Turkish Research Journal of Academic Social Science

Available online, ISSN: 2667-4491 | www.turkishsocialscience.com | Turkish Science and Technology

COVID–19 response of the Himalayan province of Uttarakhand in India and lessons for disaster risk reduction

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A R T I C L E I N F O

Research Article

Received : 22/02/2021
Accepted : 20/05/2021

Keywords:
COVID-19
Uttarakhand
Quarantine centre
Disaster management
Biological disaster

A B S T R A C T

COVID-19 has been adequately managed in Uttarakhand province of India after witnessing a peak towards the end of September, 2020 and the study recommends (i) efficient manpower management for sustained operations, (ii) developing secondary cadre, (iii) strict enforcement of COVID-19 safety measures during upcoming Holi festival in March 2021, (iv) utilisation of lessons learns from quarantine centre operations for the management of relief camps, (v) revision of disaster management plans and SOPs to make these practical, brief and operation oriented, and (vi) planned and effective public awareness campaign incorporating appeal to little tradition and customs of the masses.

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Introduction

In December, 2019 a number of cases of pneumonia of unknown aetiology were reported from Wuhan in Hubei province of China with a large proportion being associated with the Huanan seafood market (Huang et al., 2020; Hui et al., 2020; Lu et al., 2020; WHO, 2020; Zhu et al., 2020). Analysis of throat swabs of the infected persons confirmed an outbreak while deep sequencing analysis revealed novel coronavirus (CoV) as being its cause (Woo et al., 2010). First named 2019-nCoV by the World Health Organisation (WHO) this virus was later renamed COVID-19 (WHO, 2020 a, b).

CoVs are enveloped, non-segmented, positive-sense RNA virus belonging to family Coronaviridae and the order Nidovirales that are broadly distributed in humans and other mammals (Woo et al., 2010; Cui et al., 2019; Mohammadi et al., 2020) and contain crown-shaped characteristic peplomers of 80–160 nM size with 27–32 kb positive polarity (Woo et al., 2010; Cui et al., 2019; Zhou et al., 2020). These cause illness ranging from common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS)-CoV and Severe Acute Respiratory Syndrome (SARS)-CoV. WHO declared the 2019-nCoV outbreak as a Public Health Emergency of International Concern (PHEIC) on January 30, 2020 (WHO, 2020 c, d).

Basic reproduction rate, a measure of transmissibility of the virus, ranging between 2.24 and 3.58 COVID-19 spreads through droplets (Zhao et al., 2020). Public gatherings as also social interactions thus have the potential of increasing the transmission. Social and physical distancing were therefore put forth as a preventive strategy.

Global coverage, mounting fatalities, detection of mutant variant, fast resurgence and efficacy of vaccines still not completely proved, have together made COVID-

19 a major concern for the world community. The situation has not spared even the largest and most thriving economies and mounting stress of administrators, health professionals and disaster managers engaged in containing the transmission could make the situation worse.

Like other countries, India has also been severely affected by the pandemic. With its huge population of 1,201.1 million (Census of India, 2011) and generally low literacy level (74.0%) as also poor access to healthcare facilities, India figures amongst the most affected countries.

Like many other affected countries, India also has administrative apparatus and organisational structure to tackle the situation. Soon after being impacted by the Indian Ocean Tsunami in December, 2004 India enacted Disaster Management Act in 2005 and has a 3-tier structure of Disaster Management Authorities at nation, state and district level and these have been conferred extensive powers and authority. It is however a reality that despite being recognised as a distinct category, biological disasters have not been accorded due priority by the disaster managers, as these have not caused major losses in recent times (Figure 1). Overwhelmed by scientific progress in the field of disease control and eradication, as also the impact of recurring floods and cyclones together with intermittent huge losses by earthquakes, the disaster managers had not visualised a biological disaster of this magnitude. The medical fraternity has therefore not been in the mainstream of disaster management with their role restricted generally to post-disaster casualty management, triage, first aid, medical care and psychosocial support.

