# STATUS AND RESPONSE TILL THIRD STAGE OF 2019 NOVEL CORONAVIRUS DISEASE (COVID-19) IN NEPAL

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## ABSTRACT

*An outbreak of severe acute respiratory syndrome coronavirus infection occurred in Wuhan, China at the end of December 2019 and spread of this virus already reached to almost 210 countries around the world. WHO declared COVID-19 as 'global pandemic' on 11 March, 2020 and accounted South Asia as the high-risk region. Nepal, a landlocked country bordering two most populous countries, India and China, was expected to have high number of cases of COVID-19 due to its proximity to the highly infected country China, and lately spreading country India. Also, many of the Nepali people are engaged in the businesses related with China and India. However, there has been very few reported cases in Nepal. The first case was reported on 24th January 2020, one and half months after the first case was confirmed in China. It took almost three months for the number of cases to reach 45 and to kick off the community spread stage of the pandemic. This research presented the detailed situation of the cases, testing facilities, quarantine and isolation, hospital, and nursing care etc. before the start of Community Transmission stage in Nepal. The scenario has been represented graphically and the condition of other South Asian nations has also been compared and visualized. The steps taken by the government, individuals, and other organizations are also highlighted. This paper also provides the concrete data and their analysis about the pandemic which can be helpful not only for the current but also for the future pandemic controls.*
**KEYWORDS:** *COVID-19, coronavirus diseases 2019, global pandemic, South Asia, Nepal*

## 1. INTRODUCTION

An ongoing outbreak novel coronavirus (COVID 19), was reported in Wuhan, Hubei province, China (1). In the beginning, this disease was known as "2019 novel corona virus" or "2019-nCoV". Later, WHO named this virus as COVID-19 where 'CO' stands for 'corona,' 'VI' for 'Virus,' and 'D' for 'Disease'. COVID-19 is respiratory illness associated with mild symptoms of fatigue, fever, common cold, dry cough, & shortness of breath which is usually transmitted from an infected person through droplets of saliva or discharge from the nose when someone coughs or sneezes (2). The present course of this virus is unstoppable and rapidly spreading worldwide as the vaccines and specific medications are not available so far. Only way to save lives is by isolating the suspected people, monitoring the sign & symptoms, collecting clinical data, travel history, possible diagnostics & applying preventive treatments to reduce the spread of COVID-

19(3).Observing it's evolving and transmitting pattern, WHO declared the (4) outbreak a pandemic on March 11, 2020(5). In lieu of WHO guidelines, Nepal, thus, opted for a nationwide lockdown on March 24, 2020. It suspended all the air travel inbound and outbound on March 22, 2020, in the hope of containing its spread inside Nepal. The reason to this immediate response was due to its vulnerable health care services. In case the decision was to be delayed, the consequences would have led to a panic state stressing already vulnerable health care service. The vulnerability of health care services can be interpreted in terms of total available working ventilators count all over Nepal. The figure suggests that there are a total of 263 working ventilators which technically mean 1 ventilator per 114,000 people(6).

Nepal which is a land lock country accounts for a total of 0.37% of the world's population. With a population density of around 203 people per km², 21.4% of the population lives in the urban area whereas 78.6% lives in rural areas. The 44 main cities are the connecting hubs between urban and rural settings. Every year thousands of young Nepalese travel abroad in search of good job opportunities. More than 28% of the total workforce work abroad contributing to 30% of the country's GDP(7).But the figure is mostly underestimated as the workforce outflow through an open border with India is not considered. The informal economy is quite leveraged in terms of its contribution to the nation's GDP. The current attractive workforce destinations for Nepalese workers are Malaysia, Qatar, Saudi-Arabia, Korea, and Japan. Further, more than 300,000 Nepalese students applied to study abroad. Out of which, more than 63000 are currently studying in countries like Australia, Japan, Cyprus, India, China, Canada, the US, New Zealand, and South Korea as per recent 2019 data. This implies the probable influx of the abroad Nepalese would increase the COVID case as the first two patients one male and the other female were the students traveling from Wuhan and France respectively(8).

Nepal allocated a staggering Rs 2.68 billion for tourism infrastructural development through its national budget of fiscal Year 2019/2020 on 29th May 2019 (9). Moreover, declaring Visit Nepal Year, Nepal targeted to welcome more than 2 million tourists in the year 2020. The tourism sector had a total contribution of 7.9% in the country's gross domestic product and it accounted for more than 1 million job opportunities within the country (10). Likewise, if you see the trend of tourist inflow, Nepal welcomed almost 1.9 million tourists in the Year 2019. India alone was huge contributor for Nepal with 254,150 tourists in a single year followed by China at the second place with 169,543 tourists (11). And this trend was expected to increase exponentially in 2020. In retrospect, before the Wuhan was hit by the coronavirus, Nepal was all set to collect more than Rs240.7 billion in revenue for its economy from tourism sector alone. But due to the unprecedented event, Nepal had to imply with WHO guidelines and initiated its nationwide lockdown. This scenario froze the tourism industry completely. From the big chain hotels to mini food markets in the nation, everyone is severely affected by its wave. The norm of social distancing is highly communicated but there is uncertainty on its implementation. The socio-cultural norms and traditions make it hard to exercise. If the corona virus stays longer, Nepal's tourism industry is going to get a huge blow with millions losing their jobs. The new entrants, medium to large tourism industry players will have difficulties to curtail its financial obligations. Nevertheless, for time being the lockdown have barred tourist's inflow decreasing the high risk of sporadic transmission.

On the basis of transmission, the COVID19 pandemic is mainly categorized into three stages, excluding the no cases condition(12) . First, the imported cases only (sporadic transmission), which includes the cases seen on people having abroad travel history. This is the phase when the cases are first introduced in a country. After first stage, the virus is seen on the family members, friends, neighbors, or other people who are reported to be in contact with the infected person. This is the second stage of the transmission and it is called Local transmission (cluster of cases). After local transmission stage, the tracing becomes difficult and the spread of the virus starts at the community level. The number of positive cases starts to incline and there exists numerous untraceable chains between the positive samples and the previously infected patients. This stage is called Community Transmission stage and after this, the number of death cases also starts to incline(13). Now onwards, the term "stage 1" refers to Sporadic Transmission, "stage 2" refers to Local Transmission, and "stage 3" refers to Community Transmission in this paper.

