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COVID 19 pandemic: Its impact on forensics and new normal practice

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Abstract

In December, 2019, novel corona virus 2019-nCoV or SARS- CoV-2 or COVID 19 was reported in Wuhan city of China. Expenditious transmissibility, extremely virulent nature and acute pathogenicity, World Health Organization declared as a public health emergency of international concern on 30th January 2020. During the pandemic era crime and illicit economies such as organized criminal activities, domestic violence, terrorism, street crime, online crime, illegal markets and smuggling, human and wildlife trafficking, slavery, robberies and burglaries increased in the exponential manner. It was established that the viral particles remain on various surfaces 3 to 5 days, this long lasting persistence of viral particles are serious concern to public health. Since, forensic investigators as well as police personnel directly deal with the crime exhibits, which impose serious concern to their lives. In this report, we explore the impact of COVID 19 pandemic on forensic and new normal practice.

Keywords: COVID 19; World Health Organization; Pandemic; forensic; Law enforcement agencies

1. Introduction

COVID 19, which also referred to as novel corona virus (2019-nCoV) or Severe Acute Respiratory Syndrome coronavirus-2 (SARS- CoV-2), has been created the global pandemic and pause the world. The SARS- CoV-2 or COVID 19 originated from Wuhan city of China in December, 2019. This novel virus first described as 2019-nCoV and World Health Organization (WHO) renamed it COVID 19 and due to an exponential increase of confirmed COVID patients WHO declared it, a public health emergency of international concern on 30th January 2020 (1). After this declaration of international public health emergency, a pandemic situation was created across the world and all the countries focused their total attention to this critical condition to break the chain of spreading of this virus by adopting various safety measures and formulated the safety guidelines at the national level along with awareness and educating the people.

Globally, as of 11:08am CEST, 20 May 2021, there have been 164,409,804 confirmed cases of COVID-19, including 3,409,220 deaths, reported to WHO. As of 18 May 2021, a total of 1,407,945,776 vaccine doses have been administered (<https://COVID19.who.int/>). Across the globe, the United State of America (USA) has the highest number of COVID 19 cases and deaths, i.e., 32,676,954 and 581,717 respectively. India is the second most populated country aligned with diversified populations residing in urban and rural areas of the country (2), (3). The total number of COVID 19 confirmed cases and deaths i.e. 25,772,470 and 287,122 respectively, (The COVID 19 data were taken from WHO website as on 11:08am CEST, 20 May 2021; <https://COVID19.who.int/table>). As on 20th May 2021, COVID19 cases spread trends in the country are shown in figure 1.

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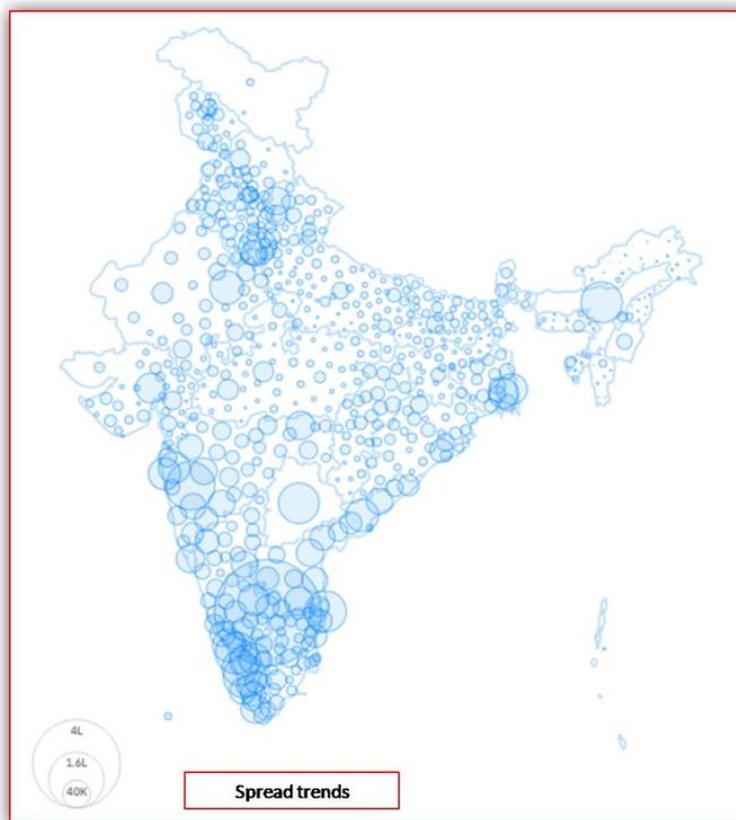