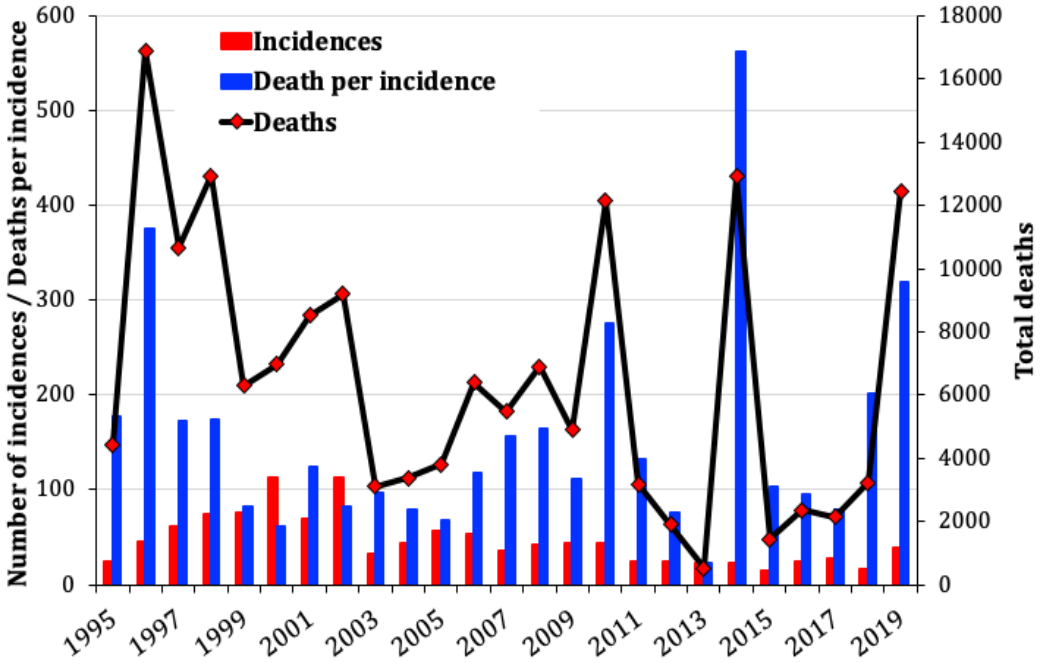

Figure 1. Global impact of epidemics over previous 25 years; 1995-2019
(Data source: www.emdat.be)

So there generally existed no operational and well-rehearsed protocols, SOPs, and plans in the realm of disaster management framework to tackle a biological emergency. The state of medical infrastructure and access to healthcare have also not been good and the same is reflected in low ranking of India in global healthcare access and quality (HAQ) index. COVID-19 thus become a major challenge for India and the present communication analyses the scenario in Uttarakhand province of India.

COVID-19 in India

The first case of COVID-19 in India was reported from Kasaragod district of Kerala on February 3, 2020 with the infected individual having travelled from Wuhan and reached Kanhangad on January 27, 2020 via Guangzhou, Kolkata, Bengaluru, Cochin and Angamaly (Vaman et al., 2020).

Most COVID-19 infected persons detected initially in the country had a foreign travel history and therefore authorities focused on identifying, tracing, testing and isolating persons with travel history, particularly to COVID-19 infected countries. However on March 10, 2020 of the first 50 COVID-19 positive cases in India, 10 did not have any travel history but had come in contact of someone who had travelled abroad. At that time only 01 COVID-19 infected person had neither foreign travel history nor contact with anyone who had travelled abroad.

Soon thereafter on March 30, 2020 more than 300 persons linked to a Tablighi Jamaat congregation in Delhi were found COVID-19 positive. Of these many were from Indonesia and Malaysia and had gathered in a Muslim religious congregation at Tablighi Markaz in the Nizamuddin area of Delhi that is global headquarter of the Tablighi Jamaat which originated in pre-independence period as an Islamic revivalist movement (Ali 2003). By April 4, 2020 the number of COVID-19 positive persons linked to this congregation increased to 1,023 (Kumar 2020). The attendees of the congregation had however dispersed by this time and were suspected of carrying the virus to their native places, posing a threat of broader community spread (Quadri 2020). A massive exercise was thus launched by the authorities to identify, trace, test and isolate Tablighi Jamaat attendees. Adequate attention

could therefore not be paid initially on screening and testing of persons routinely entering the country, as also provinces thereof.

