs are used by the writers to mark their attitude or opinion/personal stance toward a proposition, or a situation described in the newspaper editorials. As modality expresses the stance of the writers, the truth of the stance marked in the newspaper editorials with the help of modal verbs might not be objective, unbiased and value free. Thus, the hypothesis of study 'use of modal verbs by Pakistani English newspaper editorial writers injects subjective voices into the editorial texts.' Therefore, the study cautions the readers of newspaper editorials to be careful of the fact that editorialists can influence their opinions.

As far as the question the use of different modals, including generic expressions, modal verbs, reporting verbs, evaluative adjectives, modal adverbs, etc. are concerned, these were examined in the present study. It resulted that Pakistani English newspaper editorialists made extensive use of the modal

verbs of prediction, i.e. 'will' and 'would'. This means that these editorialists, while discussing the situations, make their own predictions about future happenings. It also highlights that prediction is the most important feature of these editorials. Similar results have been reported in a study by an Iranian researcher (Ahmad, Mahmood and Mahmood 2019; Bonyadi (2011). Halliday and Hasan (1989) classified modal verbs according to values into high (like must, need to, have to, ought to), intermediate (including shall, should, will, would) and low value modals (involving can, may, could, might). As the results of the study show that the editorial writers have used 'will' and 'would' with maximum frequency, it means that these editorialists make frequent use of 'intermediate value' modal verbs. And according to Qian (n. d.) different types of modal verbs are related with different degrees of politeness in the communication process. In their function, low value modals show politeness in communication, whereas high value modals express impoliteness in communication.

It implies that if the writers make use of high (impolite) and low degree (polite) modals, there can be the possibility for their writings to be approached negatively with writer's tilt in favour or against the situation. Therefore, it might be that the editorial writers make use of neither high nor low value modal verbs. Instead, they make conscious use of the intermediate value modals to cipher any negative perception among readers. Modal verbs, in the view of Palmer (2007), help language users express 'what should be', 'what may be', 'what would be', and 'what is.' Thus, the writers make frequent use of modal verbs to show possibility, necessity, and prediction in their writing. However, this is just one side of the coin. In fact, modality involves the claim/ assertion of a person assuming the position of authority and claiming/ asserting to have knowledge of what will happen in future (Lawal 2015). Therefore, the editorial writers make use of modal verbs to predict the future on one hand, and to show their authority by claiming their knowledge of future happenings. In addition, it is one of the main goals of the writers to maintain a relationship with the readers to convey their ideas. For this purpose, the writers of newspaper editorials make a skillful use of modal verbs to infuse their voice into the text, to maintain authorial presence in the text and to establish contact with their readers

(Khalid 2013; Ntsane 2015).

Conclusion

The discussion of above results leads to the conclusion that prediction is the most important feature of Pakistani English newspaper editorials and these editorialists not only report information about news events but they also provide the readers their editorials with personal judgments and stances which are realized through different modal verbs, modal adverbs, reporting verbs, generic phrases, knowledge verbs, etc. Thus, the study suggests the readers of Pakistani English newspaper editorials should be conscious of the fact that the said editorials might be biased and affect their opinion.

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COMMUNICATION AND TECHNOLOGY INTERVENTION FOR INCLUSIVE DEVELOPMENT IN UTTARAKHAND

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Providing accurate and timely health communication messages is a challenge for world leaders under normal circumstances and is especially crucial during a pandemic. The Indian government conveyed the messages regarding coronavirus through various mass media. This study explores applications of communication theory to provide insight how multiple constituencies in India perceive the effectiveness of health communication messages during the early phases of the COVID19 pandemic. This study seeks to identify perceptions of the best public health communication methods that were used during the early phase of the COVID19 in India. Health communication mainly initiates a positive dialogue between health professionals, health communicators, and media professionals to spread health awareness, health education, and health consciousness at ground level. The research methodology employed interviews with media students, media teachers, media experts, and health professionals to establish the effectiveness of health communication messages used during early stages of COVID19. Findings are presented and analyzed thematically.

Introduction

Uttarakhand state has 13 districts, of which 11 are hill districts. During rainy season the wide spreads landslides create number of problems. Farmers could not send their vegetables, fruits, and other product to the market and most of the products perish.

Uttarakhand is known to produce oranges, malt, lemon, pomegranate, tomato, pear and apple, etc. To address this problem, Technology Resources Centres (TRCs) have developed a Community Facility Centre for fruit processing, which in turn promotes Self Help Groups (SHGs) for women and socially deprived. It offers fruit processing information dissemination and training, such as: looking after raw materials, judicious use of preservatives, packaging, and marketing, etc.

A mechanism adopted by them enhanced the knowledge base of the region. More than 10,838 inhabitants take advantage of the same. In this paper an attempt has been made to highlight the successes stories of Technology Resources Centres in the dis-

semination of information.

Uttarakhand is comparatively a newly carved out state from the northern part of Uttar Pradesh and got statehood on 09 November 2000 consisting parts of greater Himalaya. The rural community of Uttarakhand has been the most marginalized section isolated of inclusive development. The state has rich natural resources and traditionally the income generating activities include agriculture, animal husbandry, handicraft, and other skilled and semi-skilled activities. Less employment opportunities, negligible industrialization, unawareness regarding science and technology, education, health, and poor infrastructure, are the major constraints. With the science and technology intervention and communication, such as, entrepreneurship development, value addition to agricultural products, demonstration, and communication of technology at grass root level brought people to the mainstream of development.

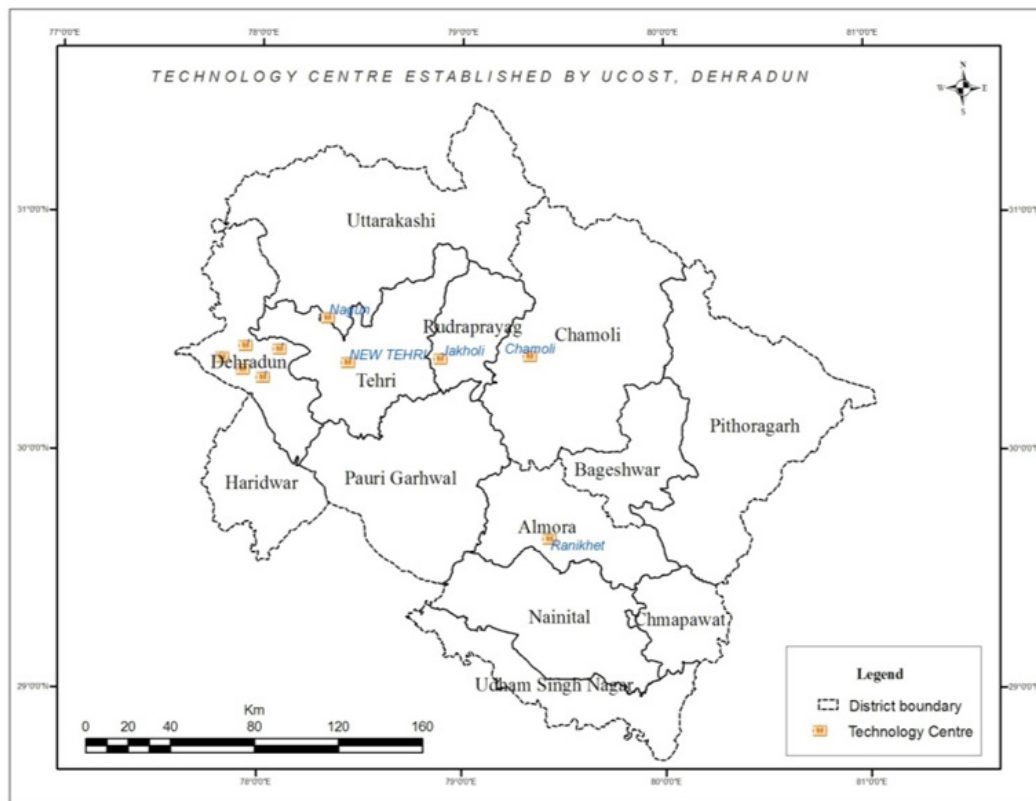
Technology promotion and communication

The Uttarakhand State Council for Science and Technology (UCOST) reaches out at grass-root level to spread technological awareness and promote technology interventions. Six Technological Resource Centres (TRCs) and 125 Vigyan Prasas Kendras were established throughout the state to pro-

vide popular science books, magazines, equipments to different stakeholders.

Capacity building and training programmes on various scientific issues are organized from time to time so that they can update the knowledge and spread awareness in the society.

Fig. 1: S&T programme by UCOST, Dehradun



The technology intervention included 3 units of poly-house demonstration, drip irrigation system, fogging system, fertilization system, sprinklers, power tiller, bari making machine, hammer machine, malt juice machine, vacuum filling head, upgradation of chullu decoration, colloidal mill with tank, mixing machine + hydro machine, potato peeler, slicer, namkeen pouch packing machine, Bhujiya making machine, pressurizer diesel stove, nitrogen gas cylinder, RTS cup sealing, filling machine, high pressure sealing machine, cap sealing machine, juice filter machine, bottle lamination machine, steam boiler, homolyser, water filter, microscope, pH meter, soil testing kit, humidity testing machine, hand refractometer for measuring concentration, seed analysis kit, anemometer, refractometer, stainless

steel top tables, electric heat sealer, weighing machines, storage drum, peeling tools, lab equipmenta and preservatives, hand operated slicer and grater, diesel bhatti, mechanical rier, grinder, crown corking machine, pulper juicer, mixing machine, fruit mill, offline water purifier, pouch sealing machine, plastic glass sealing machine, etc. A capacity building training programme and awareness campaign was also conducted by the council in different parts of the state on phenyl making and paper conversion, computer skill development, handicraft, and various other EDPs for men and women in the disaster affected areas. Some 10,838 persons were benefited by these programmes.

Uttarakhand state largely depends on agriculture and the council promotes self-employment generation

TRAINING PROGRAMME FOR WOMAN EMPOWERMENT



FISH FARMING USING NATURAL WATER RESOURCES IN PITHORAGARH



COMMUNITY FACILITATION CENTRE, CHAMOLI



TISSUE CULTURE LAB AT NAGAON, UTTARKASHI DISTRICT

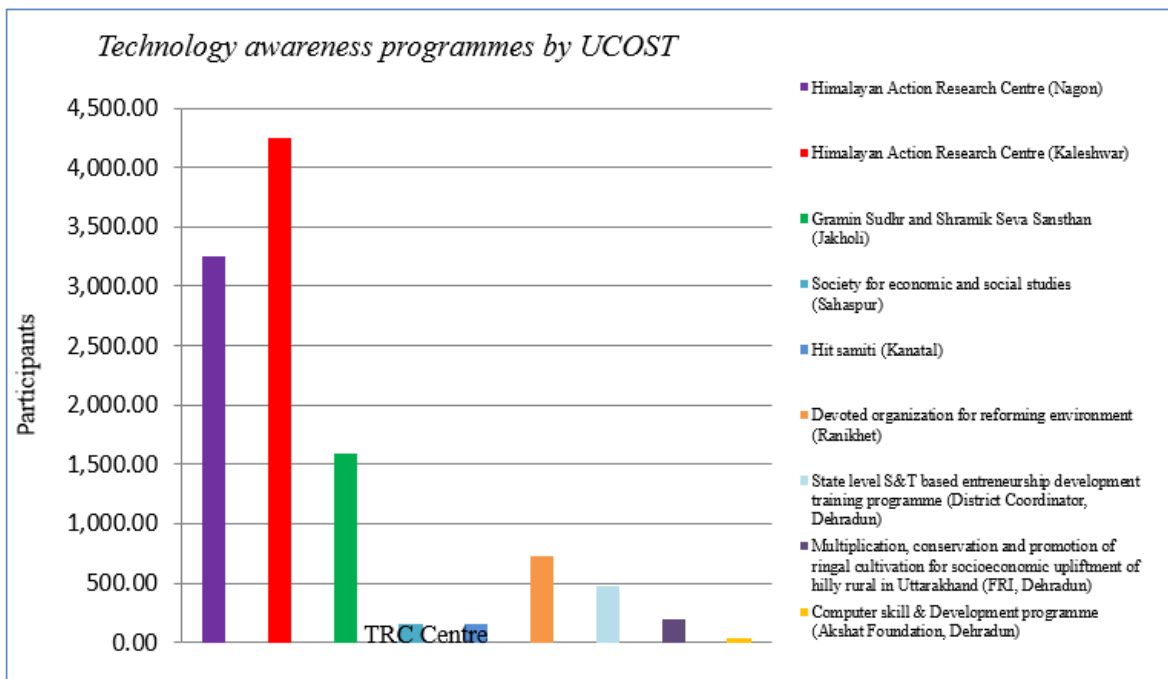
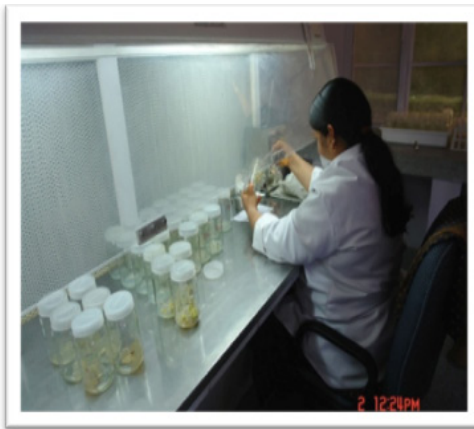