Currently Nepal is in Community Transmission stage with high risk of COVID-19 cases spiking in few days to come. We will chronologically outline the status on situation of the cases, testing facilities, quarantine and isolation, hospital, and nursing care etc. before the start of Stage 3 in Nepal here-within this paper. Firstly, Nepal borders with two most populous countries, India and China, were expected to have the high number of cases of COVID-19 in South Asia. Secondly, the influx of tourists, Nepalese students studying abroad and migrant labors would highly penetrate the diseases spread. Thirdly, the unavailability of testing kit and

testing gear would expose larger population to contract the diseases leading to unforeseen deaths in short time. Fourthly, the lack of quarantine and isolation facilities would make spread exponential. Finally, the lack of nursing care and sophisticated health care equipments would add fire to catastrophic situation. Hopefully, with this paper government agency, international/national organization, and private bodies could narrow down their probable option and decide based on the data observed and presented. End of the day, saving single life is million battle won.

## 2. SCENARIO OF WORLD

An outbreak of 2019 novel coronavirus diseases (14) in Wuhan, China has spread quickly nationwide. It was first detected in December 2019 in Wuhan city, Hubei province, P.R. China(4). Sohrabi et al. highlighted the excess with the World Health Organization (WHO) declaring the COVID-19 outbreak as a world-wide. They recommend not to travel to high-risk places, maintain distance with the suspected individuals, avoid eating meat from regions with known COVID-19, washing hands frequently, and using preventive personal equipment (15) like the face mask, etc(16, 17). On April 14th 2020, WHO confirmed 1,844,863 positive cases and Italy became the epicenter. Among the European countries, Italy initiated the complete lockdown policy by implementing it on 9th March 2020. On 14th April, 2020, the case count in Italy (159,516) reached almost twice the number of cases in China (83,696). This huge tally consists of 53,724 new cases that were confirmed between a two weeks spell that started on the 1st of April, 2020 (18).

Andrea Remuzzi & Giuseppe Remuzzi studies suggested concern regarding the Italian national health system's capacity to effectively respond to the needs of patients who are infected and require intensive care for SARS-CoV-2 pneumonia and the percentage of patients in intensive care reported daily in Italy between March 1 and March 11, 2020, the number of patients infected since Feb 21 in Italy closely follows an exponential trend. Their analysis also suggested political leaders and health authorities to allocate enough resources, including personnel, beds, and intensive care facilities, to manage the situation in the next few days and weeks(16, 18). On 14th of March 2020, Spain, the second most affected nation in Europe, officially stated an emergency condition. Poland, Czechia goes lockdown 13th March 2020 with 29 confirmed cases and 16th March 2020 with 298 cases

respectively. On 14th April 2020, 6934 confirmed cases and 6059 confirmed cases were seen in Poland and Czechia respectively. Identical cases were confirmed on 14th March 2020 in the UK and Netherlands with 802 and 804 in numbers respectively. Dramatically, on 14th March 2020, three times confirmed cases have been found in the UK compared to Netherlands (88,625 and 26,551 respectively). The Netherlands became another country to implement lockdown on 16th March 2020 with the United Kingdom following the same path from 23rd March 2020(18). The study by Chen et al has suggested some positive symptoms in the efforts of preventing and controlling the disease. They suggested the rapidly producible Continues Positive Airway Pressure (CPAP) device which has already been used extensively in Italy and China (18) .

The vast amount of cases (over 650,000) were identified in the USA in between 100 days of the CoVid-19 onset (19). Scientists are racing to find the best drugs and geographic modeling of the diseases. Bashir et al applied and compare the performance geographically weighted regression (GWR) and multiscale GWR (MGWR) models to locally examine spatial non-stationarity geographic modeling of CoVid-19(18).

Francesca Scarabel et al found evidence that CoVid-19 has more impact on the older populations, it is not unreasonable to expect relatively more severe cases and fatalities in the population overall among persons in the United States and Canada increases with age. Social distancing is recommended for all ages to slow the spread of the virus, protect the health care system, and help protect vulnerable older adults(20, 21).

According to the latest data by the John Hopkins University and Africa Center for Disease Control on COVID-19 in Africa, the breakdown remains fluid as countries confirm cases 24,696, the number of deaths 1,193 with 6,415 recoveries out of 52 African major countries as of April 22. The spread of this contagious infection in Syria, Libya, and Yemen will have a catastrophic impact not only on the citizens of these countries. Coronavirus has been confirmed in all countries surrounding Syria and full alert has been utilized in Jordan, Iraq, and Lebanon as well as those countries surrounding Libya, (Egypt, Algeria and Tunisia) and Yemen (Oman and Saudi Arabia and even the African Horn countries and Madagascar)(4, 22). The epidemic curve across the world of confirmed cases COVID-19 by WHO (20th April 2020) is shown in fig.1(23)
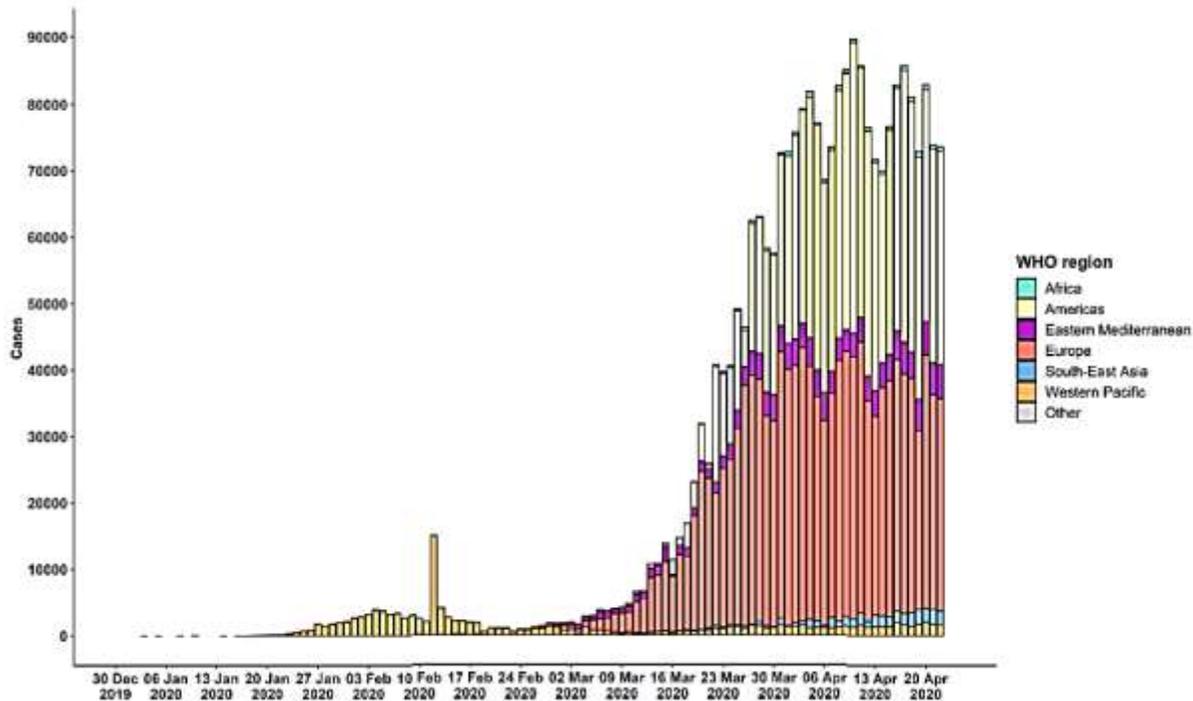
**Figure 1: No of cases around the world(24)**