Nationwide lockdown was however imposed from March 25, 2020 and the restrictions therein were eased from June 1, 2020 in a phased manner. With the restart of economic activities as also enhanced testing, there was an increase in COVID-19 cases. The positivity rate (confirmed cases/tests) for India thus increased from 2.5% in the pre-lockdown period to 6.4% in the post-lockdown phase, suggesting increase in positive cases with increased number of tests. The case fatality rate however came down from 3.6% in the first phase of lockdown to 1.5% in the post lockdown period (Table 1), which is lower as compared to other countries including Italy (3.5%), Spain (2.4%), UK (2.6%), and USA (1.7%) as on January 15, 2021 (Worldometer). The recovery rate also improved significantly from 12.5% in the first phase of lockdown to 101.0% in the post lockdown phase, which is an encouraging sign amidst the continuing coronavirus crisis (Rai et al., 2020).

COVID-19 Induced Restrictions

With rampant poverty, low income levels, large migrant population, low literacy rate, poor access to healthcare, and fragile social security system, lockdown was not an easy decision for the state. However taking note of the scenario around the globe and rapidly increasing number of COVID-19 cases (Table 1) the state decided to implement it as a strategy to buy time for putting in place required healthcare infrastructure as also to make masses aware of COVID-19 appropriate social behaviour.

The lockdown was implemented in a phased manner; Phase I (March 25 to April 14, 2020), Phase II (April 15 to May 3, 2020), Phase III (May 4 to 17, 2020), and Phase IV (May 18 to 31, 2020) and gradually lifted from June 1, 2020 with continuing restrictions in containment zones identified by public health authorities.

With minor variations suiting local ground realities restrictions imposed in the province have been similar to those in other parts of the country details of which are summarised in Table 2.

Table 1. Impact of COVID-19 in India during different phases of lockdown and thereafter*

S	Head	Pre lockdown[1]	Lockdown				Unlock		Total
			Phase I[2]	Phase II[3]	Phase III[4]	Phase IV[5]	Phase V[6]	Phase VI[7]	
1	NC	571	10,914	31,294	52,920	94,949	3,95,143	93,47,117	99,32,908
2	NT	22,694	2,22,199	8,01,557	11,81,192	15,09,385	48,60,510	14,75,90,107	15,61,87,644
3	ND	1	395	1,067	1,562	2,382	12,005	1,26,721	1,44,133
4	NR	3	1,362	10,398	25,032	55,067	2,55,979	96,80,241	1,00,28,082
5	PR	2.5	4.9	3.9	4.5	6.3	8.1	6.3	6.4
6	CFR	0.2	3.6	3.4	3.0	2.5	3.0	1.4	1.5
7	RT	0.5	12.5	33.2	47.3	57.9	64.8	103.6	101.0

*****Data source: www.covid19india.org; S: Sl. No.; NC: Number of cases; NT: Number of tests; ND: Number of deaths, NR: Number of recoveries, PR: Positivity rate (%); CFR: Case fatality rate (%); RT: Recovery rate (%); [1]January 30 -March 24, 2020; [2]March 25– April 14, 2020; [3]April 15- May 3, 2020; [4]May 4– 17, 2020; [5]May 18-31, 2020; [6]June 1– 30, 2020; [7]July 1– December 15, 2020

Table 2. Summary of restrictions imposed by the government of India to restrict the spread of COVID-19*

S	Head	Lock				Unlock	
		PI[1]	PII[2]	PIII[3]	PIV[4]	PV[5]	PVI[6]
1	Offices of government of India (GOI), provincial governments and Union Territories together with their autonomous / subordinate offices and public corporations	CL	FLA	FLA	FLA	FLA	FLA
2	Commercial, private and industrial establishments	CL	CL	OR	OR	OR	OR
3	Air travel	S	S	S	S	DFA	DFA
4	Metro rail service	S	S	S	S		
5	Railways	S	S	S	O	O	O
6	Public transport	S	S	S	AR	A	A
7	Hospitality service	S	S	S	S	A	A
8	Education /training / research / coaching institutions	CL	CL	CL	CL		AR
9	Places of worship	CL	CL	CL	CL	O	O
10	Shopping malls	CL	CL	CL	CL	A	A
11	Cinema halls, gymnasiums, sports complexes, Swimming pols, entertainment parks, theatres, bars, auditoriums and assembly halls	CL	CL	CL	CL	AR	AR
12	Social/political/ sports/entertainment /academic /cultural/religious functions/gatherings	B	B	B	B	B	AR
13	Inter-state movement of persons	CL	CL	CL	A	A	A
14	Inter-district movement of persons	CL	CL	A	A	A	A
15	E commerce	S	S	EG	A	A	A