Figure 1 COVID19 cases spread trends in India as on 20th May 2021

2. Overview of virus

In 1892, Dmitri Ivanovsky's(4) has been described a non-bacterial pathogen infecting tobacco plants which was later on discovered as the tobacco mosaic virus (TMV) by Martinus Beijerinck in 1898 (5). Viruses are the smallest among all the microorganisms, can only replicate within the host cell and showed pathogenicity. They are made up of genetic core material, either DNA or RNA that encode the structure of the proteins by which the virus acts; protein coat or capsid which protect the genetic material surrounded by a protective proteinaceous layer called 'Capsid'; Sometimes, there is a presence of spikes of lipid or glycoprotein on the coat called 'Envelope'. A Virion consists of the nucleic acid and protein layer. They encode 4 – 200 proteins(6).

2.1. Origin history of Corona Virus

The name 'Corona virus' derived from the Latin word corona means 'crown' discovered by June Almeida and David Tyrrell (7). This virus can infect the gastrointestinal, hepatic, respiratory and central nervous system of humans, birds, mouse, livestock, bat and many other wild animals(8). The emission of the Severe Acute Respiratory Syndrome (SARS) in 2002/2003 has indicated the possibility of transmission from animal-to-human and human-to-human.

2.2. Mode of transmission

The novel COVID-19, sporadically transmitting virus among the humans through the respiratory tract via liquid droplets during coughing, sneezing, loud speaking, spitting out, and close contact in the environment with high aerosol concentrations. Direct and indirect contact of infectious agents or surfaces to the mucous membranes of nose, mouth, and eyes are the most common entry route of COVID-19 into the body(9), (10). Recent studies showed that the digestive tract is also a potential route of COVID-19(11).

2.3. Interaction Corona virus and Host cell

The glycoprotein spikes of a corona virus bind with the human Angiotensin Converting Enzyme 2 (ACE2) receptor (10-20 times more affinity than the SARS-CoV spike proteins which is the cause of high transmission rates), the virus enters

the host cell through endocytosis or direct fusion of the envelope with the membrane of the host. The RNA genome gets attached to the host cell's ribosome for the process of translation. It translates the beginning of ORF (Open Reading Frame) and forms a long polyprotein which has its protease to cleave polyprotein into multiple non-structural proteins (NSP) [14]. SARS-CoV-2 replicates in the host cell and undertakes the host cell regulation, which causes severe triggering of immune response resulting in hypercytokinaemia and pulmonary tissue damage and ultimately reflected into Acute Respiratory Distress Syndrome (ARDS) and multiple organ failure (12), (13), (14), (15). In the COVID 19 infection immune system weakened by decreased and /or functionally exhausted total T cells, Cluster Differentiation T cells 4 (CD4), and Cluster Differentiation T cells 8(CD8) (16).

2.4. Symptoms and diagnostic methods of COVID 19

Symptoms of Coronavirus disease are classified as Common symptoms (Fever, dry cough, Tiredness, Pneumonia); Less common symptoms (aches and pain, sore throat, diarrhea, nausea, vomiting, conjunctivitis, headache, loss of taste and/or smell, skin rashes, discoloration of fingers and toes); and Serious symptoms (difficulty in breathing, chest pain, loss of speech and chill).

In the country, the Indian Council of Medical Research (ICMR) and National Institute of Virology (NIV) jointly formulated a standard operating procedure (SOP) for the detection of novel corona virus 2019-nCoV in suspected person using the rRT-PCR assay. In this assay TaqMan fluorogenic probe-based chemistry that uses the 5' nuclease activity of Taq DNA polymerase and enables the detection of specific PCR as it accumulates during PCR cycle. ORF 1b, RdRp gene assay, E gene Assay, and N gene assay have been recommended by ICMR- NIV. Primers and probes used for E gene and RNasePassay (<https://www.who.int/health-topics/coronavirus/laboratorydiagnostics-for-novel-coronavirus>). However there are most commonly five diagnostic methods are as follows:

- Molecular Assay (RT-PCR Test) - A Direct Method
- Serological Test (Antibody Test) - An Indirect Method
- Antigen Detection test
- Isothermal amplification assays and
- Medical imaging

3. Impact of COVID 19 on the forensic practice

Forensic science plays the significant role in crime investigation, which works at crime scene, in the laboratory, at training institutes or educational institutes. It has been established that the novel corona virus rapidly transmits through liquid droplets spread during coughing, sneezing, and loud speaking, spitting which supports the airborne transmission(17). The viral particles found in body fluids, viscera of COVID19 positive individuals; and long-lasting persistence of viral particles on various surfaces are the serious concern for forensic community, police, and legal system. In this pandemic situation, many forensic science laboratories as being remain fully functional and have significant role in the criminal investigation system with the inception of crime to the conviction of criminals in the court of law, along with several challenges. The inevitable challenges for the forensic fraternity from the scientific investigation at the scene of a crime, laboratory examination and testimony in the court of law, that need to be addressed to adopt best practices with the self-protection from the novel viral infection as well as deal with the qualitative forensic examination of evidential materials(17),(18), (19).