Fig. 2: Beneficiaries in different part of the state

Table 1: Technology demonstration and communication programmes

No	Coordinating organization	Location of Centers	Available technologies	Beneficiaries
1.	Himalayan Action Research Center (HARC)	TRC, Naugaon, Uttarkashi	3-Units of poly-house demonstration (poly sheet, poly-metal structure, poly curtains, drip irrigation system, fogging system, fertilization system, sprinkler, pump, 3 tier structure, input material, etc.), power tiller, bari making machine, hammer machine, malt juice machine, vacuum filling head, up-gradation of chullu decoration	3249
2.	Himalayan Action Research Center (HARC)	TRC, Kaleshwar, Chamoli	Colloidal mill with tank, mixing machine + hydro machine, potato peeler, slicer, Namkeen pouch packing machine, Bhujiya making machine, pressurizer diesel stove, nitrogen gas cylinder, RTS cup sealing, filling machine, high pressure sealing machine	4251
3.	Gramin Sudhar and Shramik Seva Sansthan, (GRASS)	TRC, Jakholi, Rudraprayag	Cap sealing machine, juice filter machine, bottle lamination machine, steam boiler, homolyser, water filter, microscope, pH meter, soil testing kit, humidity testing machine, hand refractometer for measuring concentration, seed analysis kit, anemometer	1589
4.	Society for Economic and Social Studies	TRC, Sahaspur, Dehradun	Pulper juicer machine, grinder, refractometer	150
5.	Hit Samiti	TRC, Kanatal, Tehri	Refractometer, stainless steel top tables, electric heat sealer, weighing machines, storage drum, peeling tools, lab equipment and preservatives, hand operated slicer and grater, diesel bhatti, mechanical rier, grinder, crown corking machine, pulper juicer, mixing machine, fruit mill	160
6.	Devoted Organization for Reforming Environment (DORE)	TRC, Ranikhet, Almora	Pulper juicer machine, juicer, offline water purifier, refractometer, pouch sealing machine, plastic glass sealing machine	729
7.	State level S&T based Entrepreneurship Development Training Programmes	District Coordinator UCOST, Dehradun	Phenyl making and paper conversion	480
8.	Multiplication, Conservation and Promotion of Ringal Cultivation for Scio-economic Upliftment of Hilly Rurals in Uttarakhand	FRI, Dehradun	Preparation of nursery for the plating of ringal rhizomes. Literature generated and distributed for farmers. Training conducted at village level.	200
9.	Computer Skill & Development Programme (CSDP)	Akshat Foundation Dehradun, Uttarakhand	Computer skill development	30
10.	Scienfun-Symphony with Science for the Children of Garhwal Region of Uttarakhand	SPECS, Dehradun	To generate scientific awareness among school children and role of science and technology in daily life	350
11.	Poor Women Entrepreneurship Development Training	District Coordinator, Dehradun	Entrepreneurship Development Training (EDP) for socially backward women	71

for local people through awareness and adoption of cost effective and proven technologies. A variety of programmes related to food processing and canning were identified and Technology Resources Centres (TRCs) established; they act as source for technology dissemination and training. All these initiatives have generated momentum in the state and channeled the message of technology for self-employment. It is refreshing to observe that many beneficiaries have already become entrepreneurs through technology demonstration and dissemination in the state besides developing and promoting scientific temper among masses.

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ROLE OF SCIENTIFIC TEMPER IN MITIGATING THE COVID19 PANDEMIC

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Introduction

The epidemic causes the disease suffering of many people or animals. However, a pandemic is an epidemic that crosses international boundaries and affects many people. The world has faced many pandemics in the past. Infectious disease outbreaks such as COVID19 threaten the loss of life, economic disruption, and social disorder. This viral outbreak has impacted almost the whole world. In Wuhan, China, it originated in December 2019 and by March 2020, this virus reached more than 200 countries. It is observed that rational thinking and scientific temper have played a crucial role in reducing this pandemic all over the world. Some countries like China, South Korea, and India tackled this outbreak logically while a number of countries didn't make logical decisions at the right time or got delayed taking rational actions such as quarantine, lockdown, etc. Public awareness and rationality also played a major role in reducing the effects of COVID. In this study, the role of scientific temper and rational decision making has been analyzed in order to create awareness and help mitigate pandemic with special reference to the Novel Coronavirus Disease (COVID19).

Any epidemic affects almost every walk of life. A pandemic of COVID19 or similarly transmissible disease could infect millions of people in a very short time. Curfew and lockdown situations disrupt the economy and GDP of the nations. It is also true that a nation devotes much its resources and money to mitigate global risks like terrorism, war or climate change. On the contrary, fewer resources and money are invested to prevent and prepare for infectious disease outbreaks. Considering the outbreak of

COVID19 which is caused by an extremely unpredictable virus and there is no medicine or vaccine for its treatment. This coronavirus is undergoing mutations and hence it is changing infection pattern in different geographic and climatic regions. This changeable pattern of coronavirus of COVID19 is favouring its spread. In April 2020, more than 200 countries of the world were facing the life-threatening crisis of COVID19. The infection of this virus produces major symptoms of sneezing, dry coughing, and shortness in breathing.

Several carriers were asymptomatic till 14-21 days and meanwhile, they may infect others. The major modes of infection were physical contact and droplets of sneezing or coughing by infected persons. Infected surfaces such as a table, chair, seats and holding poles in the metro, beddings in trains, mobile phones, laptop, TV remote, office files, etc., were also the significant sources of infection for this virus. It is obvious that awareness and prevention are the major solutions to viral infections like COVID19. To follow hand hygiene and social distancing were proved the best precautionary measures to combat COVID19 and scientific temper was the main guiding force for the nations and nationals to break the infection cycle of coronavirus. It was observed that many countries didn't plan logically while some of the countries did rational decision making to execute the containment, prevention and mitigation strategies. It was found that scientific temper among the common man and informed decision making by the countries helped reduce the spread of pandemic COVID19.

Historical review of major pandemics

The human populations have suffered from many pandemics throughout the history. It occurred in the form of smallpox, tuberculosis, plague, cholera, malaria, influenza or the recent incidence of COVID19. If we talk about the starting point of epidemic, we find that human migration, agricultural transitions and animal domestication have played major role in the spread of infectious diseases. Later in the path of human civilization, agrarian communities got involved in trade. This created chances of human-animal interactions that inspired epidemics through gastrointestinal and respiratory pathogens. Evidence of the infections such as smallpox, chronic tuberculosis, etc. has been found in ancient skeletal or mummy remains.

Table 1: A glance of historical pandemics in the world

Name	Time period	Type / Pre-human host	Death toll
Antonine Plague	165-180	Believed to be either smallpox or measles	5M
Japanese smallpox epidemic	735-737	Variola major virus	1M
Plague of Justinian	541-542	Yersinia pestis bacteria / Rats, fleas	30-50M
Black Death	1347-1351	Yersinia pestis bacteria / Rats, fleas	200M
New World Smallpox Outbreak	1520 - onwards	Variola major virus	56M
Great Plague of London	1665	Yersinia pestis bacteria / Rats, fleas	100,000
Italian plague	1629-1631	Yersinia pestis bacteria / Rats, fleas	1M
Cholera Pandemics 1-6	1817-1923	V. cholerae bacteria	1M+
Third Plague	1885	Yersinia pestis bacteria / Rats, fleas	12M (China and India)
Yellow Fever	Late 1800s	Virus / Mosquitoes	100,000-150,000 (U.S.)
Russian Flu	1889-1890	Believed to be H2N2 (avian origin)	1M
Spanish Flu	1918-1919	H1N1 virus / Pigs	40-50M
Asian Flu	1957-1958	H2N2 virus	1.1M
Hong Kong Flu	1968-1970	H3N2 virus	1M
HIV/AIDS	1981-present	Virus / Chimpanzees	25-35M
Swine Flu	2009-2010	H1N1 virus / Pigs	200,000
SARS	2002-2003	Coronavirus / Bats, Civets	770
Ebola	2014-2016	Ebolavirus / Wild animals	11,000
MERS	2015-Present	Coronavirus / Bats, camels	850
COVID-19	2019-Present	Coronavirus - Unknown (possibly pangolins)	4,700 (as of Mar 12, 2020)

Moreover the evidences of periodic acute epidemics can also be found in early written compendia (Grmek 1989). Rats, mosquitoes and other commensal species increased the pathogen risk within human settlements. Domestication of various animal species induced the emergence of many historically important zoonoses like measles and smallpox (Fiennes 1978; McMichael 2001).

The history of the pandemics cannot be discussed in a few lines. Many researchers consider 1918 Spanish Flu (influenza pandemic) as the ‘Mother of all pandemics’. Although the improved healthcare measures have progressed substantially in mitigat-

ing many epidemics, but new emerging infectious diseases have always challenged healthcare system as well as humanity. The present pandemic of COVID19 is a huge warning (Samal J. 2014).

Source of infectious diseases

The snapshot above shows major pandemics of the history, their causal organism and pre-human host or carrier of that microorganism. One more thread is linked with the infection from animals to human populations. When the infection is animal to animal, it is easily controlled. But the disease outbreak becomes out of control when a virus or any other pathogen jumps from animal to human. Most new pandemics have emerged via the zoonotic transmission of pathogens from animals to humans (Murphy 1998; Woolhouse and Govotage Sequeria 2005). Zoonoses enter human populations from both domesticated animals and wildlife. Increased human-animal interactions are giving scope the pandemic to happen. The pathogen like Ebola has emerged from wildlife reservoirs and entered human populations through hunting and eating of wild animals, wild animal trade, etc. (Pike et al. 2010; Wolfe et al. 2007).

Another pathogen group such as Nipah virus H5N1 and H7N9 influenza has not demonstrated sustained human to human transmission. Pathogens like Ebola, Lassa, and Marburg cause regional or inter-regional epidemics but the risk of a global pandemic is limited because the transmission rate of these pathogens is slow. They also have a high probability of containment. Among all known epidemic or pandemic pathogens, influenza has potential severity and because of this reason, it poses a huge threat to human society. During historical influenza pandemic (1918), billions of human population faced mortality world over. Malnutrition, co-morbid conditions and insufficient access to supportive healthcare enhanced the problem. In those days, antiviral drugs, vaccines or antibiotics were non-available. Healthcare technologies were so limited. Public awareness and rational attitude were also lacking (Madhav N. et al. 2018). Two factors are responsible to incubate an epidemic. First is the pathogen-specific factor which includes the genetic adaptation, mutation, and mode of transmission of the pathogen. Second is the human population factor that contains population density, susceptibility to infection, travel, trade,

Table 2: A glance of historical pandemics in India

Name of Pandemic	Time period	Causal microorganism
Cholera	1817, 1826, 1852, 1863, 1881, 1896, 1899	Vibrio cholerae
Influenza pandemic (Spanish Flu)	1918-19	H1N1 strain of influenza virus
Polio	1970-1990	Poliovirus (poliomyelitis)
Small Pox	1974	Variola virus
Plague (Surat)	1994	Yersinia pestis (bacteria)
Plague (Northern India)	2001-2003	Yersinia pestis (bacteria)
Dengue	2003	Dengue virus
SARS (Severe Acute Respiratory Syndrome)	2003	SARS-CoV
Meningococcal Meningitis	2004-2006	Neisseria meningitidis (bacteria)
Chikungunya	2006	Chikungunya virus (CHIKV)
Dengue	2006	Dengue virus
H1N1 Flu	2009	Inf A (H1N1), Inf A (H3N2), and pdm H1N1 strains of virus
Swine Flu	2009-2015	H1N1 and H3N2 influenza virus
Nipah	2018	Nipah virus

health surveillance and response strategies (Sands et al. 2016). Social distancing in a country like India is a big challenge. Here average population density is 464 per square Kilometer. Many people live in less spaced households. Such accommodations accelerate the risk of pathogen spread like novel coronavirus. Co-morbidity (pre-existing diseases), poverty, malnutrition, lack of hygiene and sanitation increase the risks of disease spread. In such situations, refugees, marginalized populations, and people living in urban slums are likely to face great risks of infection during a pandemic, although at the same time they enjoy better immunity.

Manifold impacts of pandemic

As discussed earlier, pandemics are large scale outbreaks of infectious diseases that increase morbidity and mortality. Relevant evidences suggest that urbanization, exploitation of the environment, change in land use pattern and increased global travel are the main reasons for occurring pandemics over the last century (Jones et al. 2008; Morse 1995). Impact of pandemic is manifold.

Social impact: Pandemics have direct social impacts. In this situation, panic and fear of unemployment, starvation, ailments, etc., cause rapid population migration. During Plague outbreak in Surat, India (1994) only a small number of cases were reported. But about 5 lac people (20% of Surat's total population) left their homes out of fear (Barrett and Brown 2008). Such population migration cannot only have health risks but it poses the risk of further spread of outbreak. During the COVID19 outbreak, India also faced such sudden population migration from metro cities like Delhi and Mumbai.

