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General Perspectives for Management of Animal Facilities during Pandemics or Similar Crisis: A Review

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ABSTRACT

The coronavirus disease 2019 (COVID-19) pandemic has brought to light a glaring issue faced by the research laboratories housing and experimenting on animals. As humans become more empathetic towards the welfare of animals, regulatory and ethical considerations surrounding the experimentation carried out on them has now become a major responsibility of these organizations and facilities. They need to ensure that animal wellbeing is not compromised at any time. To warrant this, especially in epidemics, a contingency plan needs to be put in place. In government organizations, the authorities from the top to the individual personnel working at the various facilities need to work hand-in-hand to allow these plans to be executed well. The plans, tediously put together, include risk assessment, mitigation of the risk as well as recovering from the adversity. Emphasizing on the underlying responsibilities of the government, the institutions and the facilities, which include various approvals, online meetings, transport of essentials goods, personnel trainings, stocking up essentials, *etc.* is essential. The disaster management plan for epidemics that provides guidelines on how to cope up with the situation during crisis, recuperate and restart the routine activities once things resume as per normal would be highly useful. This would secure animal care, welfare as well as the interests of the researchers working on these animals. This review article aims to describe a disaster management plan for handling similar situation if arise in future.

Key words: Animal Ethics, Animal Welfare, COVID-19, Crisis, Pandemic.

The World Health Organization defines a pandemic as, 'an epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people (Kelly, 2011). This means that once an epidemic cross the borders and spreads to other countries, it is termed as a pandemic. The stark discrepancy in the definition is that it only considers the impact of the epidemic on human beings. However, in the wake of the most recent pandemic, plaguing the world under the name of coronavirus disease 2019 (acronym COVID-19), it has become blatantly obvious that animals housed and maintained for the various purposes including animals for research testing and food were equally affected, albeit in a different sense. Novel coronavirus or severe acute respiratory syndrome coronavirus (SARC-CoV-2) caused a worldwide health issue that developed serious coronavirus disease 2019 (Sofi *et al*., 2020).

The strain of Coronavirus dubbed as SARS-CoV-2, which originated in Wuhan brought the world to a screeching halt (Zhu *et al.* 2019; Li *et al.* 2020; WHO, 2020; Wu *et al.* 2020; Singhal *et al.* 2020). The governments of various countries imposed nation-wide lockdowns. As 2019 drew to an end, cases of severe acute respiratory syndrome coronavirus (SARS-CoV-2)-linked pneumonia were reported in Wuhan, the capital of central China's Hubei province (Wang *et al.* 2020; Zhou *et al.* 2020). Epidemiologically, this initial group was associated to a wholesale market selling seafood in Wuhan (WMHC, 2020; Xiao *et al.*, 2021), however, 41 of these cases had no previous link to this market. A retrospective study suggests that the first-ever case of the now dubbed Coronavirus Disease (COVID-19) was reported on December 8, 2019 (Wu, *et al.*, 2020). SARS-CoV-2 was declared as a public health emergency of international concern by the World Health Organization on 30th January 2020 (Mullen *et al.*, 2020). More than 82,000 confirmed cases were reported worldwide as of 27th February 2020. With its ability to cause severe health concerns and have a high rate of transmission (Fig 1), WHO declared the Novel Coronavirus outbreak as a global pandemic in March 2020 (Cucinotta and Vanelli, 2020).

Amidst the chaos, where people were busy stock-piling toilet paper and ration, in the scientific community, researchers, especially research fellows had their hearts in their mouths as the supply chain of not only lab animals, but also the manpower, feed and bedding and consumables was about to be ceased. The researchers were also in an ethical tussle as they foresaw the possibility of euthanizing their beloved, mute test subjects. This was coupled by the premature notion of the possibility of the virus being able to spread by animals. Later however, it was proven that the risk of catching the disease from an infected animal is negligible when compared to getting infected from an ill

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person (Mallapaty, 2020). The amalgamation of all this meant that the future for existing laboratory animals looked bleak.

Panic euthanasia and mishandling of animals during disasters or crises is not an uncommon practice. Examples can be drawn from the various epidemics that have happened in the past. During the Ebola epidemic of 2013, a dog belonging to a healthcare worker in Spain who had contracted EBOV was euthanized in the name of public interest and obligation (Vet Rec, 2014). The Spanish authorities justified this act by implying that it was not possible to test the dog for the infection due to the lack of Biosafety level 4 (BSL4) facilities needed to quarantine the animal and train the personnel to handle it. However, when a similar case was reported in Dallas, the dog was quarantined after being tested. This proved that euthanasia was an extreme step which could have been prevented if the proper facilities were made available (Gumusova *et al.*, 2015).