3.1. Sample collection and transport to the forensic laboratory

At the scene of crime, scientific evidential material might be subjected to novel viral infection due to COVID 19 infected victim, suspect, or other related individuals. The biological fluid, i.e. blood, semen, saliva, tissues, and other evidential exhibits found at the scene of a crime, might be prone to novel viral infection, leads the risk of direct infection to the forensic experts (17). Therefore, forensic experts must follow the safety guidelines formulated by the national level and must wear the Personal Protective Equipment (PPE) kit, i.e. standard mask, gloves, face shield, body cover (full sleeve gown). The evidential exhibits must be collected according to standard procedure formulated by the laboratory; additionally, the sealed packet must be externally covered in the water-resistant outer covering to sanitize the packet at every stage of handling.

Similarly, the samples are taken during the medico-legal examination of the victim and suspect of sexual assault cases, during post-mortem examination, etc., the sample must be collected according to standard procedure, sealed with additional outer water resistant surface to sanitize the samples at every handling stage. If the victim, suspects, and deceased have been confirmed of SARS-CoV-2 infection, then their samples must be labeled properly and sealed in such

a way to sanitize the outer surface every step of handling. Our laboratory has passed a guideline for the samples forwarded to the laboratory, in which it is stated that the forwarding letter along with other relevant letter must be packed in the sterilized zip-lock polybag, and its outer surface should be sanitized before sending to the laboratory and should be sanitized again at the time of receiving. The samples must be carried with the special messenger with PPE kits and sanitized before at every handling step. A competent authority should issue a certificate of proper sanitization of the samples before sending to the laboratory. This will lead an effective step to reduce the risk factor of this novel viral infection in the forensic community during this pandemic situation.

3.2. Laboratory Examination of the COVID 19 suspected samples

WHO recommended that every sample to be analyzed in the laboratory and collected during this pandemic must be considered as a potential source of infection? This assumption must be followed at the time of forensic examination of the evidential exhibits, and the laboratory should be followed in a Biosafety level 2 laboratory working conditions, and all the laboratory personnel must treat their work at a high risk of infection.

The case opening room of the laboratory must be disinfected with extensive care. The biosafety cabinet II must be used for opening the case and all the downstream examinations. This practice leads to a low risk of air born transmission of the SARS-CoV-2 virus. Before the examination, preprocessing steps should be adopted in the examination, in which the sample must be handled with extra care, and before opening the packets sanitization of the outer surface of the packets must be assured. After the sampling for examination, the remnants of the samples must be discarded by following the recommendations of the Biosafety level 2 laboratory. Before the pandemic situation, the forensic samples were examined at the standard laboratory open benches without the use of special protective equipments. To prevent the cross infection among the laboratory personnel, social distancing at least 2 yards must be maintained and must follow the guideline formulated by the WHO, national, and state level.

After the examination of forensic exhibits sealed properly additionally water resistance outer cover and sanitized before sending to the concerned authority. The report must be sealed properly and kept in a zip-lock polybag, sanitized before sending it to the competent authority.

It has been established that long period wearing of PPE kits create various problems, such as discomfort, the heat, loss of normal sense of smell, loss of tactile sensation, difficulties in hand movements, impaired visibility, stress, anxiety, and problems in verbal communication (18). Keeping these challenges in the minds, the rotational duties for short duration must be followed by the administration in this pandemic situation. The laboratory work should be categorized into various groups and work responsibility must be under taken according to the COVID 19 infection risk factors. The laboratory personnel who are above the age of 50 years or low immunity person and the pregnant women must be kept away from the high-risk zone. All the laboratory personnel must maintain proper social distance at least 2 yards and follow the guidelines formulated by WHO, National level, and State level. By rotational way crime scene must be an investigation along with extended care of handling the high-risk articles.