Economic impact: In addition to social impacts, pandemic can also cause short term or long-term damage to economy of the affected country. Containment and mitigation of the disease outbreaks need significant human resources like the medical staff. Diagnostic kits for massive human testing, personal protective equipment (PPE), ventilators, drugs, etc., are required on a large scale as the outbreak spreads. The financial burden is involved to meet all these needs (Herstein et al. 2016). Public transport, factories, markets, trade, etc., are shut-down during the epidemic. Labourers become un-

employed. The government has to provide food, healthcare, and other essential services to the public. These unexpected expenditures pose great losses to the country's economy.

Health impact: Economy of the country can be revived but not the people lose their lives in pandemic. Pandemic has direct health impacts. Children, pregnant women, people with co-morbidity and older people are more vulnerable in the epidemic. These population groups have lower immunity. No country has as much medical strength that could handle the pandemic situation. Often the doctors and nursing staff also catch the infection that make the scenario worse. During pandemic, the healthcare system of any country faces unexpected stress. USA and Italy are the superpowers in the healthcare systems. But during the pandemic of COVID19, they felt huge stress to handle the infected cases and treat them. According to Madhav N. et al. (2018), during the Ebola epidemic (2014) in West Africa, medical facilities and healthcare closures were done because of under-staffing and fear of disease infection. In the COVID19 pandemic, healthcare of OPD patients, as well as routine health check-ups are postponed for months.

Environmental impact: Anthropogenic environmental changes affect the emergence of infectious diseases among wild animals, domestic animals, and humans globally. It happens mostly in biodiversity rich countries (Alessandra Nava et al. 2017). However, very little is known about how the majority of human infectious diseases will be affected by future global environmental changes such as climate, land use, etc. (David W Redding et al. 2019). On the other hand, pandemic of COVID19 stopped all means of human transport. Lower pollution levels had reported from most parts of the world. Kimberly Nicholas, a researcher at Lund University in Sweden says that alone transport makes up 23% of global carbon emissions and COVID has dropped this emission to some extent. Pollution levels have reduced.

Measures to reduce the impact of pandemic

Pandemic preparedness: The impacts of a pandemic can be reduced if the nation ensures the preparedness and response against it. This task involves

the coordination across multiple authorities. Governance is a complex exercise across international, national and sub national multiple institutions. Testing, isolation, quarantine, treatment and vaccine/drug development are done by concerned experts and these activities involve government, health departments, and researchers (Aylward B. et al. 2014). Historical pandemics provide a birds-eye view to guide nations on how to prepare and respond. Since each of the pandemics is quite different from the other, therefore it is like a challenge to contain and mitigate the new outbreaks of the epidemic.

Rational thinking: The challenge of containment and mitigation of a pandemic are resolved through necessary preparedness, appropriate response, and the rationality. Since long, rationality and innovative protection practices have been used to control the epidemics and such interventions make people aware (Carmichael 1986). Quarantine is one of the best rational measures to contain epidemics. This practice was begun in 1377, in Ragusa (now Dubrovnik, Croatia) to protect coastal cities from plague epidemics. Port authorities had mandated 40 days halt of any ship prior to arrive in Venice from infected ports (Grmrk 1980). The word ‘quarantine’ is originated from Italian phrase ‘quaranta giorni’ that stands for 40 days. Brockliss and Jones (1997) illustrate that the systematic use of quarantine effectively restricted appearances of plague to the port cities.

The incubation period of novel coronavirus is 14-21 days in humans. Symptomatic human carrier of this virus reflects disease symptoms within 5-7 day while asymptomatic people produce symptoms within 14-21 days. Keeping in view the above incubation period of coronavirus several countries including India implemented lockdown from 15 days to 2 months to break the infection chain of the virus. This is also a rational approach to contain the COVID pandemic.

Scientific temper: Scientific temper is a Key Player of Behavioural Change. Logical thinking, curiosity and rationality are the congenital qualities of human. Scientific temper represents all these qualities. This temperament is based on method of science. This method tells that one should not reach a definite conclusion without experimenting, verifying and analyzing the facts. This gives us a lesson

that no fact should be considered as truth unless it is verified (Patairiya M.K. 2016). In fact, scientific temper is a way of life that includes questioning, testing with experiences and analyzing. This is the essence of logic, discovery, humanism, cooperation, improvement, and innovation. Logical thinking inspires discovery and invention. Those who have adopted scientific temper, become curious and responsive. Scientifically tempered persons don’t believe anything blindly. They apply their brain (discretion) and then only reach up to an ideal conclusion or decision. India’s first Prime Minister Jawaharlal Nehru introduced this phrase ‘Scientific Temper’.

He explained that it is based on a fearless search for truth on the solidarity of man, even on the divinity of everything living and on free and cooperative development of the individual and the species. (Discovery of India pp. 567-573). The Constitution makers included the development of scientific temper, humanism, and reform as the fundamental duty in the Constitution of India [Article 51 A(h)]. Indeed, scientific temper sparks behavioural changes among citizens. This is the main goal of science communication that is an informal way of learning. Formal learning of science is a student centric activity. But science communication benefits the common man and it has four basic objectives: 1. Dissemination of S&T information in simple language; 2. Elimination of superstitions or unscientific traditions prevailed in the society and development of scientific temper through behavioural changes; 3. Dialogue between scientists and layman; and 4. Diffusion of S&T knowledge among youth and their skill development.

Effective risk communication: Communication makes people aware, and risk communication informs and alerts people about the risk of natural calamity as well as epidemic. What you say, only it is not so important. It’s more important how you say or communicate (Parveen S. et al. 2016). The World Health Organization (WHO) has illustrated this specific communication element saying “It can play a significant role in the control of an emerging epidemic or pandemic by providing information that people can use to take protective and preventive action. Risk communication has great potential. Through this communication, the very fundamental information and knowledge of pathogen transmis-

sion mode, protective measures, containment and mitigation strategies, patient care guidance, healthy practices, etc., are disseminated. This helps reduce disease transmission significantly. Risk communication is an essential information service given in an epidemic or calamity situation that enables people to manage risk and hazards. Such communication must be clear, simple and easy to understand language. This communication is to be received from credible sources and it must be diffused to the target group in a timely manner.

Logical and timely decisions: When the risk of epidemic is handled with scientific temper, it is resulted in logical and timely decision making. The recent pandemic of COVID19 examined the scientific temper and rational decision-making ability of the world. Some countries like Italy, Spain, New York, Washington, and California responded to COVID19 very late and come into action mode (imposed lockdown) when disease outbreak situation went beyond control. In such conditions, they faced the burden of a great number of infected cases and resultantly the anarchy emerged (Fauci A. 2020).

This is the lesson that the overall infected and deceased cases could be reduced if these countries would have used scientific temper. A graph is given here that shows a glance of those countries which have the most reported coronavirus cases. On the other hand, China, South Korea and India responded proactively to COVID19. China sealed the borders of affected cities and imposed lockdown (Kucharski A. 2020). South Korea focused on rapid testing on a large scale. India imposed the nationwide lockdown, traced out infected people and their contacts for necessary treatment and quarantine. Such scientifically tempered actions yield favourable results in these countries. Table-1 illustrates those 4 major countries of the world which were badly affected with COVID-19 till 14 April 2020. These countries delayed in containment measures. On the other hand, South Korea and India are examples where containment of disease transmission was done through wide testing and lockdown. Till 14 April 2020, South Korea and India have 10,564 and 10,461 COVID cases respectively. These were very small numbers in comparison to four most affected countries given in table-3.

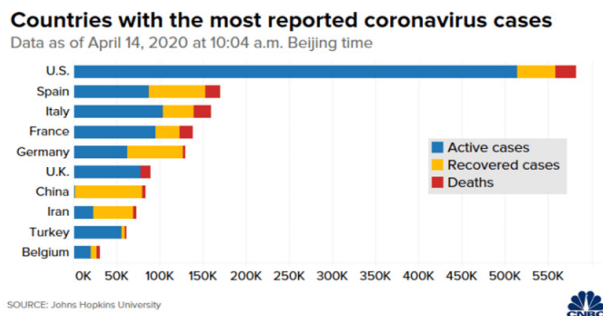
Mitigating misinformation

Scientific temper and logical thinking again become necessary in not believing rumours. Usually during epidemics, misinformation and rumours create anxiety and deviate public opinion (Madhav N. et al. 2018). Scientific temper or evidence-based reasoning ability of people acts like a shield that protects them from the unscientific and illogical cloud of misinformation. Rumors can impede disease control at large. Government, public health officials and science communicators need to identify and address misinformation and put the right scenario of the situation. Here if science communication succeeds, active public participation is observed. With our enlightened response and awareness to COVID19, containment and prevention of disease are easily achieved.

COVID appropriate behaviours and practices

During the pandemic of COVID19, the following actions and behavioural changes are expected by the people having a scientific temper. Eventually such actions and behaviours help in mitigation of epidemic or pandemic.

1. Staying at home and following the guidelines of the government that are being issued as per the inputs of health authorities and research findings. Sanitize the daily life gadgets like mobile phone, laptop, TV remote, etc., repeatedly.
2. Avoiding going to crowded places like a grocery store, market, etc. If it is necessary, then wear mask and gloves and follow the 6 feet physical distancing. Collect the required grocery items or vegetables quickly and carefully. Be cautious that thousands of people visit these public places daily. Try to pay digitally because currency notes and coins may contain the virus (Gill V. 2020). Soon after reaching home sanitize your hands and face. If possible take a bath with soap.
3. Vegetables and fruits should be cleaned and kept at an isolated place for at least 12 hours (Chapman B. 2020). Plastic packets having milk can be washed with soap properly. Grocery items can be put outside the home to a safe place like a porch for a day.
4. The handling of vegetables, fruits, groceries is very important. We should not forget to wash

Fig. 1: Most reported cases of COVID-19

our hands with soap and never touch our face, nose or mouth.

- Twenty seconds hand-washing with any kind of soap (solid, liquid or scented) is essential to destroy the fatty outer membranes of the virus (Pogrebna G. and Kharlamov A. 2020). We must understand the science behind this and follow this sincerely.
- Maid, servants, gardener and drivers should not be allowed to continue their work till the pandemic persists. They may be passive carriers of the novel coronavirus.
- If possible, stop taking newspapers and get news updates by e-papers online. In this way, you will stop the risk of virus entry through the newspaper. Visualize via how many surfaces, it reaches to our doors and balcony.
- Try to use stairs without touching the side handles or grills. If your flat is above 4-5 floors, you may use the lift but don't forget to sanitize your

hands, doorbell and doorknob.

- During the COVID19 pandemic, the internet and social media were flooded with solutions to get rid of the virus. But checking facts before action is always necessary and logical. Several fact-checking sites are available to verify the video, photo, statement in such a crucial time. Official websites of WHO, Ministry of Health & Family Welfare, Govt. of India, Indian Council of Medical Research, Council of Scientific & Industrial Research, Department of Science & Technology, and Department of Biotechnology are the central sources of authentic information during COVID19 outbreak. It is very logical to believe in those research findings which are published in peer-reviewed journals rather than social media posts without any authentic research base.
- During the lockdown, usually, all the public transport, trade, hotels, clubs, gyms, stadiums, etc., are closed. To use train coaches, gym, hotel, stadium, and vacant buildings as the quarantine centers and making them equipped with all necessary medical facilities indicate the rationality. Bombay Municipal Corporation (BMC) made 117 such quarantine centers in Mumbai. In several other cities of India, such quarantine and isolation centers were created in a very short time in March-April 2020 during the COVID19 outbreak.
- District administration and police authority of Bhilwara district of Rajasthan have shown a ra-

Table-3: COVID cases in 4 countries till 14 April 2020

Country	COVID Cases
France	1,37,000
America	5,87,357
Spain	1,72,655
Italy	1,59,516

tional decision making in response to COVID19. The local administration imposed a super curfew. During this, vehicle movements of essential services were also restricted to a greater extent to those pockets of the district were infected or suspected COVID cases were present. Police took the responsibility to handle the supply of food, milk, vegetables, medicines, etc. to the public (Chawla D. 2020). This extraordinary move yields great results. Infected cases drastically reduced after super curfew lockdown in Bhilwara. Many other Indian cities followed this 'Bhilwara Model' to reduce the effects of the COVID outbreak.

These are the small steps towards the wider results of disease prevention. And without imbibing scientific temper we cannot fight a pandemic like COVID19.

Discussions and conclusion

Pandemics are rare and challenging events which affect the human life manifold. Many of the countries have to manage and mitigate the pandemic risk with the limited resources and capacities. The damage can be mitigated through prompt action and good coordination among various agencies and stakeholders at the government, institution, society and individual levels. In the lack of weak public participation and engagement, the risk of high spark and spread of disease infection is increased. Here scientific temper, logical thinking and the stuff of science communication boost the individual to fight the pandemic at the individual level. Government, health authorities and science communicators have the responsibility to enlighten the common man with right kind of scientific knowledge in a lucid and logical manner. In nutshell, we can say that the scientific temper is the light present in the mind of humans that removes the darkness of misinformation and makes them aware to help reduce the spread of pandemic like COVID19.