Scenario during the Covid-19 pandemic

As of February 02 2021, 419 mink farms, 81 dogs, 27 captive big cats, 115 cats, 3 gorillas in captivity, 1 domestic ferret and 1 wild mink have been found infected with SARS-CoV-2 (American Veterinary Medical Association, 2021). Non-human primates and carnivores were reported to be the most susceptible to SARS-coronavirus and SARS-CoV-2, respectively, whereas the dromedary camel was susceptible to MERS-coronavirus (Gautam *et al.* 2020). The investigation of 29 dogs and 10 cats companioned with 21 infected patients revealed nine dogs (31%) and four cats (40%) from 10 (47.6%) households infected with or seropositive for SARS-CoV-2 (Calvet *et al.* 2021). Infection in various non-human primates clinically manifested with a fever and quite, mildly labored breathing in aged animals (Smits *et al.* 2010). As per World Health Organization's description general symptoms of COVID-19 infection in humans include fatigue, cough and breathing problems such as shortness of breath. Critical cases of COVID-19 infection may result in pneumonia, renal failure and even death (Swelum *et al.*, 2020). At the Max Delbrück Center for Molecular Medicine (MDC) situated in Germany, 1500 young mice and rats had to be euthanized because of the issues posed by the pandemic (Johri, 2020). Most mice and rats used for experimentation are expected to be in a specific age range. The animals at the time were too young to be experimented on and by the time the researchers would be able to carry out the experiments, they would have been too old, rendering the animals virtually useless.

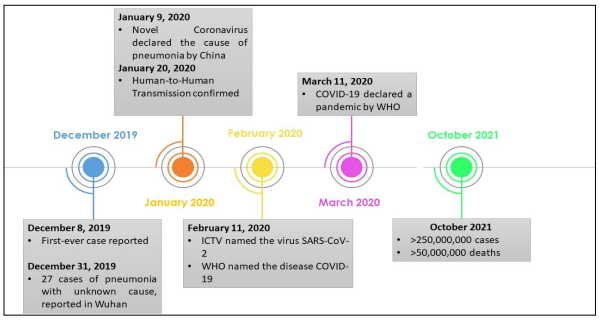

Fig 1: First reporting and spreading of COVID-19 Pandemic across the globe.

At the University of Pennsylvania Perelman School of Medicine, Sunny Shin, a microbial immunologist was helpless when she had to euthanize more than 75% of her research animals specially acquired European and Asian varieties of rodents (Grimm, 2020). It had taken them an absolute age to acquire and breed these animals as they required specific genotypes to study the response of the immune system to foreign invaders. Shin described the situation as "scientifically and emotionally heart-breaking". From the above scenario, it would seem like the possibility of protecting and preserving laboratory animals from their eventual fate is bleak. However, even in the state of emergency, a few institutes and centers rose to the occasion to set an example on how to ethically deal with the situation.

Andreas Lengeling, the animal research and welfare officer at the Max Planck Society, was responsible for 65 species of animals housed at the various institutes under the Max Planck Society. He noted that they reacted early in enforcing their emergency plans, saving the animals (Johri, 2020).

Two herpetologists, Vivian Páez and Brian Bock, at the University of Antioquia in Columbia were about to hatch 100 temperature-sensitive turtle eggs at their university. In order to save these eggs by the difficulties faced during the imminent lockdown, they moved the eggs to their garage, hustling an environment suitable to hatch the eggs (Nowogrodzki, 2020).

In these testing times, there have also been instances where the institutes were already well equipped and continued animal care as per normal (Thorat and Ingle, 2020). In another instance, take the University of Washington in Seattle as an example. They staggered the break and lunch schedules of staff and are even working on animals to develop potential COVID-19 treatments (Nowogrodzki, 2020).