4. Suggested safety guidelines for forensic practice

- Formation of a central advisory body to cope up with the challenges during this pandemic.
- COVID testing of victim or deceased should be done prior to handing over the exhibits for forensic DNA examination.
- Examination of received dried evidence samples (clothes, weapon of offence, vaginal slide, vaginal swab, pubic hair etc.) can be delayed for a period of few weeks at room temperature to avoid any chance of further spread till any further report on survival of COVID virus comes out.
- At least referral sample collection and transport should be delayed till the generation of DNA profile from the evidence material.
- The evidence material should be transported in a covering which can be removed at the laboratory at the time of receiving of evidence.
- The opening and processing of case exhibits must be done following Biosafety Level 2 (BSL2) laboratory recommendations.
- Safety norms for the working DNA analysts should be framed and executed.
- Regular sanitization of whole laboratory twice should be practiced.
- Specific guideline for disposal of used consumables should be framed.

5. Conclusion

To prevent the spread of the novel SARS-CoV-2 virus, we must strictly follow the safety guidelines and use of PPE kit during the handling of infection-prone exhibits or sites. Routine forensic laboratories should extend their laboratory condition according to the Biosafety Level 2 (BSL2) laboratory. Rotational working conditions will lead to reducing the chance of risk factors for infection. This article will be helpful for the forensic community as well as other law enforcement agencies to understand the infectious nature, pathogenicity, rapid transmission, and challenges that arise during this pandemic situation and safety measures to be adopted during a forensic investigation.

Compliance with ethical standards

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Disclosure of conflict of interest

Authors declared that they have no conflict of interest.

References

- [1] Sun J, He W-T, Wang L, Lai A, Ji X, Zhai X, et al. COVID-19: epidemiology, evolution, and cross-disciplinary perspectives. *Trends Mol Med*. 2020.
- [2] Tamang R, Thangaraj K. Genomic view on the peopling of India. *Investig Genet*. 2012;3(1):20.
- [3] Basu A, Mukherjee N, Roy S, Sengupta S, Banerjee S, Chakraborty M, et al. Ethnic India: a genomic view, with special reference to peopling and structure. *Genome Res*. 2003;13(10):2277–90.
- [4] Ivanowski D. Ueber die mosaikkrankheit der tabakspflanze. *St Petersburg Acad Imp Sci Bul*. 1892;35:67–70.
- [5] Beijerinck MW. On a Contagium vivum fluidum causing the Spotted disease of the Tobacco-leaves. *K Ned Akad van Wet Proc Ser B Phys Sci*. 1898;1:170–6.
- [6] Lai MMC, Cavanagh D. The molecular biology of coronaviruses. *Adv Virus Res*. 1997;48:1–100.
- [7] Tyrrell DAJ, Fielder M. *Cold wars: the fight against the common cold*. Oxford University Press, USA. 2002.
- [8] Chan-Yeung M, Xu RH. SARS: Epidemiology. *Respirology*. 2003; 8: S9–S14.
- [9] Lu C, Liu X, Jia Z. 2019-nCoV transmission through the ocular surface must not be ignored. *Lancet (London, England)*. 2020;395(10224):e39.
- [10] Xia J, Tong J, Liu M, Shen Y, Guo D. Evaluation of coronavirus in tears and conjunctival secretions of patients with SARS-CoV-2 infection. *J Med Virol*. 2020;92(6):589–94.
- [11] Zhang H, Kang Z, Gong H, Xu D, Wang J, Li Z, et al. The digestive system is a potential route of 2019-nCoV infection: a bioinformatics analysis based on single-cell transcriptomes. *BioRxiv*. 2020.
- [12] Villar J, Zhang H, Slutsky AS. Lung repair and regeneration in ARDS: role of PECAM1 and Wnt signaling. *Chest*. 2019;155(3):587–94.
- [13] Channappanavar R, Perlman S. Pathogenic human coronavirus infections: causes and consequences of cytokine storm and immunopathology. In: *Seminars in immunopathology*. Springer. 2017; 529–39.
- [14] Wang H, Ma S. The cytokine storm and factors determining the sequence and severity of organ dysfunction in multiple organ dysfunction syndrome. *Am J Emerg Med*. 2008;26(6):711–5.
- [15] Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet*. 2020;395(10223):507–13.
- [16] Diao B, Wang C, Tan Y, Chen X, Liu Y, Ning L, et al. Reduction and functional exhaustion of T cells in patients with coronavirus disease 2019 (COVID-19). *Front Immunol*. 2020;11:827.
- [17] De Ungria MCA. Forensic DNA testing during the SARS-CoV-2 pandemic. *Forensic Sci Int Genet*. 2020;102346.

- [18] Vidua RK, Chouksey VK, Bhargava DC, Kumar J. Problems arising from PPE when worn for long periods. *Med Leg J.* 2020;0025817220935880.
- [19] Hanley B, Lucas SB, Youd E, Swift B, Osborn M. Autopsy in suspected COVID-19 cases. *J Clin Pathol.* 2020; 73(5): 239–42.