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DEDICATED TO THE MEMORY OF DR. PRADEEP K. BASU, FORMER DIRECTOR SSPL, DRDO, NEW DELHI GÖDEL'S PROOF

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Introduction

Most people have heard the Einstein's Theory of Relativity and Quantum Theory. Why are these theories special? Because they defy common sense. But there is another insight in human thought that is not so well known, which also defies common sense. It belongs to the field of mathematics. It is called Gödel's Incompleteness Theorem. During my visit to Baltimore this time, I requested my son, who happens to be a professor of mathematics, to explain to me, in a layman's language, what this epoch-making theorem was.

He did give me a birds eye view but suggested that it would be better if I went through the book "Gödel's Proof" written by Ernest Nagel, who was John Dewey Professor of Philosophy at Columbia University, and James R Newman, who was the author of 'What Is Science' and editor of 'The World of Mathematics', with a foreword by Douglas R Hofstadter, who is the College of Arts and Sciences' Professor of Computer Science and Cognitive Science at Indiana University and author of the Pulitzer Prize-winning 'Godel, Escher, Bach: an Eternal Golden Braid'. My son assured me that the authors had tried to explain Gödel's Proof to the lay person through this book and no special maths skills was required to understand it. Since I had long wanted to understand this theorem after I had read about it in Roger Penrose's book "Emperor's New Mind" and Hofstadter's famous book "Gödel, Escher, Bach" and wanted to get my teeth into it, if possible, I tried to go through the book.

The Greeks had discovered the 'axiomatic method' of proof which consists in accepting without proof certain propositions as axioms or postulates (like the axiom that through two points just one straight line can be drawn) and then deriving from the axioms all other propositions of the system as theorems. Euclidian geometry is an example of such a system. The question then arose, can all other branches of thought, other than geometry, be placed upon a secure axiomatic foundation? It was found possible to do it for the system of natural numbers 1,2,3....A climate of opinion was thus generated in which it was tacitly assumed that each sector of mathematical thought can be supplied with a set of axioms sufficient for developing systematically the endless totality of true propositions about the given area of enquiry.

Gödel's paper showed that this assumption is untenable. According to his theorem he showed that the axiomatic method has some inherent limitations, and what is more, he proved that it is impossible to establish the internal logical consistency of a very large class of deductive systems - number theory, for example - unless one adopts principles of reasoning so complex that their internal consistency is open to doubt, as that of the systems themselves, and no absolutely impeccable guarantee can be given that many significant branches of mathematical thought are entirely free of internal contradiction. One of Euclid's axioms was that through a point outside of a line only one parallel line can be drawn. Think-

ers had a reservation about this as the concept of asymptotic lines were known, which are lines that meet at infinity. Was there a way of showing that this axiom flowed from the other axioms of Euclid? After generations of mathematicians broke their heads on this, finally the impossibility of deducing the parallel line axiom from the other axioms was demonstrated. This was epoch making as for the first time this fact came to light that a proof can be given of the impossibility of proving certain proposition from the other axioms of a system. Godel's theorem is a proof of the impossibility of formally demonstrating certain important propositions in number theory.

In fact, new geometry was developed in which the parallel line axiom was replaced by the axiom that no parallel lines can be drawn. The traditional belief that axioms of any system can be established by their apparent self-evidence was undermined. Mathematics thus was thus the business of deriving theorems from the postulated assumptions. It was not the mathematician's concern whether the initial axioms are true or not or what the axioms or theorems represented. For example, in geometry we use the terms point, line etc. To us it has some common sense meaning but to the mathematicians these are primary assumptions, and he is not concerned whether they have any meaning in reality. Mathematics was completely formalised giving rise to new kind of algebras like vectors, tensors etc.

The abstractness of mathematics gave rise to a fundamental question of whether a given set of postulates is internally consistent i.e. no mutually contradictory theorems can be derived from the initial axioms. A general method for solving this issue was devised. The underlying idea is to find a model (or interpretation) for the abstract postulates of the system, so that each postulate of the system is converted into a true statement of the model. For example, for elliptic geometry, a model can be found embodying the postulates. Each elliptical postulate is then converted into a theorem of Euclid. And since Euclidian geometry is believed to satisfy the consistency test, elliptical geometry will satisfy the consistency test. Basically, it means that if Euclid's geometry is consistent then so is elliptical geometry. But is Euclid's geometry consistent?

Hilbert tried using Cartesian coordinate geometry

and Euclid's axioms were simply transformed into algebraic equations such as $y=mx+c$ for a straight line etc. But again, though a powerful technique, it is not "absolute" proof. The consistency of Euclidian geometry depended upon the consistency of Cartesian coordinate geometry. The trouble with both methods is that the consistency proof requires a model with infinite number of elements, leading to the possibility that, while till date theorem S and its converse S' are not derivable from the axioms of the system, there is no guarantee that somewhere in the future this may not arise. So, search was for a model which has a finite number of elements. Intuitively we think that for non-infinite models, consistency can be determined if the axioms of the system are transparently 'clear' and 'distinct'. But in certain areas of mathematical research, contradictions have risen even when the axioms appeared clear and distinct. Such contradictions, called "antimonies", have arisen in the theory of infinite numbers and it was seen that even the apparent clarity of such an elementary notion of 'class' (sets) does not guarantee the consistency of a system built on it.

Bertrand Russell developed a contradiction within the framework of elementary logic itself. It goes like this. Classes(sets) are of two kinds. Those that do not contain themselves as members (called 'normal' classes), and those that do (non-normal). Let 'N' be the class of precisely all normal classes. Is N a normal class? If N is normal, then it is a member of itself as by definition N is the class of all normal classes. But if N is a member of class of all normal classes, then by definition of non-normal classes it is a non-normal class. On the other hand, if N is non-normal then it is a member of itself by definition of non-normal; but in that case N is normal as N is a class of all normal classes. We come to a contradiction that N is both a normal and a non-normal class. More such contradictions came up before mathematicians and they realised that relying on system familiarity and intuitive clarity are not dependable pillars to rest on. Inherent limitations exist in models for establishing consistency.

Hilbert looked for a new approach in which establishing consistency of a system would not depend on establishing consistency of another system, or in other words, he was looking for "absolute" proof to establish consistency of a system. This was done by

draining the expressions occurring in a system of all meaning and treating them just as signs. These signs are to be manipulated through set of rules. The postulates and theorems of such a system would be 'strings' of signs. One may say a string is palindromic (same read forwards and backwards) or has two signs in common with another string or one string is made up of three others, and so on. Such statements about the strings may be meaningful and may convey important information about the system. But such meaningful statements about meaningless (or formalised) mathematical system plainly do not belong to that system. They belonged to what Hilbert called "meta-mathematics", to the language that is about mathematics. A few examples will help to understand this better. For example, $2 + 3 = 5$ belongs to mathematics but ' $2 + 3 = 5$ ' is an arithmetical formula but does not express an arithmetical fact and does not belong to the formal language of mathematics; it belongs to meta-mathematics. Other examples:

Example 1: If the sign '=' is to be used in a formula of arithmetic, the sign must be flanked both left and right by numerical expressions.

Example 2: the following formulas belong to mathematics

$$x=x$$

$$0=0$$

$$0\neq 0 \text{ (}\neq \text{ is not equal to)}$$

But the following belong to meta-mathematics:

- a) 'x' is a variable
- b) The formula ' $0=0$ ' is derivable by substituting numeral 0 for the variable x in the formula ' $x=x$ '
- c) ' $0\neq 0$ ' is not a theorem in formal system X

The formal system that mathematicians construct belongs to the file 'mathematics'; the description, discussion and theorising about the system belongs to meta-mathematics. Failure to recognise the distinction between mathematics and meta-mathematics has produced paradoxes and confusion. Hilbert based his 'absolute' proofs of consistency based on this distinction. It was the distinction between a formal calculus and its description that he based his attempts to build absolute proofs of consistency.

The analysis of a finite number of structural features of the expressions in completely formalised systems will lead to proof of consistency. The analysis consists in noting the basic signs, indicating how to combine them into formulas, prescribing how formulas can be obtained from other formulas, and determining whether formulas of a given kind are derivable from others through explicitly stated rules of operation. He believed that it was possible to show every mathematical calculus as a sort of "geometrical" pattern of formulas, in which the formulas stand to each other in a finite number of structural relations. He hoped to show that with these structural properties within the formulas of the system, contradictory formulas cannot be obtained from the axioms of the system. That means that the demonstration of consistency will involve only such procedures as would make no reference either to an infinite number of structural properties of formulas or to an infinite number of operations with formulas. Such procedures are called "finitistic"; and a proof of consistency conforming to this requirement is called "absolute". An "absolute" proof achieves its objectives by using a minimum of principles of inference and does not assume the consistency of some other axioms.

The game of chess is analogous to a formalised mathematical calculus. The pieces and the squares are the basic signs of the calculus; the legal position of the pieces on the board, to the formulas; the subsequent position of pieces on the board, to the formulas derived from the axioms (i.e. to the theorems); and the rules of the game, to the rules of inference (or derivation) for the calculus. Meta-chess statements would be, for example, given a position on the board, 'white mates in three moves' etc. General meta-chess theorems can be established whose proof involves only a finite number of permissible configurations on the board.

Thus, Hilbert's "absolute" proof basically depends on using the finite number of structures in meta-mathematics to demonstrate consistency of the calculus. Even when mathematical proofs are rigorous, they presume certain principles which are not explicitly stated and mathematicians are at times unaware of it. Take the logical principle, 'either p or non-p'. 'p' here is called a sentential variable. By using the 'Rule of Substitution of Sentential vari-

able' according to which a statement can be derived by substituting the statement for each occurrence of that variable, if for 'p' we substitute 'x is a prime', then it becomes 'either x is a prime or composite (i.e. not a prime)'. Another important development in mathematics was to exhibit pure mathematics as a chapter of formal logic. This was the attempt by Whitehead and Russell in their *Principia Mathematica*. This seemed to provide the final solution to the problem of consistency in mathematics if formal logic is shown to be consistent. Unfortunately, it did not provide this final answer. An example of absolute proof of consistency can be demonstrated for a small portion of *Principia*, the elementary logic of proposition. The sequence is as follows:

Every axiom of the system is a tautology. Tautologousness is a hereditary property. Every formula properly derived from the axioms (i.e. theorems) is also a tautology. Hence any formula which is not a tautology is not a theorem. One formula has been found (e.g. 'p \vee q') which is not a tautology. This formula is therefore not a theorem. But if the axioms were inconsistent, every formula would be a theorem. Therefore the axioms are consistent. Sentential calculus which means "elementary logic of proposition", is an example of a mathematical system for which the objectives of Hilbert's theory of proof are fully realised. But this is for only a fragment of formal logic. But is Hilbert's finitistic method powerful enough to prove the consistency of a system such as *Principia*? Many efforts were made but in 1932 Godel's Theorem showed that it is impossible to give a meta-mathematical proof of the consistency of a system comprehensive enough to contain the whole of arithmetic (such as *Principia Mathematica*). He showed that *Principia*, or any other system within arithmetic which can be developed, is incomplete. For example, Goldbach's conjecture - which states that every even number is the sum of two primes - and no deviation from this has been found as yet, is possibly non-derivable from the axioms of a formal system of number theory.

Consider "Richard's Paradox". We define 'x is Richardian' as a shorthand for stating 'x does not have the property designated by the defining expression with which 'x' is correlated in the serially ordered set of definitions. Consider a language (e.g. the English language) in which purely arithmetical prop-

erties of cardinal numbers can be formulated and defined. For example, we define a prime number by the sentence 'not divisible by any integer other than 1 and itself'. Let's order such sentences and give them numbers. Suppose for the sentence for prime above this number is 17. Note that 17 itself has the property of the defining sentence (17 is a prime). On the other hand, let the sentence 'the product of some integer by itself' have the order number 15. 15 does not have the property of the defining sentence. We define Richardian as the number that does not have the property of the defining sentence. Clearly, 15 is Richardian and 17 is non-Richardian. The defining expression for the property of being Richardian ostensibly describes a numerical property of integers. It follows that the expression is related to a position-fixing number or integer. Let this be n. We now pose the question: Is n Richardian? Now, n is Richardian, if and only if, n does not have the property designated by the defining expression with which n is correlated (i.e. it does not have the property of being Richardian). In short, n is Richardian, if and only if, n is not Richardian; so that n is Richardian' is both true and false. Paradox?

No, we cheated. The serial ordering of definitions was supposed to be only purely arithmetical properties of integers. But we accepted a definition in the series that involves reference to the language in formulating arithmetical properties. The construction nevertheless suggests that it may be possible to "map" or "mirror" meta-mathematical statements about a sufficiently formal system in the system itself. The exploitation of the notion of mapping is the key argument in Godel's famous paper.