Emergency response to ensure animal care and welfare

Disasters such as pandemics and wars, especially ones capable of bringing the world to a halt are not a one-time thing. With rampant mutations, the pathogens evolve and endanger the lives of not only humans, but the existence of life on this planet In order to avoid chaos and provide the personnel and animals the best of care, a disaster management plan sounds like an absolute necessity (Thorat and Ingle, 2020, Kohale, 2020). Institutional Animal Care and Use Committee (IACUC) has mandated the Institutions receiving federal funds, under the Public Health Services policy to have a disaster management committee and plan in place before hand, the animal welfare authorities round the world should also take notice and include disaster management, planning and mitigation in their set of rules and regulations (Pullium, 2020).The plan should seamlessly introduce a channel of communication between institutions at various authoritative levels to ensure an indefectible

corridor of services towards arrangement of manpower, feeds and other consumable materials to either minimize or avoid suffering of the animals. Immediately after the announcement of first lockdown from 24th March 2020 for 21 days by Indian Prime minister, the animal facility in-charge at TIFR brought the crisis to the notice of authority. The arrangement of accommodation for the animal care personnel were made in the campus. This arrangement has helped tremendously to avoid travelling of animal care personnel from long distance and availability of manpower to take care of live animals maintained in the facility during entire pandemic period.

Approvals by the apex authority

During the times of state or national emergencies, the government is at the apex of planning the various strategies for disasters management. With the announcement of first ever lockdown by central government in India, movement of the public and goods transport was severely affected. This step not only disabled the movement of the staff to visit their offices, but also ceased the supply of feed and other consumable materials to the research laboratories. Keeping the issue of animal welfare as the major focus, during such situations, it is indispensable to bring the gravity of the situation to the notice of the government authority which would force them to promulgate orders to allow the continuation of certain services for the animal facilities.

Recognition of services as essential

The movement of vehicles carrying livestock, feed and feed ingredients was badly impacted after the announcement of lockdowns (COVID-19 Impact on Feed Market). In view of this the first and foremost, an important decision at government level should be taken to bring all the activities associated with animal facilities under essential or emergency services category. This will enable authorities at different levels to permit movement of the essential commodities directed towards the animal facilities. The permission for the continuous functioning of the factories, animal feed manufacturing units, bedding material processing installations and other consumable items will ensure a regular supply of these items to the animal facilities (Department of Animal Husbandry and Dairying, Krishi Bhavan, New Delhi, 2020).

Approval for logistics

Shutdowns resulted into a loss in demand for meat, dairy and animal products impacting the feed market. Due to disruption of supply chain the feed production was affected leading to slow down the feed market (COVID-19 Impact on Feed Market). After production, distribution and retail of the goods or consumable items become the next most important aspect. The permission for commutation of the animal facility staffs, transport of the animals and other essential materials will be highly useful in streamlining the process. The vehicular permission under essential services shall also enable supply of the raw materials to the manufacturing units for continuous production of feed and other items. Smooth logistics would ensure an unbroken supply chain between origin and consumer of these essential items (Department of Animal Husbandry and Dairying, Krishi Bhavan, New Delhi, 2020).

Remote approval of the projects

During the situation of a lockdown, some studies require approvals for continuation or new approvals on a priority basis. However, due to the inability of panel members to be physically present, in-person meetings would be unfeasible. Members of the committee may be suffering from the epidemic or might be unavailable due to various reasons. Coupled with the inability to gather in public or common areas, a physical meeting was completely out of the question. With the advancements in technology, enabling low latency video conferencing *via* a host of applications, this hurdle can be overcome by conducting meetings using the electronic mode. In this regard, the respective authority under the ministry should promulgate the order to recognize IAEC/IACUC meetings using the online mode as legitimate (CPCSEA, 2020).

Approvals at the organization level

Certain arrangements and special approvals at the institute level are necessary during the crises of flood, strike, protest or war. It is essential that the in-charge of the animal facility should convince the head of the institution/organization for making such provisions for an outbreak or epidemic as well. A disaster management plan needs to be put in place and approved by the institution.

Generally, such a plan should consist of 4 essential phases:

Risk assessment

This is considered as the most important part of the entire crisis management plan. This phase helps to identify the severity of the situation, its consequences and the weak points to be addressed on which the rest of the plan can be worked towards.

Preparedness

Preparedness generally is referred to as a research-based group of activities to ensure precautions are taken and so that the institutions' facilities are ready to cope with the crisis, as and when they are faced with it. Preparedness includes everything from stocking up resources to training the personnel so that the ongoing research activities are not affected during the crisis.

Response

This is the phase during which the disaster management plan is executed as per the preparedness planned in the second phase. Response to the crisis is executed during or immediately after the disaster or crisis has taken place. The main aim of this phase is to ensure the safety of the animals and people.