Middle east countries increase COVID-19 pandemic alert and AbdulkarimAl-Rabiaah et al highlight the need to establish psychological support programs for medical students during an infectious disease outbreak(24). Rajib Shaw et al studies the governance, technology, and citizen behavior pandemic in East Asian countries like China, Japan, and South Korea from COVID-19 analyzes peculiar government mechanism to reduce the spread of COVID-19(25).

Abdul Waris et al studies COVID-19 outbreak current scenario of Pakistan is not satisfactory, and the hospital, Psychological Crisis Intervention Model (PCIM), and quarantine facilities are not adequate as required(26). U. U. R. Qureshi et al suggested that Pakistan being the neighboring country of China is at risk, and the travelers from either of the countries should be scanned and suspicious should be in quarantined; the suspicious samples are sent to labs in China and Netherlands for testing. Their studies also suggest that the diagnostic and treatment facilities should be provided in risky areas(27).

Balaji Krishnakumar and Sravendra Rana analyzed that most of the affected people reached India from different parts of the world as like of COVID-19 carrier. They also appraised government announcement based on the international learning to maintain social distancing (1 m), forbidding the social gathering, provision of daily basic needs required for the livelihood of the people(28). Deblina Roy et al suggested to overcome pandemic COVID-19 via education, and the increase in adult willingness for the preventive aspects(29).

The purpose of this part of study is to present the COVID-19 confirmed cases and deaths data scenario of countries in the world reported to WHO laboratory. On 20th April 2020, in Nepal, the number of confirmed cases reached 45(30) and the community transmission of the disease started. This study assures and increases the level of confidence to government of Nepal to apply the preventive measures. Nepal is a country having comparatively less technological development, insufficient medical test kits, inadequate health care and treatment. However, still having the smaller number of confirmed cases is a result of the different preventive measures, which we will discuss in the further sections of this paper.

## 3. COVID-19 in Nepal

The first confirmed case of coronavirus infection in Nepal was reported on January 24, 2020. The 31 year-man doing Ph.D. in Wuhan returned from China on January 9, 2020. He felt sick and was aware of the coronavirus outbreak in China, so, he self-visited Sukraraj Tropical and Infectious Disease Hospital (STIDH) in Kathmandu on January 13, 2020. He was isolated keeping his travel history in mind and provided

with the supportive treatment along with broad-spectrum antibiotics. The throat swab was sent to the WHO Collaborating Center, Hong Kong. After clinical improvement, he was discharged on January 17, 2020. He was kept 4 days in isolation. On January 24, 2020, the hospital received test results; positive for COVID-19. He was informed with advice to remain under self-quarantine. Subsequent follow-up tests on January 29 and 31 were found Negative for COVID-19 and the patient was declared cured(18, 31).

The following topics cover the major causes of the transmission of COVID19 virus in Nepal.

*By Aerial Route*

With the cancellation of all the international flights from March 20, 2020, there were no more chances of additional cases to be transmitted through the aerial route. However, there are people who traveled earlier than such cancellation, who are tested positive. The table below shows the details of such cases. Here, the "Correlated Case No." column refers to the tracing identification of the cases. The number 'y' in the "Correlated Case No." column for the "$x_{th}$" case indicates that the case 'y' is seen concurrently or after case 'x' and have the connection with case 'x'. The connections can be the same family, same locality, and the same flight. The column is left empty if there were no other cases having such a relationship such that other cases were identified prior to the current case.