Godel showed that meta-mathematical statements about a formalised arithmetical calculus can indeed be represented by arithmetical formulas within the calculus. The more devastating (for Hilbert, Whitehead, Russell school of thought mathematicians) outcome of his paper is that he devised a method of representation such that neither the arithmetical formula corresponding to a certain meta-mathematical statement, nor the arithmetical formula corresponding to the denial of the statement, is demonstrable within the calculus. Since one of these formulas must codify an arithmetical truth, yet neither is derivable from the axioms, the system is incomplete. Godel's paper is difficult. However, the authors have

tried in this book to give a flavour of its ascent and crowning glory. Gödel described a formalised calculus PM within which all customary arithmetical notations can be expressed, and familiar arithmetical relations established. The formulas are constructed out of a class of signs, a set of preliminary formulas (or axioms) as the starting point, and the theorems are formulas derivable from the axioms with the help of a carefully enumerated set of Transformation Rules (or rules of inference). Gödel first showed that it is possible to assign a unique number to each elementary sign, each formula, and each proof. This number, which acts as a distinctive tag or label, is called the “Gödel number” of the sign, formula, or proof.

The signs are also assigned the usual meanings. For example, the sign ‘V’ (Gödel number 2) stands for ‘or’; ‘=’ (Gödel number 5) stands for ‘equal to’; ‘s’ (Gödel number 7) for ‘the immediate successor of’ etc. If therefore we can derive theorems such as ‘ $0 + 0 = 0$ ’; ‘ $0 + s0 = s0$ ’; and ‘ $s0 + s0 = ss0$ ’ by following the rules of the formal system, we may start to gain confidence that ‘0’, ‘=’ and ‘+’ are acting as one would hope a symbol for zero, equality and addition would act respectively. Similarly, if ‘ $\sim(0 = s0)$ ’, ‘ $\sim\sim(0 = 0)$ ’ are theorems of the system, then we will gain some confidence in ‘ \sim ’ as a symbol whose natural interpretation is “not”. Gödel showed that there is an infinite class of theorems in the system, every one of which, if interpreted according to such table of usual meanings as explained above, expresses an arithmetical truth, and conversely, that there is an infinite class of arithmetical truths every one of which, if it is converted into a formal statement via the table, yields a theorem. This is called “Correspondence Lemma” today. One then sees how truth and meaning are inextricably intertwined.

There is a slightly deeper relevance of the “correspondence lemma” which is important for establishing the second incompleteness theorem. The correspondence lemma is used to show that the reasoning/proof of the first incompleteness theorem can be written down in the formal system of Principia Mathematica (because the reasoning is “finitistic” and the correspondence lemma shows any finitistic reasoning can be written down in Principia Mathematica). This idea is key to establishing the impossibility of a proof of consistency (using reasoning

that is not stronger than the methods of Principia Mathematica itself).

Gödel's system also has three kinds of variables:

Numeral variables ‘x’, ‘y’, ‘z’ etc. for which numerals (such as ‘ss0’) and numerical expressions (such as ‘ $xa = y$ ’) may be substituted;

Sentential variables ‘p’, ‘q’, ‘r’, for which formulas (sentences) may be substituted; and

Predicate variables ‘P’, ‘Q’, ‘R’ etc. for which predicates, such as “is prime”, or “is greater than” may be substituted.

These variables are also assigned Gödel numbers; with numeral variables a prime number greater than 12, with sentential variables square of a prime greater than 12, and with predicate variables cube of a prime number greater than 12. Then an expression is associated with a number which is the product of the first n prime numbers, each raised to the Gödel number of that sign, where n is the number of ‘signs’ in the formula. For example, the Gödel number for the formula ‘ $(0 + s0 = s0)$ ’ will be:

$$2^8 \times 3^6 \times 5^{11} \times 7^7 \times 11^5 \times 13^7 \times 17^6 \times 19^9$$

This way a Gödel number can be assigned to each sign and formula of the formal system. This results in completely “arithmetising” the formal calculus. The Gödel number of every expression can be calculated. Conversely, given a number we can determine whether it a Gödel number and find out the expression it represents. Then comes Gödel’s mind boggling insight. He showed that it can be shown that meta-mathematical statements about the structural properties of the expressions in a formal calculus can be accurately mirrored within the calculus itself, thus making meta-mathematics completely arithmetised.

“Arithmetisation of meta-mathematics” means that the typographical properties of long chains of symbols can be talked about in an indirect but perfectly accurate manner by instead talking about the properties of prime factorisations of large integers. True meta-mathematical assertions of the form “such-and-such demonstrates so-and-so by the rules of the system” are faithfully reflected in theorems of the

system. How Godel presented his arguments:

Step 1: Godel demonstrated how to construct a formula G of the system that represents the meta-mathematical statement: ‘The formula G is not demonstrable using the rules of the system’.

Step 2: Godel also showed that G is demonstrable if, and only if, its formal negation $\sim G$ is demonstrable.

Step 3: Then he showed that, though G is not formally demonstrable, it nevertheless is a true arithmetical formula.

Step 4: It is the realisation that since G is both true and formally undecidable (within the system), the system must be incomplete.

This ends Godel’s first ‘Incompleteness Theorem’. Godel did not stop here. His second ‘Incompleteness Theorem’ is more awe inspiring. As stated above, Godel showed how to construct a formula G of PM that represents the meta-mathematical statement ‘The formula G is not demonstrable using rules of PM’. He also showed how to construct formula A of PM that represents the meta-mathematical statement ‘PM is consistent’; and then he showed that the formula ‘If A then G ’ is formally demonstrable inside PM. This is one place where the correspondence lemma is needed, for example. The formal sentence ‘If A then G ’ states precisely the first incompleteness theorem. Since the reasoning of the first incompleteness theorem is ‘finitistic’, the correspondence lemma tells us that the formal statement corresponding to it is demonstrable in PM. Finally, he showed that the formula A is not demonstrable inside PM. More explicitly stated, if we can establish ‘ A ’ in PM, we have also arrived at ‘If A then G ’ in PM. Using the ‘modus ponens’ rule (law of implication) in PM, we have thus established ‘ G ’. But we have the metamathematical result that if PM is consistent, then we cannot establish ‘ G ’ within PM. Hence, we cannot establish ‘ A ’ in PM (our first assumption). Thus it follows that the consistency of PM cannot be established by any chain of logical reasoning that can be mirrored within the formal reasoning system that PM itself constitutes. We are in a zug-zwang like situation of a chess game ! We have to accept that if PM is consistent, its consistency cannot be established by any meta-mathematical reasoning that can be mirrored within PM itself or consistency cannot be established by finitistic methods that are a subset of PM.

Some of the conclusions below are the authors’ conclusions from Godel’s theorem. Many philosophers, mathematicians and computer scientists, however, do not agree with all of these inferences that the authors’ make:

- That the prospect of finding for every deductive system an absolute proof of consistency, is almost impossible.
- Godel does show that the proof of consistency of PM or equivalent systems cannot be established using arguments that can be formalized in the system.

Hence, any proof of consistency must use methods of proof which are stronger than the system that is being analysed, and hence the validity of such arguments are themselves under doubt. there are endless number of true arithmetical statements which cannot be formally deduced from any given set of axioms by a closed set of rules of inference:

- Apparently no machine can be built which can match the human brain as the machine will work on logical formal systems which, according to Godel’s theorem, is not able to ‘reach’ step by step, based on such formal system, the solution to each truth. Even the human brain may have such limitations, and there may be mathematical problems which it cannot solve.
- The brain appears to embody a structure of rules of operation which is more powerful than the structure of currently conceived artificial machines.
- Mathematical propositions which cannot be established by formal deduction from given set of axioms may, nevertheless, be established by informal meta-mathematical reasoning.
- The inherent limitations of calculating machines imply that we cannot hope to explain living matter and human reason in physical and chemical terms.

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BREAKING THE NUCLEAR JARGONS INTO DIALECTS: CONVERTING THE TECHNICAL LANGUAGE INTO COMMON MAN'S LANGUAGE

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Introduction

Communication is not a rocket science, but not less important either. In this highly competitive communication world, winning the hearts and minds of your target audience is a strenuous task. Today's common man is clogged with information. He is the ultimate target for every single science, technology, and business institution. Motor companies want them to know the better technology that their product by which they try to influence the buying decisions.

Pharmaceutical companies try to explain their drugs' chemical combination to the people and want them to understand how enhanced their drugs are than others. Climate scientists want the common man to understand how mankind is making irreversible harm to the environment and urge us to lead an eco-friendly life. The rocket and satellite agencies want the people on the earth to know their extraordinary scientific feat.

Besides, it is needless to say how the makers of Fast Moving Consumer Goods (FMCG) are targeting the common man to increase the sales of their products and to make a good business. Amidst these, communicating to the public about nuclear power generation and making them understand the science behind it is an eternal challenge.

It was a few years back, when I was a fresher in the nuclear industry, I told a reporter that the new reactor attained criticality last evening. Instantaneously, he asked me "how many workers are affected?" I

was taken aback upon hearing this. He thought that criticality was something crucially urgent or something wrong happened. Something like, "a bus met with an accident and 15 people are affected".

The word "criticality" may be a common parlance of the nuclear community, but it surely is an alien term for the common men. When you say that "in the nuclear reactor the effective multiplication factor of neutrons that is the Keff is equal to one which refers to the critical condition of the reactor", a layperson will certainly feel dizzy. Instead, tell him that "the continual splitting of the atom has begun in the nuclear reactor, and this process is called criticality, means the reactor has become functional", you will get your point across.

Criticality, fission chain reaction, radiological emergency, and many more such technical jargons that revolve around in the nuclear industry make the public sick of such a jargonized language. Before communicating, a communicator who is into nuclear familiarization needs to think in the way his audience thinks. He needs to match the frequency of a common man. Moreover, the message is to be as much simple as possible and should be jargons-free.

There are ample ways to communicate about nuclear energy: One-to-one interaction, awareness lecture to a group, through mass media, like print, radio and TV, use of social media, etc. We may have to use all of them to reach out to the different classes of our target groups.

Post-Fukushima, public concerns about nuclear energy grew multifold and almost all the nuclear establishments in this world faced a fresh round of challenge. But some projects were badly affected. One of them was the Kudankulam Nuclear Power Project (KKNPP) of India's Nuclear Power Corporation. The public staged a prolonged protest against the usage of nuclear energy and KKNPP. As a consequence, the project was stalled for about eight months even before the plant began its operation.

It was then realized that public communication is as crucial as power generation itself. A special public outreach programme was set up and a dedicated team of communicators was formed to address the concerns of the public about nuclear power and to dispel their speculative apprehensions. It took so long to make the people aware of how nuclear power is generated and the complex technology behind it. Slowly, public confidence was built, and they began to believe that nuclear power plant was not to harm the people and the environment but to benefit the humankind.

In about one decade of experience, the communication team of KKNPP evolved tailor-made communication methodologies to reach out to the desired audience effectively. Here are some ways to communicate the complex nuclear science to common men that yielded good results:

Interesting analogies

One of the frequently asked questions faced by the Indian nuclear community is when the nuclear power reactor is going to blast like a bomb? One can simply reply that the fuel in the nuclear power contains only a few percent of fissile material whereas the fuel in a nuclear bomb requires more than 90% of fissile content. Perhaps none of our target people might have seen a nuclear bomb or fuel for a nuclear power reactor. So, when we talk about the fissile content of nuclear fuel, it is really hard to catch on. And you can't show them one, either. A hard task, really.

Yet, we can make them understand the difference of both by drawing inferences using analogies. A hard-to-understand technical stuff can be compared with simple objects that are familiar to the audience.

For the above scientific explanation of nuclear fuels, we may take matchstick and firecracker for comparison. Here is the analogy: "Both the matchstick and firecracker are fire related things. All of us use them. But there are two major differences between them. One, control. When you ignite a matchstick you have a complete control over the action - you can light a lamp or blow it off. On the contrary, the moment you ignite a cracker you lose control over the action - it may explode or otherwise, but the control is not in your hands.

Two, the kind and amount of chemicals. The amount of chemicals used in a firecracker is several times more than that of the matchstick, and the kind of chemical used in firecracker is superior. Same is the case with the fuel used in a nuclear power reactor and a nuclear bomb. In a nuclear power reactor, the process of splitting of atom is totally a controlled action, whereas in a nuclear bomb it is uncontrolled. Secondly, the fissionable content in the fuel of a nuclear power reactor is far less than that of the nuclear bomb.

Analogies help people comprehend with the unfamiliar technical subject by drawing inferences from the things that are already familiar with.

Seeing is believing in most cases

Human imagination capability has limitations. It is difficult to make one visualize something with verbal communication alone. If the matter is of science, especially the intricate nuclear science, it is even more difficult to secure the message in the minds of the audience. Instead of asking them to see things in their mind's eye, it is better to show them once. Because, in most cases seeing is believing. That is why the "visit KKNPP" initiative has been started. People, students, policymakers, villagers and many other class of public are taken inside the Kudankulam Nuclear Power Plant and provide them a chance to glimpse at how nuclear power is produced.

In this everyday ritual, people get firsthand information about nuclear basics and get a chance to see the reactor building, turbine building and other auxiliary units. A briefing about nuclear power generation and the safety features followed by a field visit actually help the audience understand the concept

easily. Certainly, it is an effective way of public understanding of nuclear science.