Recovery

After a catastrophe, it is of paramount importance that the institute is able to reconcile and return to its normal day-to-day functioning. This is where the recovery phase kicks in. This may be a difficult, laborious and time-consuming phase to execute, as it requires physical recovery in the form of equipment and animals as well as emotional recovery for the employees (Dupepe *et al.*, 2018).

i. Organization of workforce

In well-established animal facilities, the staff usually comprises of an in-charge/veterinarian, technicians and animal care personnel. In view of day-to-day work in the animal facilities, regular attendance of the animal care personnel is required. During a disaster or crisis, the human resource section (HRS) of the institute should bring animal facility staff under essential services, quoting the reference of the apex authority by passing officer memorandum (OM). This OM will enable animal facility in-charge to arrange personnel on rotational or shift duty using the available manpower. The office order for essential services will also help streamline the entry and movement of animal care personnel in the facility.

ii. On-site housing for the facility staff

The provision of campus accommodation shall prove beneficial to the animal facility staff during the crisis under the provision of essential services. This eliminates the issue of traveling which might arise if the staff members have to commute from distant places, especially during such an unprecedented situation where the transport system is badly affected. The facility in-charge should explore this issue with the administration to arrange on-campus accommodation to animal care personnel to take care of minimum husbandry and other activities in the facility (Chipangura, *et al.* 2021).

iii. Stocking of feed and other consumable items

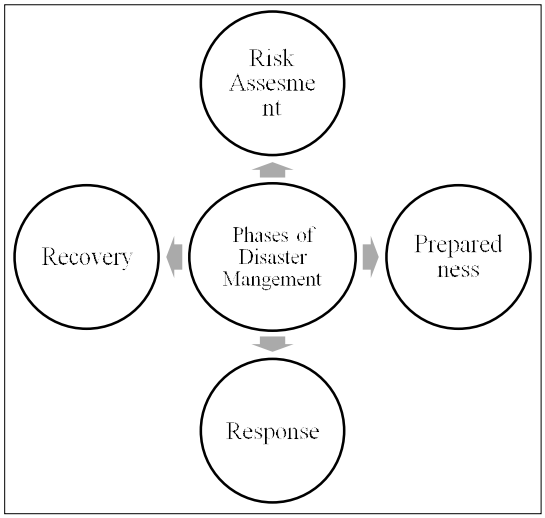

Fig 2: Phases of disaster management.

In many animal facilities, stocking of the daily required materials such as feed, bedding and other consumables, enough for the few weeks is a general practice. However, during a crisis, especially seen during the COVID-19 pandemic, when the lockdown was extended for several weeks, the stocks needed to be procured, enough to last for more than just a few weeks (Chipangura *et al.* 2021). Of the major feed market players, World Health Organization reported that many of them, for example Cargill had to put a stop to their international and non-essential services, causing a shock in the supply chain and an eventual decline in the available feed (Markets and Markets). In the absence of the concerned staff, processing of the documents for material procurement becomes difficult. Here, online processing and approval of the concerned documents might prove useful. Institutions should develop portals in advance to make provision in the system that will allow online approvals to place purchase orders for essential items so that the routine activities of the animal facilities are not hindered. This would be useful, not only during an epidemic, but would also be useful in keeping an accurate record during normal functioning as well (De Briyne *et al.* 2020).

iv. Provision of technical maintenance services

For the viable functioning of any animal facility uninterrupted supply of power, water and ventilation is as important as feed and water to the animals. It is seen that these services can be badly affected during the period of crisis and demands on call availability of maintenance people in the campus. The concerned authority in the institute should coordinate with the engineering services to make necessary arrangements for the availability of maintenance personnel in the shifts duties so that they can attend the breakdowns, if any, in a swift and efficient manner. It is also necessary to make provisions of the power generators for electricity backups, multiple water storages, stand by air conditioners and thermostats along with their consumables to fix the breakdowns during the situation of Pandemic or similar crisis.

v. Personnel training

The planning done by the institute and facility will only be viable if the personnel are able to understand and execute the disaster management plan. To do this efficiently, it is of great importance for the staff to not only have thorough knowledge of the protocols but also have ample practice in the form of drills to ensure they are ready when disaster strikes. Practice drills and orientations should be organized by the institute/facility either annually or at regular appropriate intervals. This would make disaster response second nature to the staff. It may also teach the personnel aspects beyond the scope of their expertise and may also include non-technical training ranging from stress management to decision making and leadership skills. The present arrangement at the facility is to train newly recruited animal care staff and research scholars to tackle the breakdown in the facility during holidays or after office. Additionally the fire safety grills exercise is being regularly

conducted in the institute as a part of disaster management program. The staff and research scholars staying in the campus are the first line army to attend breakdown in the facility. The culmination of all this ensures that the precautions taken by the institute are executed properly.