**TABLE 1. Stage 1 COVID19 confirmed cases until 04/22/2020 in Nepal: From Aerial Route**

| S.N. | Travelled From | Arrival Date | Case Confirmed Date | Gender | Age | Case No. | Correlated Case No. |
|---|---|---|---|---|---|---|---|
| 1. | China | 01/09/2020 | 01/24/2020 | Male | 32 | 1st | |
| 2. | France | 03/17/2020 | 03/23/2020 | Female | 19 | 2nd | |
| 3. | UAE | 03/19/2020 | 03/25/2020 | Male | 32 | 3rd | |
| 4. | UAE (via New Delhi) | 03/20/2020 | 03/26/2020 | Male | 34 | 4th | |
| 5. | Belgium (via Doha) | 03/17/2020 | 03/28/2020 | Female | 19 | 5th | 2 |
| 6. | Belgium (via Doha) | 03/17/2020 | 04/02/2020 | Female | 65 | 6th | 2, 5 |
| 7. | UK | 03/18/2020 | 04/14/2020 | Male | 58 | 15th | 16 |
| 8. | UK | 03/18/2020 | 04/14/2020 | Female | 81 | 16th | 15 |
| 9. | UK (via Hongkong) | 03/18/2020 | 04/17/2020 | Male | 27 | 29th | 30 |
| 10. | UK (via Hongkong) | 03/18/2020 | 04/17/2020 | Female | 63 | 30th | 29 |

The first case seen in the nation was from the Aerial route. The Nepali student, studying at Wuhan--the epicenter of the novel COVID19 virus-- travelled on 9th January 2020. Furthermore, 7 out of 10 cases were seen on people traveling from Europe. The remaining two other patients were from the United Arab Emirates (UAE). Excluding the first patient who recovered at the end of January, all other cases are seen on people traveling to Nepal only one week before the shutdown of aerial transportation. Considering the imposition of indefinite flight cancellation, and with the median incubation period of 5.1 days and the symptoms are seen on almost all the infected people within 14 days(32), it is unlikely that any new stage 1 cases will be seen on Nepal which are related to the Aerial route.

*By Road*

The open border between Nepal and India extends to 1751 km with India surrounding Nepal from East, South, and West. China is on the north side of the Himalayan nation and due to the mountainous topography, the two countries are connected through only a few locations by the road links. So, the terrestrial travel cases are seen on people who travelled to Nepal through the Nepal-India open border.

Due to open-border policy, cultural similarity, and low travel cost, a large number of Nepali people, especially from western Nepal, migrate to India in search of a job(33). However, due to the coronavirus outbreak in India, they returned to Nepal in thousands of numbers before the border lockdown was announced officially on March 20, 2020. But the border lockdown still left many returning Nepali people waiting to enter the country. Due to open travel access, the exact number of

such people entering Nepal is only known roughly and there is no record of the date they entered. With the incubation period of the virus passed already, it is unlikely that more COVID19 stage 1 cases will be seen on people who traveled by road. Also, the date when they entered Nepal has not been traced Following table depicts the cases seen on people travelling by road.

**TABLE II. Stage 1 COVID19 cases in Nepal: From India (By Road)**

| S.N. | Case Confirmed Date | Gender | Age | Case No. | Correlated Case No. |
|------|--------------------|--------|-----|----------|---------------------|
| 1. | 04/04/2020 | Male | 21 | 7th | |
| 2. | 04/04/2020 | Male | 41 | 8th | |
| 3. | 04/13/2020 | Male | 19 | 14th | |

The table above shows all the patients are male. As most of the job-seeking Nepali population in India are male, depicted data sounds logical. Also, the empty Correlated Case No. column shows that there are no relations between these detected cases.

*Transmission on people without recent abroad travel history*

The table below shows the data of people who have not travelled to any abroad countries recently but still are tested positive on Polymerase Chain Reaction (PCR) test. Nepal entered to Stage 2 of corona outbreak on 4th of April, 2020, when the relative of fourth patient was tested positive on PCR test. This shows that it took 72 days for Nepal to enter stage 2 from stage 1. However, neglecting the first case, considering this as an outlier, it took 13 days for Nepal to enter stage 2 from stage 1. Also, the first community transmitted case was confirmed officially on 21st of April when, 11 Nepali citizens of Udayapur district are tested positive on PCR test. It took 30 days for Nepal to enter the third stage of pandemic, neglecting the first case as an outlier. However, considering that data also, it took Nepal 89 days to enter the third stage of pandemic.

**TABLE III. COVID19 cases other than stage 1 seen in Nepal**

| S.N. | Case Confirmed Date | Gender | Age | Location | Case No. | Correlated Case No. | Transmission Stage |
|------|--------------------|--------|-----|----------|----------|---------------------|--------------------|
| 1. | 04/04/2020 | Female | 34 | Kailali | 9th | 4 | 2 |
| 2. | 04/13/2020 | Female | 65 | Kailali | 13th | 10,11,12 | unknown |
| 3. | 04/17/2020 | Male | 34 | Udayapur | 28th | 18 to 27, 31 | unknown |
| 4. | 04/21/2020 | Male | 18, 18, 20, 33, 40, 41, 41, 52, 58 | Udayapur | 32nd to 40th | 18 to 28, 31 to 42 | 3 |
| 5. | 04/21/2020 | Female | 36, unknown | Udayapur | 41st, 42nd | 18 to 28, 31 to 42 | 3 |
| 6. | 04/22/2020 | Male | 24, 60, 72 | Udayapur | 43rd, 44th, 45th | 18 to 28, 31 to 45 | 3 |

*Transmission seen on Indian Citizens in Nepal*

**TABLE IV. Transmission seen on Indian Citizens in Nepal**

| S.N. | Case Confirmed Date | Gender | Age | Location (in Nepal) | Case No. | Correlated Case No. | Transmission Stage |
|------|---------------------|--------|-----|---------------------|----------|---------------------|--------------------|
| 1. | 04/11/2020 | Male | 37 | Birjung | 10th | 11,12,13 | 1 |
| 2. | 04/11/2020 | Male | 44 | Birjung | 11th | 10,12,13 | 1 |
| 3. | 04/11/2020 | Male | 55 | Birjung | 12th | 10,11,13 | 1 |
| 4. | 04/17/2020 | Male | 34, 29, 26, 28, 28, 28, 22, 25, 20, 40, 19 | Udayapur | 17th to 27th | 18 to 28, 31 | 1 |
| 5. | 04/18/2020 | Male | 65 | Udayapur | 31st | 18 to 30 | 1 |

Due to the open border, many Indian people visit Nepal for several purposes like business, tourism, religious visits, and so on every year. The first COVID19 case on Indian citizens in Nepal was seen on the 11th of April 2020 at Birjung, where three Indian citizens residing together were tested positive on the PCR test. Twelve more Indian citizens were tested positive a week later at Udayapur, notifying the chances of a third stage outbreak. The stage 3 outbreak followed three days from the same place.