The telling testimonials

Nuclear power is environment friendly. True. But how many of them really buy this idea? When just statements are made, probably there won't be any takers of it. That is why, to substantiate the fact that in nuclear power generation no obnoxious gases are released, you need to have strong testimonials. At Nuclear Power Corporation of India, the voluntary Environment Stewardship Programme (ESP) renders testimonials on how nature and nuclear technology can go hand in hand.

Through ESP, many scientific studies on birds, butterflies, plants, and other forms of life are being done. From time to time, the findings of these studies are published in the form of articles, booklets, and photographic books. These reports are endorsed or technically vetted by respective experts in the field of natural history. Such reports strengthen the fact that nuclear power is environmentally benign.

NPCIL has so far published four coffee-table books based on the studies of biodiversity in and around its sites, the recent being "Fliers of our courtyards - a book on some birds of Indian nuclear power plant sites".

Once there were only negative headlines about nuclear power and KKNPP in the local media, but due to persistent and concentrated efforts, there came a turnaround in the way of reporting nuclear information. The biased news stories turned out to be balanced ones. Today a reporter before publishing a story on nuclear does a fact checking with us. And nowadays many positive headlines on nuclear and KKNPP are appearing, as a contrast to earlier days of public ignorance.

It is easy to create a brand image or to position a product, but, restoring the image of a brand or organization is quite challenging. Secondly, the technology is too complex to understand for a common man. Therefore, communication should be very simple, using plain language preferably in the language of the receivers that makes a big difference.

PROF. DINESH KUMAR: A HIGHER VERSION OF HIMSELF

Prof. Dinesh Kumar, a well-known biologist and Former Head, Dept. of Botany, Lucknow University left behind him a legacy of numerous students and scholars with a blend of science and communication, as he also served as the Director, Institute of Mass Communication in Science & Technology, Lucknow University and conducted a course leading to M.Sc. Tech. Mass Communication in Science & Technology at the University, supported by NCSTC, DST for over 2 decades.

Prof Kumar had been admitted to a Noida hospital after testing positive a few days ago there after he left for his heavenly abode on 13 December 2020, he was 73. He had retired from Lucknow University in 2010 and was living in the NCR since then with his son. He did his M.Sc. from Lucknow University in 1969 and Ph.D. in 1974 before joining the Punjab University. He came back to Lucknow University as a teacher in 1977 and taught there for 33 years till his retirement in 2010.

A devoted researcher and academician, he supervised 24 Ph.Ds and published large number of papers in international journals. He also held various administrative positions in the university. Apart from being a brilliant botanist, he was a cheerful person, full of positive vibes, and smiling. Prof Kumar is survived by his wife and two sons, who are based in Noida and Gurugram.

He had been actively associated with the Indian Science Communication Congress (ISCC), when it was first organized in Vigyan Bhavan, Lucknow in 2001. Since then, he not only en-



couraged his students in botany and science communication to take part and present papers on different aspects of science communication, but also helped them carry out research, develop research papers and prepare power point presentations for the annual ISCCs organized in different parts of the country.

He used to bring large contingents of scholars and a few teachers with him with high quality research papers, some of them won the best paper awards at ISCCs. In addition, he also guided the project works, dissertations, and research theses as part of university's MSc Tech and PhDs Mass Communication in Science & Technology.

He was fondly remembered at condolence meeting organized by Lucknow University Retired Teachers' Association. He was an extremely lively person and a dedicated academician.

In the year 2006, he was the Proctor when a group of rowdy students had attacked his residence, but he didn't give up and continued with his administrative role. He was a brilliant teacher, a good administrator, and a finest human being. He would be remembered for his excellent work and good deeds as he was a highly evolved version of his own self.

A PHYSICIST WHO LIVED AN AGE OF SCIENCE LEADERSHIP AND POLICY

Prof. Shri Krishna Joshi, one of the best science leaders and condensed matter physicist of this country left to his heavenly abode on 15 May 2020. Through his academic journey from Allahabad University to National Physical Laboratory, he contributed to the research work in different fields and bagged many prestigious awards. Prof. Joshi was born on 06 June 1935 in a small village of Anarpha in Kumaun, Uttarakhand. After his schooling through tough terrains of Himalayas, he obtained his B.Sc. and M.Sc. degrees in first class from Allahabad University. Prof. Joshi pursued his research work in measurement of diffuse X-ray scattering from organic crystals for his doctoral degree with K. Banerjee and received his Ph.D. degree in 1962 from Allahabad University.

Later in 1965, he worked for two years as Visiting Lecturer in University of California, Riverside, USA. Thereafter he returned India and joined as Professor of Physics at University of Roorkee (now IIT Roorkee) and worked there till 1986, when he was appointed as the Director of National Physical Laboratory (CSIR-NPL), New Delhi and worked there till 1991. His expertise in the lattice vibrations made it easy for him to take the research activities of high temperature superconductors at CSIR-NPL. He proposed a new variational method for the periodic Anderson model to study the ground state behavior of heavy fermions and estimated the c-axis resistivity of high temperature superconductors.

CSIR-NPL also started work on nanotechnology under his guidance. He investigated transport of electrons in mesoscopic systems, particularly, the conductance of a single quantum dot and a double quantum dot system. Apart from being an outstanding scientist, he was a visionary leader as well. To attract research scholars to NPL, he got a hostel built for them. For his distinguished contributions in science, Government of India honoured him with Padma Shri in 1991. He was then given the responsibility to the position of the Director General of the



Council for Scientific & Industrial Research (CSIR), and Secretary, Department of Scientific & Industrial Research (DSIR), Government of India, New Delhi for 1991- 1995. After 1995, he stayed at CSIR-NPL and continued as Scientist of Eminence.

Prof. Joshi was an academic leader in many ways. He served the nation and played a crucial role in establishing new institutes of higher learning, i.e. IISER, NISER, new IITs, etc. He guided leading institutions of the country through the Chairmanship of their apex Boards, including IIT Roorkee, Institute of Mathematical Sciences, Chennai, Institute of Physics, Bhubaneswar, Indian Association for Cultivation of Science, Kolkata, Recruitment Assessment Center (RAC DRDO), Recruitment Assessment Board (RAB CSIR), Visvesvaraya National Institute of Technology (VNIT Nagpur), Inter-University Accelerator Centre (IUAC), UGC-DAE, Indore, etc. He also served as a member of the Scientific Advisory Committee to Government of India, and as Chairman of selection committees to select Directors and Vice Chancellors of many prestigious Institutes and Universities. For his contributions, in 2003 he was honoured by Padma Bhushan, the third-highest civilian award in the Republic of India.

- Padma Shri (1991)
- Padma Bhushan (2003)
- Watumull Memorial Prize (1965)
- Shanti Swarup Bhatnagar Prize for Physical Sciences (1974)
- CSIR Silver Jubilee Award in (1973)

- Meghnad Saha Award for Research in Theoretical Sciences (1974)
- Dr. K.S. Krishnan Memorial Lectureship of INSA (1987)
- FICCI Award in Physical Sciences (1990)
- Dr. Mahendra Lal Sircar Prize by IACS Calcutta for 1989 (in 1994)
- Goyal Prize in Physics by Goyal Foundation (1993)
- CV Raman Medal of INSA (1999)
- Kamal Kumari National Award (2011)

Prof. Joshi also served as the Chairman of the 3rd Review Group for the Programmes and Activities of the National Council for Science & Technology Communication, Dept. of Science & Technology, Govt. of India. I was the Member Secretary of the 3rd Review Group. The Group worked for several months in 2001-2002 and had several rounds of meetings and interactions, the final report was submitted to Prof. V.S. Ramamurthy, then Secretary, DST in May 2002.



Prof. S.K. Joshi presents Report of 3rd NCSTC's Review Group to Prof. V.S. Ramamurthy, Secretary DST, May 2002

It was an opportunity to work closely with such a stalwart of Indian science like Prof. Joshi during the review and preparation of final report. It required me to visit him at NPL several times. Once I was getting down from auto-rickshaw (as office vehicle was unavailable) and he was just entering the gate of the NPL building and saw me. It was an afternoon in May 2002 when temperature in Delhi goes up to 44-45. I met him and had discussion as usual and came back. On the day of final submission of the Report of the Review Group Prof. Joshi smilingly

asked Secretary DST, pointing towards me, "Prof. Ramamurthy, do you know him?", "Yes, I know, he is Patairiya", Prof. Ramamurthy replied. Again, Prof. Joshi asked him, "Prof. Ramamurthy, do you know this boy came to me several times and by auto-rickshaw at a temperature of 44-45 degree for the work?" Prof. Ramamurthy said, "No, I didn't know that. I knew Manoj is doing great in science communication."



3rd NCSTC's Review Group led by Prof. S.K. Joshi meets Prof. V.S. Ramamurthy, Secretary, DST, May 2002

It shows his minute observation and careful appreciation of the hard work. It was quite a learning and understanding experience while working on the review and putting together the report, organizing meetings, preparation of agenda papers and minutes, etc.

Prof. Joshi became approachable and friendly since then and we benefitted from this long association in terms of inviting him to various conferences, seminars, and meetings, etc., and he always blessed us with his gracious presence and loving support.

Prof. Joshi also served as Chairman of the Research Council, the highest body of a CSIR Lab/ Institute, of the National Institute of Science Communication and Information Resources (CSIR-NISCAIR), New Delhi, during my tenure as the Director, CSIR-NISCAIR, 2016-2019. In addition of Research Council Meetings, we had number of occasions of interactions and fruitful exchanges of views and ideas on promotion of science and communication.

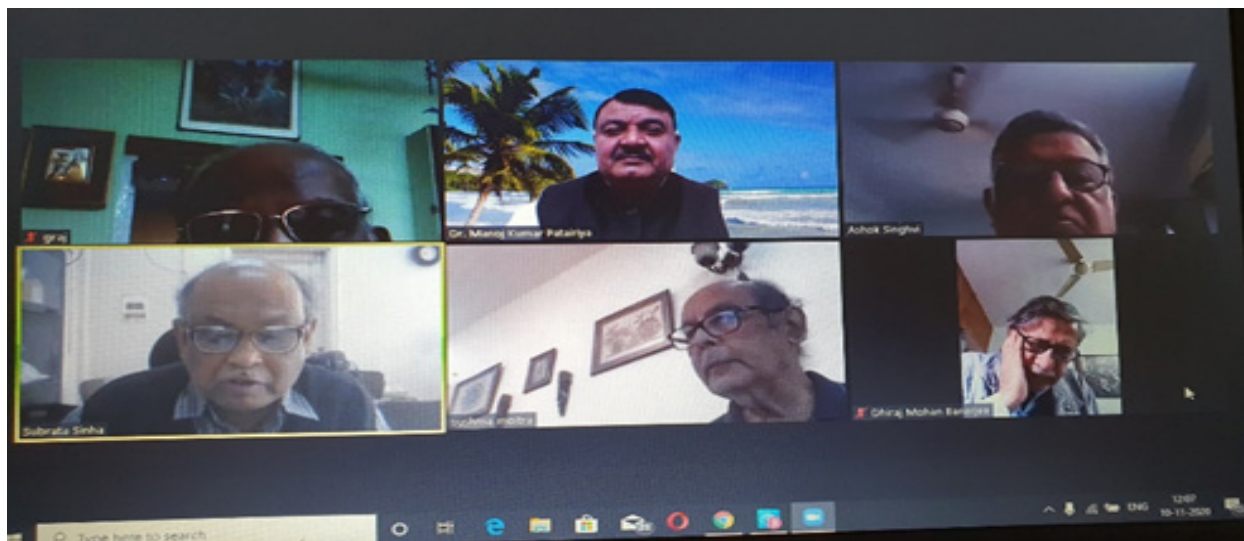
[Dr. Manoj Kumar Patairiya, NCSTC, DST, New Delhi-110016]

EDITOR IJSC BAGS INSA AWARD FOR SCIENCE POPULARIZATION 2020

Indira Gandhi Prize for Popularization of Science for 2020 was announced by the Indian National Science Academy (INSA) during its Anniversary General Meeting held on 16-18 December 2019 at Goa. Dr. Manoj Kumar Patairiya, Editor, IJSC, and Adviser, NCSTC, DST has been awarded the Indira Gandhi Prize for Popularization of Science for 2020 under the category of science popularization efforts in English language by a career media personnel.

The INSA award was conferred on Dr. Patairiya in a programme held online on 10 November 2020 on the World Science Day. INSA President Dr. Chandrima Saha, INSA NCR Chapter Convener Dr. Subrat Sinha, and various INSA Fellows graced the occasion. The award carries a cash prize of Rs. 25,000, a bronze medal and citation.

ence, observing science, and appreciating science, and creating scientific awareness in the society and nurturing scientific temper. The creative potential of young people may support science communication for social inclusion. The newer areas, such as science centres and cities may look for newer ways and means using emerging technologies for attracting one and all to know science and practice a scientific temper. Conceptualizing new and innovative themes for centres and galleries of general interest, such as science of social dynamics, science of sports, science of wars, understanding weather, climate, disasters, etc., in addition to traditional attractions would be an advantage for larger inclusion. The children must be encouraged to think in an innovative manner towards problem solving and creating new ideas and concepts for the exhibits, activities, and working models, etc.