Decisions at the facility level

The in-charge of the animal facility is administrative head and required to take certain decisions at the facility level. The decisions of the head should be focused on the husbandry practices, nutrition, health, sanitation and the ongoing research programs. During a crisis priority should be given to the essential activities in the facility, necessary to reduce the suffering and support survival of the animals. When the animal facility staff is available at full strength, all services in the facility should be carried out, however, the daily workload can be reduced by removing certain non-essential practices whilst still withholding ethical guidelines, in case the facility faced situation of under staffed.

Reprograming animal breeding

In many of the research animal facilities, breeding of the strains or breeds constitute a core venture to support animal-based research. In general, the breeding of these strains or breeds are necessary to multiply numbers of the existing strains to propagate their colonies and mass production of the animals to carry out ongoing and new experiments. During the crisis of current lockdown or similar situations that extended for a longer duration, the stock of the existing resources would start shrinking if large number of animals are produced with the regular animal breeding program. In such a scenario, the facility manager should take a decision to scale down production of breeder as well as experimental animals so that the burden on the available resources will be reduced and the existing resources can be utilized better way to sustain the ongoing research (Chipangura, *et al.* 2021, Thorat and Ingle, 2020). In many biomedical research institutes the investigators halted new research projects except the projects associated with COVID 19 infections and continued with few important ongoing experiments. With less demand from the research community, helped the facility managers to scale down the breeding of research animals that further helped for the judicious use of the available resources for the ongoing research. Many investigators stopped the breeding of mice, scale down the size of colonies and established contingency plans for the sick staff if contact the infection (The Scientist, 2020). In US poultry and pig industry was impacted during pandemic leading to 45% reduction in the slaughter of pigs alone on daily basis. The availability of less workers at the processing units and the slowdown of transport sector reduces the supply of animals to processing units. This has resulted into crowding of animals at the farm that forced the management to produce small quantity of food animals (Marchant *et al.* 2020). The pastoral communities and livestock keepers were also badly disturbed due to lockdown situation affecting their economy due to less demand because of transport restrictions and less demand from the market.

Preservation of valuable strains

Breeding of animals seems like a far-cry, especially in a time where euthanasia of laboratory animals due to various constraints seems like a simpler option. However, this does not mean that a researcher has to lose the intangible breeds or strains of laboratory animals they have procured for experimentations. Cryopreservation of sperm or embryos of valuable genetically engineered lines is the most effective way to ensure their safeguard and revive in future when required. This can be achieved by freezing germ plasms of the strains in their own cryo-preservation facility or outsource to other institutes where such arrangement is available (Thorat and Ingle, 2020). Additionally, three to four breeding pairs of strains having this unique genetic quality can be identified and maintained if their embryos aren't cryopreserved.

Management of research projects

The role of the facility manager during the crisis should focus on how to continue ongoing pre-clinical and/or basic research programs carrying out on animals with the available resources. Keeping the scarcity of resources in mind, upcoming research projects can be delayed and initiated when the situation is improved. The researchers should work with the animal facility staff to coordinate day to day care of the animals under experiments when the enough animal care personnel are not available.

Procurement of the surplus stock

Once the documentation from the institute is approved, the process of ordering, collecting and storing the surplus stock that will last for longer period should be executed. A bulk purchase order with the provision of delivery at multiple intervals should be put in place with the supplier. The supplier shall provide the materials as per the request by the facility, if the storage duration of the feed or other consumable items is limited. Institutes can enter AMC with the suppliers for the maintenance of equipment to ensure streamlined functioning of the equipment during the crisis. When the usual supplier is unavailable or unable to meet the bulk requirements, an alternate supplier shall be contacted (University of Tennessee Health Science Centre, 2018).

Sanitary considerations

Covid-19 pandemic have brought to light the importance of hygiene and sanitation. The common areas in the facility shared by the staff that can spread the infection among the staff, include door handles, switches of elevators and lights, sitting places, chairs, workbenches, animal handling equipment and washrooms. The risk of spreading infection through these areas can be avoided by proper sanitation using effective sterilizers at the regular interval. It is also the responsibility of the facility to ensure proper sanitary standards are maintained for the personnel as well.