### 3.1 Prevention Infrastructure
*Governmental Approach*

As per the report of the Ministry of Health and Population (MoHP) Government of Nepal on 28th January 2020, Government instructed all main and satellite hospitals to identify a dedicated space and beds with isolation facilities for COVID-19 cases. The MoHP prepared documents for the investigation and containment of COVID-19, and the thermal scanner was installed at Tribhuvan International Airport(34). The MoHP updated the capacity of National Public Health Laboratory (NPHL) for laboratory confirmatory diagnosis of COVID-19 from 27 January 2020, ensured availability of Personal Protective Equipment at different places and developed and disseminated information education and communication (IEC) materials(35). The capacity of main hospitals in Kathmandu regarding the collection and safe transfer of laboratory samples to NPHL for laboratory confirmatory diagnosis was developed. A high-level technical team has been formed to monitor the situation across the hub and satellite hospitals network in Kathmandu valley.

| Date | Important decisions, activities and approach |
|------|---------------------------------------------|
| Jan 17 | • Screening of passengers landed in Tribhuvan International Airport from China, Thailand and Japan was started. |
| Jan 28 | • Instructed to focus on the process of managing isolation facilities along with preparing medical resources, emergency spaces for COVID-19 cases to all main hospitals.<br>• Installation of thermal scanner at Tribhuvan International hospital for investigating, documenting & preventing COVID-19.<br>• Renovated the capacity of laboratory equipment's for performing diagnosis of COVID-19 cases in NPHL i.e. National Public Health Laboratory.<br>• Survey on 5 Hub Hospital and 13 key satellite Hospitals to maintain proper allocation & isolation facilities for COVID-19 cases. |
| Feb 14 | • Preparation was carried out to bring Nepali citizens stranded in epicenter of COVID 19 outbreak, Wuhan and to keep them in isolation in Bhaktapur and also decided to aware the people and distribute protective kits. |
| Feb16 | • Evacuates 175 citizens, mostly students, from Wuhan. |
| Feb 29 | • A high-level committee was formed in the leadership of deputy prime minister to fight against COVID 19<br>• All the activities for Visit Nepal 2020 along with its promotion was stopped.<br>• Labor migration to South Korea was also suspended. |
| March 1 | • Announcement of suspension of <u>visa-on-arrival</u> service for China, South Korea, Japan, Italy and Iran.<br>• General public was requested to avoid large gatherings |
| March 2 | • An interim order was issued by the Supreme Court to suspend flights to and from countries affected by COVID-19 |
| March 9 | • Visa-on-arrival service suspension was extended to include France, Germany & Spain. |
| March 12 | • On-arrival tourist visa was suspended for all countries, excluding to diplomats and officials.<br>• Land border entry points were closed for third country<br>• Mandatory two weeks self and home quarantines in Nepal was introduced to all who want visit to Nepal. |
| March 18 | • All classes were suspended and examinations from school to universities level were postponed |
| March 20 | • The National Assembly was suspended for indefinite period. |
| March 22 | • Land border with India and China was closed for a week effective from 03/23/2020. |
| March 24 | • The country-wide lockdown started. |
| March 29 | • The suspension of international flights was extended until 04/15/2020.<br>• The country-wide lockdown was extended until 04/08/2020. |
| April 14 | • The countrywide lockdown was extended until 27 April.<br>• The border closures and suspension of international flights were extended until 1 May. |
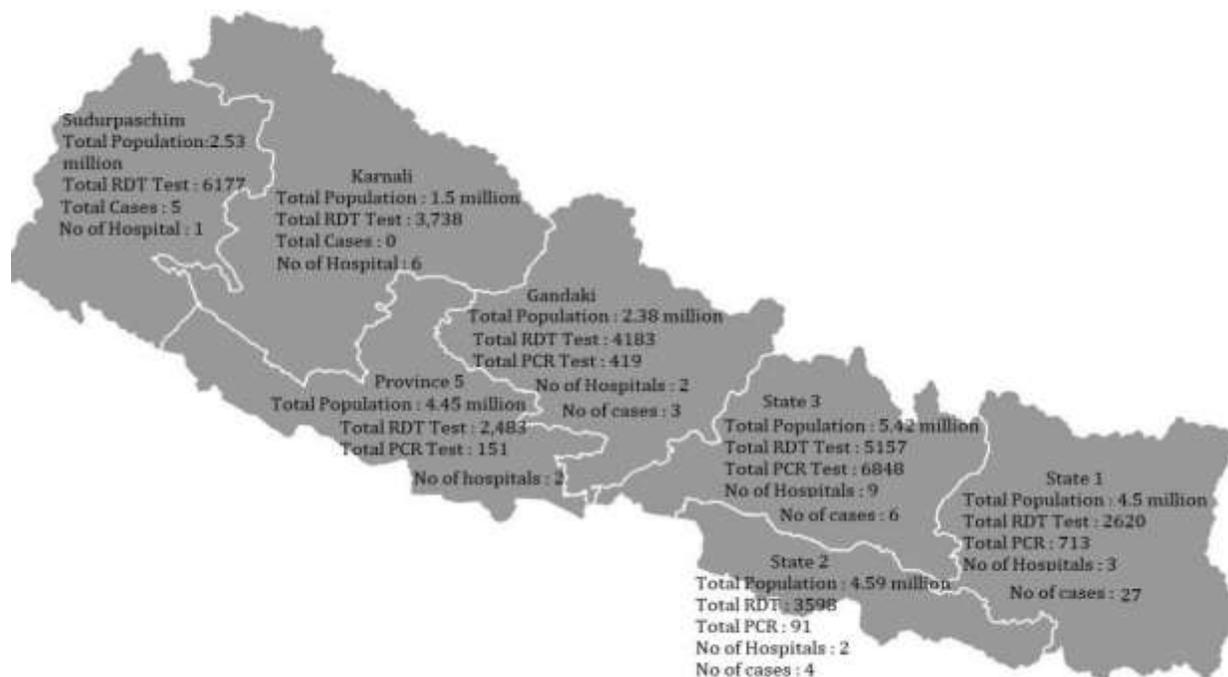
**Figure 2 : Status of COVID 19 cases and test facilities according to the demographic and political structure of Nepal**

*Hospitals and Testing Facilities*
Two types of method have been practiced in Nepal to detect presence of virus on body of human i.e.