Dr. Patairiya also delivered the INSA Award Lecture on “Science Communication for Social Inclusion” as part of his acceptance of the recognition. He said, “the effective and popular science communication and outreach programmes are supplementing knowledge through non-formal modes of science education, promoting hands-on experience of doing sci-

The major objectives of social inclusion can be summarized: to enhance engagement of students and common population with science and impress upon them the significance of science and technology for betterment of their life quality; to disseminate scientific information for an informed and knowledgeable society; to promote the spirit of enquiry,

observation, learning, analysis and logical thinking so that it contributes towards their own social and economic development and problem solving at the local level; to sensitize them to issues and challenges related to sustainable development; to encourage the youth, particularly school students, to pursue higher studies and also a career in pure sciences, applied sciences and in emerging disciplines.

Mass media is a powerful vehicle to popularize science and develop clear understanding about difficult scientific concepts as well as developing scientific temper, especially for those with limited access. Special initiatives are also called for rural areas by means of rapid and precise delivery of science messages. The National Council for Science & Technology Communication and Vigyan Prasara are the two arms of the Department of Science & Technology engaged in a variety of science communication programmes and activities.

India Science, an OTT based online 24x7 channel offers an opportunity to demonstrate the best of science, technology, and innovation. AWSAR, Augmenting Writing Skills for Articulating Research scheme encourages doctoral and postdoctoral researchers to write popular stories on their research. National Children's Science Congress, and National

Teachers' Science Conference engage 2.5 lakh children every year with the method of science to encourage them to take science for higher studies and research as a career. IRIS: Initiative for Research & Innovation in STEMM is yet another programme



that infuses and recognizes the spirit of innovation amongst children. Science communication not only offers a wide range of programmes and activities of two-way communication to involve various cross sections of the society but also it offers social connect through traditional means such as folk arts, folklore, and folk media, as well as modern technology including digital and social media, films, virtual reality, and augmented reality, etc., for a wider social inclusion". A lively interaction followed.

INSA Indira Gandhi Prize for Popularization of Science is an opportunity offered by the National Science Academy (INSA) to writers, editors, journalists, lecturers, radio or TV programme directors, science photographers, or illustrators.

The award was instituted by INSA in 1986 to encourage and recognize the popularization of science in the country. The prize will be awarded once in three years for outstanding work done by an individual for the popularization of science in any Indian language, including English.

The Citation reads as, "Dr. Patariya has evolved a robust science popularization ecosystem through his original and innovative initiatives in science popularization. The President, Indian National Science Academy is pleased to honour Prof. Dr. Manoj Kumar Patariya for his unique and outstanding contributions for promotion of science popularization".

COMMUNICATING ENVIRONMENTAL SCIENCES OBSERVED IN THE VEDAS

Dr. Vedprakash Borkar

Assistant Professor, Hindi
Rashtriya Sanskrit University, Tirupati

For the holistic study of a synthetic subject like environmental science, holistic study and knowledge of the entire nature is necessary. From this point of view, abundant and authentic principles are available in Vedic literature.

The love for nature contained in Vedic literature is an emotional expression of conscious awareness towards the importance and conservation of nature. Vedas are a beacon of light and source of strength for mankind. Vedas have the credit for giving cultural knowledge to the world.

Today, Earth Summits being held at the global level, World Environment Conferences, and other forums, such as Kyoto Protocol, Nuclear Weapons Non-Proliferation Treaty, ecological curriculum, and environmental education are some of the efforts being made to overcome these ill effects and prevent future destruction.

The ideas contained in the Vedic hymns seen by the Siddha Yogis of the inner world can become a guide for the modern science developed based on systematic laboratory characterizing of the idea, including the Vedic thinking of environmental science in the form of environmental protection and natural balance.

Vedic sages connected human life with the world of nature by developing Tapovans in dense forests, educating celibates in ashrams



The author meets Dr. APJ Abdul Kalam earlier as a student

and worshipping natural elements like sun, water, river, and air, etc., as divine elements. Many principles like Vedic era polytheism, nature worship, interrelationship between man and nature, Rita Anrit system, Yagya institution and Tapovan culture illuminate and express environmental science.

Despite achieving all these proud achievements like huge scientific progress, unlimited industrial development, invention of innumerable devices and abundant knowledge of every element of the environment, today, surrounded by serious environmental disasters, man has been forced to reconsider the direction of development and science.

To achieve this desired goal, we will have to look at the environmental thinking of the Vedas.

PRIME MINISTER SHRI NARENDRA MODI INAUGURATES IISF-2020

Prime Minister Shri Narendra Modi in his inaugural address of India International Science Festival (IISF-2020) on 22 DEC 2020 said, “India has data, demography, demand, democracy to achieve world class scientific solutions; we want our scientific community to share and grow with the best of global talent. The Prime Minister gives a call to the global community to invest in Indian talent and innovate in India.

The IISF-2020 got off to a grand start with the inaugural address by the Prime Minister, Shri Narendra Modi in the presence of Minister of Science & Technology, Earth Sciences and Health & Family Welfare, Dr Harsh Vardhan. This year’s festival was organised in a virtual mode during 22-25 December 2020 with the theme ‘Science for Self-Reliant India and Global Welfare’. Addressing on the occasion on virtual mode, the Prime Minister said that this Festival is a celebration of science and added that India has a rich legacy in science, technology, and innovation. Our scientists have done path breaking research. Our tech industry is at the forefront of solving global problems. But India wants to do more. We look at the past with pride but want an even better future, Shri Modi said.



The Prime Minister said all our efforts are aimed at making India the most trustworthy for scientific learning. At the same time, we want our scientific community to share and grow with the best of global talent. One of the steps taken to achieve this is hosting and participating in hackathons to provide exposure and opportunity to Indian scientists. The Prime Minister asserted that the New National Education Policy (NEP-2020) will help foster scientific temper from an early age. He said now focus has shifted from outlays to outcome, from textbooks to research and application. The Policy will encourage creation of a pool of top-quality teachers. This approach will help the budding scientists. This is being supplemented by Atal Innovation Mission and Atal Tinkering labs, he said.

For quality research, the government is running Prime Minister Research Fellows Scheme to encourage the best talent of the country to undertake research as per talent and interest. The Prime Minister informed that the scheme is helping scientists in the top institutes. He emphasized the importance of bringing the benefits of science and technology to all. He said that Science and Technology are bridging the gap of scarcity. It is connecting the poorest of the poor with the government. With digital advances, India is becoming a centre of evolution and revolution of global high-tech power, the Prime Minister added.

The Prime Minister stressed that the biggest challenge facing science now, may be a vaccine for COVID pandemic. But the biggest long term challenge science faces are to attract high quality youngsters and retain them. He further added what is called science today, becomes

the technology of tomorrow and an engineering solution later. He said for attracting good talent into our science domain, the government has announced scholarships at various levels. But it needs a big outreach from within the science community as well. He said the excitement surrounding Chandrayaan Mission was great starting point to evince interest from youngsters. He said Science brings out the best within the person and uses the power of difference. He lauded our scientists for keeping India ahead and in a better position in the fight against Corona. Dr. Vijay P. Bhatkar, National President, VIBHA, lauded the efforts scientists across the country and congratulated large number of science enthusiasts who were present to hear the inaugural address by the Prime Minister.

IISF 2020 is organized jointly by Council of Scientific and Industrial Research (CSIR), Department of Science and Technology (DST),



Department of Biotechnology (DBT), Indian Council of Medical Research (ICMR), and Ministry of Earth Sciences, in association with Vijnana Bharati. The nodal institution for science festival this year is CSIR-National Institute of Science, Technology & Development Studies (NISTADS), New Delhi

The Union Minister for Science & Technology, Earth Sciences and Health & Family Welfare, Dr. Harsh Vardhan made an announcement at a review meeting held in New Delhi earlier. He said that besides promoting love and passion for science among young people and students

by bringing science outside the labs, IISF 2020 must also reflect on the role of Indian Scientists and S&T innovations for not just Atmanirbhar Bharat but global welfare also. The first and second IISFs were held in New Delhi, the third in Chennai, fourth in Lucknow, and fifth IISF was held in Kolkata, all these IISFs have generated immense response from people within India and from abroad, and the 6th IISF in the series would mark a grand impact amongst masses in the days to come, he said.

Watching Solar Eclipse



The National Council for Science & Technology Communication (NCSTC), Department of Science & Technology (DST) in association with Vigyan Prasar organized watching of Solar Eclipse live with solar filter spectacles on 21 June 2020 Sunday in the campus of the department. Children, women, scientists, and other officials and staff members enjoyed watching the spectacular celestial event and experienced the thrill of being able to witness the phenomenon of light and shadow that causes an eclipse. Specially designed goggles made of metallic mylar film were provided to the individual viewers produced earlier by NCSTC and Vigyan Prasar. The phenomenon of an eclipse was narrated to the viewers in popular form and photographs of the eclipsing sun taken by using mylar film.

In Delhi, solar eclipse became visible at 10:19:58 in the morning and continued till 01:48:40 in the afternoon. The maximum coverage of the solar disc was seen at 12:01:40 mid-day. With a little



cloudy weather, Delhi witnessed the entire sequence of partial eclipse as mostly it remained a sunny day. The annular ring, also known as the Ring of Fire, was visible from parts of Rajasthan, Haryana, and Uttarakhand, including some northern parts of the country, whereas other parts on the belt of eclipse have witnessed a partial eclipse. Incidentally, June 21 also marks the longest day of the year in the northern hemisphere and offers easy viewing of the celestial event. This rare kind of solar eclipse also coincides with the summer solstice, the first day of summer. An eclipse, solar or lunar, offers an opportunity for scientists to carry out various scientific experiments and studies. For science communicators, it is a chance to make people aware of the science behind spectacular celestial show as well as to remove various myths and misbeliefs associated with the eclipses and promote scientific temper.



A rare celestial event, annular solar eclipse, popularly called as ring of fire eclipse was visible on Sunday. The first solar eclipse of the year took place on the summer solstice, which is the

longest day in the Northern Hemisphere. While people living along the path annular eclipse passing through Anupgarh, Suratgarh, Sirsa, Jakhal, Kurukshetra, Yamunanagar, Dehradun, Tapowan and Joshimath could see the annular phase, people in rest of India witnessed a partial eclipse.



When Moon comes between the Sun and Earth, the shadow falls on the surface of the Earth. The Sun is entirely covered by the Moon for a brief period. Those places that are engulfed by the dark, dense umbral shadow of the Moon experience the total solar eclipse. In the regions that plunge into the soft diffused penumbral shadow of the Moon experience the partial eclipse. In all, solar eclipse of the Sun, Moon and Earth may not be perfectly aligned, and then we only have a partial eclipse. When the three celestial bodies happen to be in a straight line, we have a Total Solar Eclipse.

One may recall that when the Total Solar Eclipse occurred on 16 February 1980, the situation was altogether different from today's scenario. Most of the people had opted to remain inside their houses to safeguard themselves from so-called ill effects of the eclipse. Except a few science enthusiasts, roads were empty; schools, markets, and many other establishments were closed with the fear of the unknown! Thereafter, another Total Solar Eclipse was visible in India on 24 October 1995 and NCSTC took the lead to organize series of awareness programmes across the country by involving children, teachers, science communication organizations, scientists, and common people at large that involving them in safe viewing of the eclipse with the help of mylar film goggles.

The situation started changing with such concerted efforts, and subsequent total solar eclipses have witnessed a sea change in the mindset of the people at large. This time people preferred to come out and experience the excitement of watching the solar eclipse live, although by following social distancing and precautionary measures. Several autonomous institutions of DST like Aryabhata Research Institute of Observational Sciences (ARIES), Nainital, Indian Institute of Astrophysics (IIA), Bangalore, and Vigyan Prasar captured the eclipse from different locations and organized live streaming via Zoom, YouTube, and Facebook connecting thousands of people.

Webinar on Popular Science Writing

The National Council for Science & Technology Communication (NCSTC) and Vigyan Prasar, organised two webinars on “Popular Science Writing” for capacity building of research scholars under Augmenting Writing Skills for Articulating Research (AWSAR) programme to create a brigade of science communicators in June 2020.

Scholars from 28 States and Union Territories across the country and from 12 other countries USA, Germany, United Kingdom, and Israel, etc., were introduced to the importance of communicating science, writing popular articles from research and to tips and techniques of popular science writing.



Dr. Manoj Patariya, Head NCSTC, DST and Dr B.K. Tyagi, Scientist F, Vigyan Prasar addressed the audience and shared tips on science communication. The webinars received huge response with a total 1282 registered participants from India and abroad.

“Writing of a popular science story based on one’s research does wonders in enhancing our own understanding of how the deep and narrow of my knowledge relates to the broader questions of science and the needs of society. I have found that if I can explain my research to people across ages and educational backgrounds in a manner that engenders understanding, appreciation, and even some excitement, then I have understood the many dimensions of the problem better myself” said Prof Ashutosh Sharma, Secretary, DST.