Promotion of hand-washing with soap and water, use of hand sanitizers is necessary. Hands-free sanitizers should be made available at accessible locations throughout the facility. The staff should be encouraged to inform the in-charge if they are feeling ill, or having symptoms related to the epidemic. The personnel should be encouraged to not touch their nose, eyes, *etc.* unless their hands are sanitized or washed thoroughly. Regarding sanitation of animal housing equipment and accessories, the lack of enough staff would make it difficult to maintain high sanitary standards. The in-charge should make necessary changes to the schedule to accommodate the issues posed by being under-staffed to maintain animal health and welfare, carried out on alternate dates (Roble *et al.* 2010).

Working space arrangement

In order to maintain social distance as per national guidelines framed during the pandemic, it is important to manage working or sitting space and keeping safe distance between two persons in the animal colonies or other service areas inside animal facilities wherein there is a risk of spreading the infection through physical contact or air transmission is anticipated. Terminating the transmission of disease, especially in animal care personnel working in the facility is a crucial task. This can be best achieved by proper arrangement of the workplaces or sitting areas so that gathering is avoided and safe distance of preferably 1.6-3.0 m (5.2-9.8 ft) is maintained between two persons (Sun and Zhai, 2020). In the areas wherein more than 1 person is worked, decongestion can be made through proper work schedule, rotational duties and staggering work timings. (University of Georgia, 2015).

Need for the personal protection

Use of good quality personal protection equipment (PPE) is important for the animal care personnel, veterinarian and administrative staff while working in the animal colonies and other areas of the facility. A generic PPE kit includes lab coat, face mask (preferably of N95 grade), head cover, hand gloves, eye goggles and foot ware. It is also important to dispose PPE kits as per standard protocol after usage to avoid contamination to other people or the environment (Roble *et al.* 2010).

Getting back of track

During COVID-19 pandemic the social distancing, self-isolation and travel restrictions have resulted into a reduced manpower across all economic sectors and many jobs have been lost. Educational institutions have closed down andthe demand for commodities and manufactured products has decreased. Contrary to this, the need for medical supplies has significantly increased. There was an increased demand from the food sector due to panic-buying and stockpiling of food products (Alsafi *et al.*, 2020).

Once the danger of the epidemic has subsided, the resumption of routine laboratory functioning is important. Complying with the approach adopted by the regulatory and Government authorities, the animal housing and testing facilities shall resume. It is necessary to ensure that the areas not under use for the duration of the lockdown are sanitized and cleaned properly. The equipment which was unused during the period should also be cleaned and sanitized and checked for proper functioning. Maintenance protocols should be followed for the same. Essential workers who served industriously during the times of turmoil should be given some time-off to recuperate. Mental therapy and assistance should be provided to them if necessary (Dupepe, Donaho and Roble, 2018). Mandatory screening of the animal facility staff with reliable diagnostic tests and vaccination against the diseases should be recommended before resuming the work at the facilities.

CONCLUSION

The pandemic caused by SARS-CoV-2 infection has major impact on human and animals across the globe. The functioning of the several public and private institutions was badly affected leading to interference in the day-to-day activities of the public. In the research laboratories it was nightmare to arrange services for running the animal facilities. For the first time in the human history when public services, transport and manpower availability were badly affected for the months. The research activities in the established animal facilities associated with national laboratories/institutions/corporate were not affected to that extent during the COVID-19 pandemic, however, many small facilities in the colleges and small establishments were unable to survive the onslaught due to the unavailability of manpowerand other essential resources.COVID-19 pandemic and similar crisis, bring with them a wave of uncertainty, melancholy and challenges. It is times like these where the appropriate planning and execution become extremely important. Outlining a strategy for such times is a tedious task, needed to be done with extreme caution and detail. However, the responsibility of this is not on the shoulders of an individual or an institution. It is an intricate operation, involving organizations at various authority levels, requiring them to closely coordinate and make sure what is on paper is accomplished effectively when faced with adversity. This would ensure the health and welfare of the animals as well as the personnel working at the facility. The plan includes articulation of several authorities at different levels to co-ordinate for providing services towards arrangement of manpower and materials to ensure proper animal care.

Conflict of interest: None.

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