### 1) RT-PCR (Real time Reverse transcriptase- Polymerase Chain Reaction):

RT-PCR is not a diagnostic test, it is process for research purpose. Worldwide, it is used because there is no other option. When the virus infects upper nasal cavity then, through nose swab which is known as Nasopharyngeal and Oropharyngeal swab which is like cotton bud. The swab is big enough with flexible head & used to take sample & the sample is enough to find out the presence of virus by using RT-PCR. (32). WHO-recommended gold standard for the diagnosis of COVID-19 is the qualitative detection of COVID-19 virus nucleic acid via reverse transcription polymerase chain reaction (RT-PCR)(32). From the investigation in china, RT-PCR is reported to have a sensitivity of 95% and a specificity of 100%; for every 100 COVID-19 positive patients, RT-PCR would have a falsely negative result in 5 patients (36). So, the test result on Nepal by RT-PCR also shows the same unreliability. It gives data currently are you infected or not.

### 2) RDT (Rapid Diagnostic Test):

RDT kit works on the idea that our body is already been infected with the virus through blood sampling which is like pregnancy kit. Our Body will produce antibodies Immunoglobulin G (IgG) and Immunoglobulin M (IgM) against the virus & the body will take at least 6 days for producing IgM and 15days for IgG, once when virus infect human body. The antibody will fight against the virus & tries to kill the virus. So, they start producing more & more antibodies to kill the specific bacteria or virus. Thus, it is prove that the virus has already attacked.

Among two antibodies, IgM is known as primary immune response antibodies it is produces by the body when first time our body has been infected with new virus or bacteria i.e. SARS-CoV-1 and SARS-CoV-2 & IgG which is produces for the second time when our body has been infected with the same virus or bacteria. RDT kit will just detect the presence of IgM or IgG antibodies in our body. So, if IgG is more then it means we are infected with couple of times with same virus or bacteria & if IgM is more it means we are infected with new viruses i.e. COVID-19. In this way the RDT kit shows its result & it is only 86% sensitive and cannot distinguish whether it is SARS-CoV-1 and SARS-CoV-2. WHO suggested, it's more appropriate to use the real-time PCR for the

COVID-19 testing rather than Rapid Diagnostic Test(37).

*Private and Individual Approach*

Along with government of Nepal numerous steps including lockdown to contain COVID-19 and prevent its spread into community, different private institution and individuals also shown some initiatives for COVID-19 relief program. Most of these organization keep in mind the health risks the medics looking after the coronavirus victims are exposed to, they had worked on making personal protective equipment PPE. Although government of Nepal tried to import the PPE and other medical equipment to fight against COVID-19 pandemic, due to the scarcity in the global market, many hospitals and testing center lack of these facilities. So these private organizations and individuals contribute in manufacturing PPE and other facilities in Nepal.



**Figure 3 : Swab collection booth made by NIC(38) (left side); swab collection booth in Korea. (39)**

As single-person booth to test for COVID-19 was launched first time in world from Korea, Social activist and scientist Mahabir Pun' National Innovation Center (NIC) took initiative in preparing PPE in Nepal as a copy of the booth in Korea. Doctors safely swab a sample from the patient inside the booth using gloves equipped on the booth and talk to the patient via intercom. NIC has also taken initiative to manufacture or repair other medical equipment like ventilator, PPE, N-99 masks, robots etc. After the initiation from NIC other organization like Nepal Engineers Association, Robotics Association of Nepal etc also started making these facilities to help government. Besides these efforts, Non-Resident Nepalese Association (NRNA) also contribute for the providing medical equipment and facilities in Nepal along with other relief packages.



**Figure 4:  From left: N-95 masks, ventilator, Aerosol Box manufactured and repaired by NIC (40)**

## 4. ANALYSIS AND DISCUSSION

Our main objective is to visualize the context of Nepal that is seen until the onset of stage 3 or pandemic. The following are the different plots that summarize the demographic details of the cases that are seen until the third stage outbreak. The python programming language along with the libraries like Matplotlib and Pandas were used for data visualization purposes.
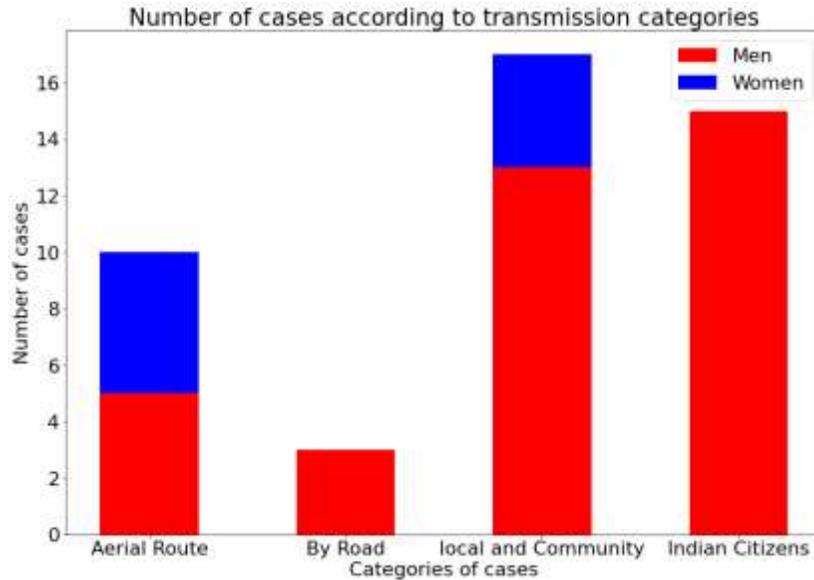