“In Conversation With” interaction series with thought leaders

The series was inaugurated by Dr. Harsh Vardhan, Minister of Science and Technology on 28 August 2020. He was in conversation with Prof. Ashutosh Sharma, Secretary, DST. It was the first conversation of the series, streamed live on Science Policy Forum YouTube Channel. In the context of India’s 5th National Science, Technology, and Innovation policy (STIP-2020), the Office of the Principal Scientific Adviser to the Government of India and the Department of Science and Technology have initiated a decentralized, bottom-up, and inclusive process for the formulation of a new science policy.

To make the policy true to its essence, the initiative of “In Conversation With” - a series of exclusive interactions with thought leaders from across the country to share their ideas and vision for the policy and the Science, Technology, and Innovation Ecosystem, at large.

The fifth S&T policy of India is being formu-

Science, Technology and Innovation Policy 2020

In Conversation with
DR HARSH VARDHAN

August 28, 2020
03:00 PM

Event Highlights

- Inauguration of "In conversation with..." series under STIP 2020 public consultations
- Launch of STIP 2020 Page on Mygov.in portal

Prof. Ashutosh Sharma
Secretary, Department of Science and Technology

Reach Out Using
#ChatWithDrHarshVardhan

Live On: SCIENCE POLICY FORUM

#STIP2020

For more details visit: <https://bit.ly/32mMx3Y>

lated at a crucial juncture when India and the world are tackling the COVID19 pandemic. This is only the latest among the many important changes in the past decade that have necessitated formulation of a new outlook and strategy for Science, Technology, and Innovation. As the crisis changes the world, the new policy with its decentralized manner of formation will reorient STI in terms of priorities, sectoral focus, the way research is done, and technologies are developed and deployed for larger socio-economic welfare.

The Science, Technology, and Innovation Policy (STIP-2020) has been presented jointly by the Office of PSA and DST as India and the world reorient in the wake of the COVID19 crisis. The new policy is expected to be released

soon replacing the existing policy, which was formulated in 2013. The STIP 2020 formulation process is organised into 4 highly interlinked tracks:

Track I involves an extensive public and expert consultation process through Science Policy Forum, a dedicated platform for soliciting inputs from larger public and expert pool during and after the policy drafting process. Track II comprises experts-driven thematic consultations to feed evidence-informed recommendations into the policy drafting process. Twenty one (21) focused thematic groups have been constituted for this purpose.

Track III involves consultations with Ministries and States, Track III nodal officers are nominated in States and in Ministries, Departments and Agencies of Government of India for extensive intra-state and intra-department consultation.

Track IV constitutes apex level multi-stakeholder consultation with institutional leadership, industry bodies, global partners and inter-ministerial and inter-state consultations represented at the highest levels.

The consultation processes on different tracks have already started and are running in parallel. The six-month process involves broad-based consultations with all stakeholders within and beyond the scientific ecosystem of the country –including academia, industry, government, global partners, young scientists and technologists, civic bodies, and public.

A COLLECTIVE OF SCIENCE, ART, SATIRE, AND LITERATURE FOR EFFECTIVE COMMUNICATION

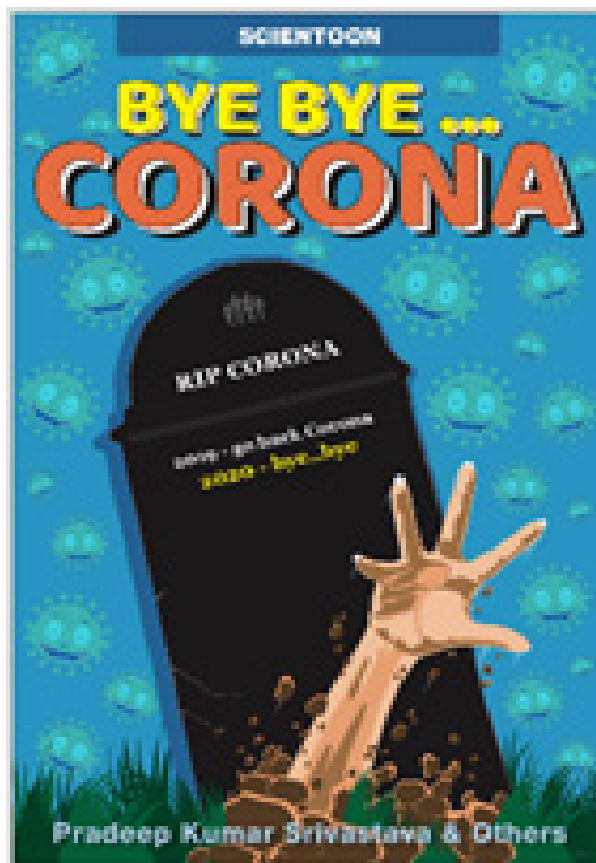
SCIENTOON: Bye Bye Corona
 By Pradeep K. Srivastava & others
 Chief Editor Dr. Nakul Parashar; Editor Nimish Kapoor
 Published by Vigyan Prasar, A-50, Sector 62, Noida-201301
 First Edition 2020
 ISBN: 978-81-7480-332-0

It is said that a picture is worth a thousand words. Cartoon is a combination of caricature and satire. When a cartoon is drawn on a science subject, it is called science cartoon. Sci-entoon is a new class of science cartoons that not only makes you laugh but also provides information about new research and concepts in a simple, understandable, and interesting manner.

The present book tries to present complex scientific information on SARS-CoV-2 in a lucid manner that can be easily comprehended by common people. Hopefully, this would ensure propagation of right information, dispel myths and rumours, and inform people to follow safety protocols to save themselves and the community at large.

Scientific research and education are facing a challenge to connect to the masses and reach to the society for larger societal good. Quite often, science is taught in a way which is too technical, less interesting, and sometimes even boring. Educationists are expressing their concerns as more and more students are opting for lucrative career options in business, commerce, and information technology.

This is not a very healthy trend as no country can progress without development in science



and innovation. Increasingly, scientific research is becoming interdisciplinary and multidisciplinary where experts from diverse backgrounds work together. Communication in such circumstances, becomes even more challenging.

Sci-entoonics is a new branch of science, which deals with effective science communication using a novel class of science cartoons called scientoons. They have been recognized and appreciated all over the world by several international organizations including WHO, UNESCO, UNEP, Royal Swedish Academy, International Union of Pure and Applied Chemistry, Amer-

ican Chemical Society, Junior Chamber International (USA), DECHEMA, Germany and by NCSTC (DST, Government of India), CSIR, Indian Science Congress Association and many more. European Science Festival 2008 held during July 18-22, 2008, at Barcelona, Spain, organized a full session on Scientoonics (www.esof2008.org).

This Scientoon-based audiovisual technique is more useful when a scientific programme on higher education or mass awareness is undertaken on subjects like environment, biodiversity, conservation, nanotechnology, DNA and human genome, AIDS awareness, and AI, etc.

Since such programmes involve experts from different disciplines communicating different subjects, Scientoon adds the humour with a sense of internalization the subject in a much entertaining and seamless manner.

I am extremely grateful to all who contributed to this book and worked hard to make the concept interesting, informative, and useful. This booklet is an attempt to show that how common man can be made aware about SARS-CoV-2 infection or COVID19 disease with the help of colourful, interesting, and eye-catching Scientoons. Since there is no drug or vaccine to cure COVID-19 till now, making people aware is the only way to save them from this disease. Awareness is the best tool for prevention, which in turn is the best way to save us from this pandemic.

The scientoon book has come in a crucial time of COVID19 pandemic and would be immensely useful for all cross sections of the audiences. It carries a lot of information in the form of scientoons and would help people understand how to avoid the risk of the coronavirus and save them from the ill effects of the pandemic.

NATIONAL HEALTH & RISK COMMUNICATION PROGRAMME: YEAR OF AWARENESS ON SCIENCE & HEALTH (YASH), 2020-2021

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The National Council for Science & Technology Communication (NCSTC) being the apex body of the Govt. of India as part of the Dept. of Science & Technology has a mandate of evolving policy initiatives, implementation mechanisms and extending support for promoting science communication and scientific temper among masses in the country. In view of COVID19 pandemic and emerging threats to human life such as earthquakes, landslides, extreme weather events and other risks posed by different uncertainties in today's scenario, the NCSTC has taken initiative to put together a National Health & Risk Communication Programme - Year of Awareness on Science & Health (YASH) to combat such risks and mitigate the crises with the help of public awareness and preparedness. The programme also intends to empower and enable people to take informed decisions, especially when it comes to conflicting choices to reach a better solution to the crises! A National Organizing Committee has been formed to steer and implement the YASH programme at the national level. Communication of associated risks through effective science popularisation for promoting community-level response will help translation and usage of authentic scientific and health information and facilitate crisis management. Several activities on



health and risk communication as part of YASH programme are pouring in. Some 3000 volunteers trained under different NCSTC projects across the country on health and hygiene and water and sanitation are contributing to health and risk communication in their respective areas by following social distancing measures.

Dr. Harsh Vardhan, S&T and Health Minister releases COVID Katha



Dr. Harsh Vardhan, S&T and Health Minister releases COVID Katha, a multimedia guide on A to Z of COVID19. It provides authentic information in an interesting and interactive manner for the masses and can reach through smart mobile phones at the grass-root level. NCSTC

in association with the Gujarat Council of Science & Technology (GUJCOST), has organized a Citizen's Science Webinar Series on 'Science Communication and Awareness in the Time of COVID-19' during 10-16 May 2020 everyday between 10-11 a.m. The webinars were accessible online through the internet. Over 3000 active participants joined through video conferencing from across the country and interacted with the experts from different walks of disciplines. The webinars address the ways of tackling the current pandemic by applying various methods and means, an urgent need of the hour. It will develop awareness and preparedness to deal with and address current health crisis posed by COVID-19 to help overcome the situation.

Dr. Manoj Kumar Patariya, Head & Adviser, NCSTC making presentation on YASH

To facilitate necessary actions and preparedness of the society to address the challenge, such strategies to reach out to society with the necessary



information by involving various stakeholders, including students, academics, media, and volunteers, and so on, would be an advantage. DST releases information brochure on Health & Risk Communication Programme Focusing on COVID-19 on 08 May 2020. A logo on YASH has also been developed and released. Special communication modules are developed depending upon especially marked zones. The National Council for Science & Technology Communication (NCSTC), Department of Science & Technology (DST) has launched programme on Health & Risk Communication 'Year of Awareness on Science & Health (YASH) with focus

on COVID19'. The brochure carries information on the genesis and need of such a mega programme in the country to address the issues of risks, crises, disasters, and uncertainties especially posed by the COVID19 pandemic. The programme focuses on enhancing public understanding and awareness on science and health for better preparedness to cope up with the present and future challenges. Prof. Ashutosh Sharma, Secretary, Dept. of Science & Technology said that a wide array of programmes and activities built around awareness and outreach have been envisaged involving print, electronic, digital, folk, and interactive media to reach out to large cross-sections of the society under the campaign. He added that the logo of the YASH programme given on the brochure has been designed to create a wave of peace and bliss and depicts a sense of overcoming the situation at large and would act as a harbinger of taking forward the messages of science, health, risk, and awareness.

In view of providing authentic information in an interesting and interactive manner at the grass-root level, a comprehensive National Health & Risk Communication Programme has been planned and being implemented in a big way with a mechanism of PAN India presence and reach. State Councils of Science & Technology have been involved. The three major ingredients of the programme include software and content development, capacity development, and dissemination and outreach with feedback mechanism. The activities are spread over six regions, East, West, North, South, Central and Northeast. Special communication modules are developed depending upon especially marked zones, and networking and training of communicators and volunteers for activities related to community health would be an advantage. The current scenario of the pandemic caused by COVID19 has posed concerns and challenges all around where scientific awareness and health preparedness can play a significant role to help combat the situation with translation and



usage of authentic scientific information and to convey the risks involved and facilitate the communities to overcome the situation. The information brochure highlights a comprehensive and effective science and health communication effort for promoting grass-root level appreciation and response on health and saving and shaping the lives of people at large, as well as building confidence, inculcating scientific temper, and promoting health consciousness among them. The brochure can be downloaded from www.dst.gov.in Preventive and proactive health and risk communication is the strategic mantra especially during public health emergencies like the current one. Much before the outbreak was declared as a public health emergency, India has been much ahead in implementing actions targeting core capacities, including augmenting healthcare systems, promoting breakthrough research, measures of social distancing and public awareness using a novel concept of ringtone messages of do's and don'ts on cell and telephones, amongst others. Since the onset of pan-

dem, India has taken leadership and assisted neighbouring and other countries in multiple ways. As our scientists and doctors are exploring new and innovative measures to minimize the risk and new solutions are going to be a tremendous support to our unified efforts towards mitigating COVID-19 pandemic. Effective science and health communication at mass scale with necessary health awareness will provide further reinforcement to these efforts. Finally, the COVID-19 also teaches us why investments in communication and education, research and healthcare including promotion of scientific temper are most crucial for the nations and societies! Refraining from over exploitation of natural resources, cutthroat competition to reap more profit, and heavier consumerism should be the doctrine for the future and a balanced approach is a must for overall wellbeing of mankind.



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