**Figure 5. Graphical representation of cases of each gender with respect to the transmission classes**

Excluding the cases seen on people coming from the aerial route, we observe that the male population comprises the maximum number of cases for each of the categories. In the excluded category, the number of male and female cases are equal. Also, all the stage 1 patients who entered by road and all the positive tested Indian citizens are found to be male. So, until the onset of the third stage of the COVID19 outbreak in Nepal, the total percentage of the male infected population is found to be 80% and the female infected population is found to be 20%. Here, the point to be noted is that all the Indian citizens who are infected came by road through the open border.
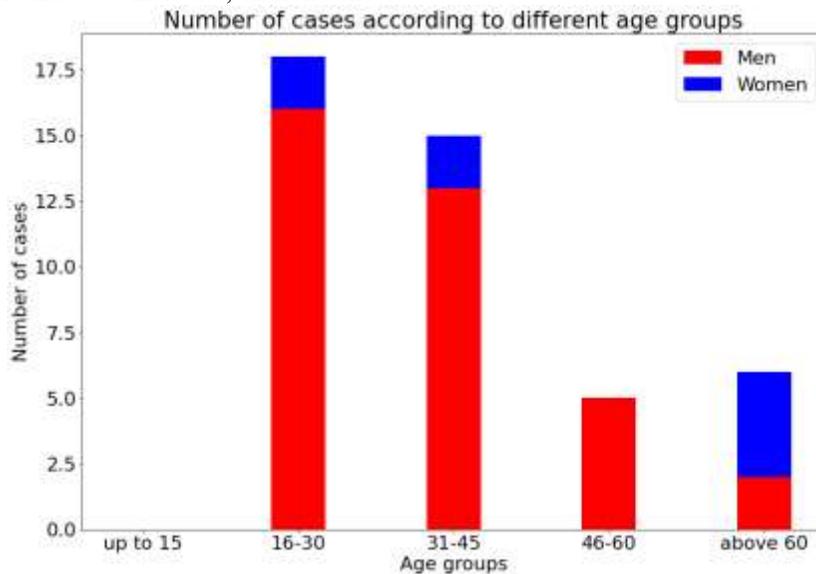


**Figure 6. Number of cases according to the age groups**

Another important parameter to be considered is the age group of the infected population. It is seen that the maximum number of infections are seen in the age groups between 16 to 30 years of age. Considering gender, the maximum numbers of male infected people are between 16 to 30 years. In the case of female, the maximum number of patients are found to be over 65 years of age. In this graph, the data of one woman was not included whose age was not identified.
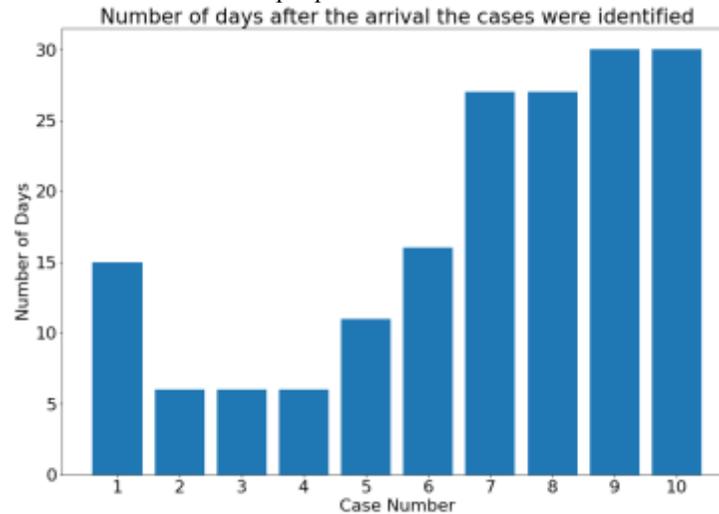


**Figure 7. Graph showing the number of days required to identify the cases after arrival of the paritents from the aerial route**

The graph above shows the number of days taken to diagnose the infection after the arrival of the patients by the aerial route. In general, the patients are diagnosed within a week, which is well inside the incubation period of the virus. However, the outlier data points also represent that the numbers of patients were diagnosed only after 25 days of their arrival. The condition of all of them were found to be normal and they did not develop any acute symptoms throughout the incubation period.
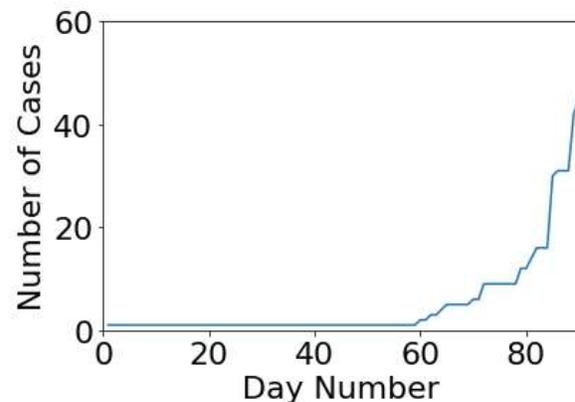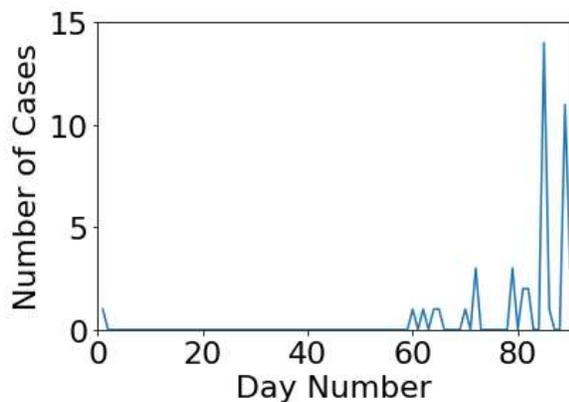


**Figure 8. (a) Waveform indicating the number of cases per day from day 1 to day 90 (b) Waveform indicating the cumulative number of cases from day 1 to day 90**

The waveform above shows the number of COVID19 cases seen in Nepal from Day 1 (Sporadic Transmission onset) to Day 90 (second day of Community Transmission). It is clear from the diagram that the second case was seen only after 60 days of the first case. However, after the second case, the graph starts to incline showing the increment in the number of patients. This shows the slow increment in the number of cases in Nepal while comparing to the other countries in the world.

Comparison of scenario in Nepal and Abroad
Till the onset of the third stage of the COVID19 pandemic in Nepal, no death cases were seen. However, it is important into take in account the risk factors in the future. The south Asian nations have almost a similar lifestyle, cultural norms, and economic status of the people. Therefore, we have compared the scenario in Nepal with the other south Asian nations namely Bhutan, India, Maldives, Sri Lanka, Pakistan, Bangladesh, and Afghanistan.
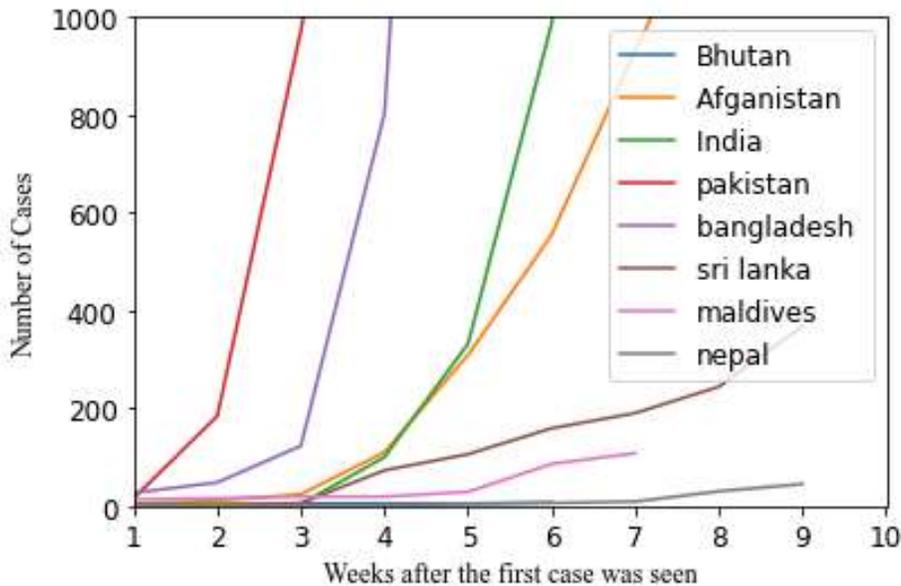


**Figure 9. COVID19 cases increment trends in the south Asian Nations for the first 10 weeks**

Figure 6 in this section represents the case increment nature seen in all the South Asian nations for the first ten weeks. We can see that in the most populated four countries of the region, namely India, Pakistan, Bangladesh, and Afghanistan, the number of cases crossed 1000 within the first few weeks. However, four other countries—Nepal, Sri Lanka, Maldives, and Bhutan—have a controlled increase in the number of cases.
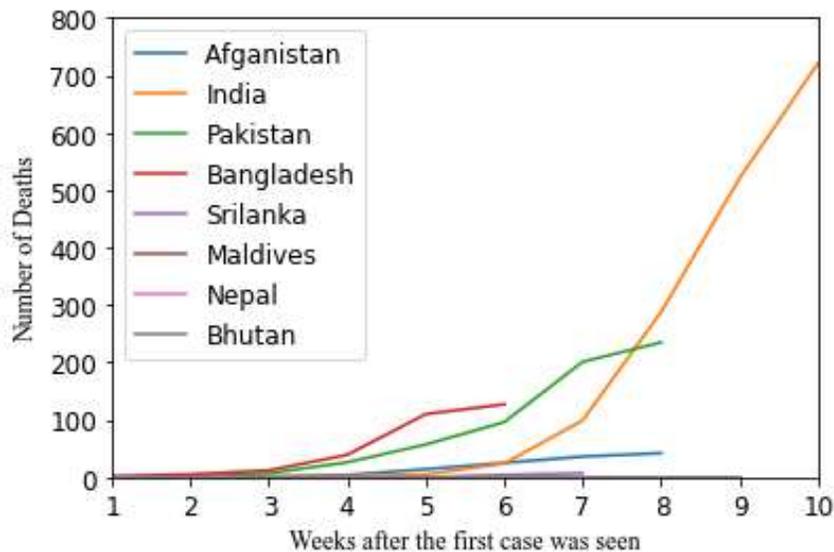


**Figure 10. COVID19 cases increment trends in the south Asian Nations for the first 10 weeks**

Similarly, it is seen that Nepal, Maldives, and Bhutan are the countries having no death cases until the first 10 weeks of the pandemic. This is the significant information to deal with as in most of the nations around the world, the death cases start to appear within this period.

All in all, Nepal has controlled the exponential increment and delayed the onset of stage 3. On a positive note, the major credits behind this go to the support that the government has received from the people in the implementation of lockdown. However, the lack of test facilities in the first few weeks can be another cause due to which the numbers were significantly low for the first few weeks. But still, Nepal comes in the better half of South Asia in controlling the outspread of the pandemic jointly with Maldives and Bhutan.

## 5. CONCLUSION

Nepal's initial response to COVID-19 was comparably slow but the government accelerated the efforts after COVID-19 was declared as a 'global pandemic' by WHO. Government of Nepal's steps to lock down the nation and shut down the land border and international flights prevented the risk of spread of COVID 19 from abroad countries. Furthermore, the countrywide lockdown afterwards prevented the spread of COVID-19 from the infected people who came to country before lock down. These all steps are in the right direction but very few cases were confirmed till the seventh week after first cases was seen. However, the significant growth in the number of confirmed cases after that shows there was a lack of testing facilities in country. However, the government's efforts are commendable to slow down the spread and delay the community spread. Inferring from the data, Nepal is in a better situation than many other countries in the world and in better position in comparison to many other countries in south Asia. However, aggressive efforts should be taken by the government and the testing facilities should be maximized throughout the nation. In the meantime, government should also extend the health service by hiring a greater number of doctors and nurses, importing PPE, ventilators and other medical facilities to Nepali hospitals. Meanwhile, public should also practice non pharmaceutical methods like social distancing, personal hygiene habits like hand washing, using tissues, and also quarantining the people through contact tracing. If government and public both equally fight against this global pandemic likewise, Nepal can be an example of how a society can respond quickly to a crisis and protect themselves.

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