*Source: Ministry of Home Affairs, Government of India orders that are available at www.mha.gov.in; S: Sl. No.; [1]March 25 – April 14, 2020; [2]April 15 - May 3, 2020; [3]May 4 – 17, 2020; [4]May 18 – 31, 2020; [5]June 1- 30, 2020; [6]July 1 – December 15, 2020; CL: Closed; FLA: Functional with limited attendance; OR: Operational with restrictions; S: Suspended; DFA: Domestic flights allowed; O: Operational; AR: Allowed with restrictions; A: Allowed; O: Open; B: Barred; EG: Essential goods only

Uttarakhand: Geography and Demography

Shaped largely by socio-economic profile of the population together with the state of health infrastructure, the problems faced in managing COVID-19 were different and diverse for the constituent provinces of India. This communication reviews COVID-19 related situation in the Himalayan province of Uttarakhand in India (Figure 2) that shares international frontiers with Nepal to the east and Tibet (China) to the north and provincial boundaries with Himachal Pradesh to the west and Uttar Pradesh to the south.

Uttarakhand with its capital at Dehradun, is the 27th state of Union of India that was carved out of Uttar Pradesh on November 9, 2000. With geographical area of 53,484 sq km the province has a population of 1,00,86,292 (Census of India 2011). The province comprises of two administrative divisions; Kumaun in the east and Garhwal in the west. Kumaun division comprises of 6 of the 13 districts of the province; Almora, Bageshwar, Champawat, Nainital, Pithoragarh, and Udhamsingh Nagar and accounts for 39.33% of the geographical area with Pithoragarh being the largest district accounting for 13.40% area of the province and 34.08% area of the Kumaun division. Uttarkashi and Chamoli of Garhwal division are however the largest districts of the province accounting respectively for 14.99% and 14.06% area. Together these two districts account for 47.87% area of the Garhwal division.

6 districts of Kumaun division account for 41.93% population of the province. Udhamsingh Nagar with 16.35% population of the province and 38.99% of the division is the most populous and densely populated (540 persons per sq km) district of Kumaun. Haridwar and Dehradun of Garhwal division with 18.74% and 16.82% population of the province are however the most populous and densely populated districts of the province with population density of 801 and 549 persons per sq km respectively as against provincial average of 189. Together these two districts account for 61.24 percent population of Garhwal division (Figure 3 and 4).

Topography and ruggedness of the terrain have a direct impact on access and the same is responsible for differential economic development. Elevations in Uttarakhand range between 190 m (Sharda Sagar) and 7,816 m (Mt. Nanda Devi) above mean sea level and the same is controlled by geo-tectonic setup of the region. From south to north Himalayan Frontal Fault (HFF), Main Boundary Thrust (MBT), Main Central Thrust (MCT) and Tethyan Fault constitute the main tectonic discontinuities of the Himalayan orogen that are exposed in the province. These respectively separate Indo-Gangetic Plain, Outer Himalaya, Lesser Himalaya, Central Crystallines and Tethyan Himalyan tectonic units and along these sudden increase in elevations is observed. Outer and Lesser Himalayas with gentle topography support major portion of the population of the province.

Distribution of population being controlled by ease of access and availability of resources, o4 plain districts of the province; Dehradun, Haridwar, Udhamsingh Nagar and Nainital account for 61.38% population despite having only 22.30% geographical area. Though having significant area in the plains Pauri Garhwal is not considered a plain district as most of the plain area of the district falls under reserve forest and is devoid of human habitations. The plain districts of the province have population density of 519 as against 94 for the hill districts.

Demographic changes in Uttarakhand have been shaped largely by migration. Able bodied, young and educated men constitute major share of the migrants from the hill districts, as also province (Mittal et al., 2008, Jain 2010), with many settling down in the plain districts that provide better employment and economic opportunities. The plain districts thus have a large floating population of migrant workers and students coming from far and wide. Means of access being generally dependent on topography, the plain districts of the province are better connected by road, rail and air. Jolly Grant in Dehradun and Pantnagar in Udhamsingh Nagar are operational airports in the province while Naini Saini in Pithoragarh, Chinyalisaur in Uttarkashi and Gauchar in Chamoli have airstrips. All the plain districts together with Kotdwar in Pauri Garhwal and Tanakpur in Champawat have rail connectivity.

Figure 2. Location of Uttarakhand province in the map of India (above) and the map of Uttarakhand (below) depicting administrative boundaries of the constituent districts with four plain districts of the province depicted in colour

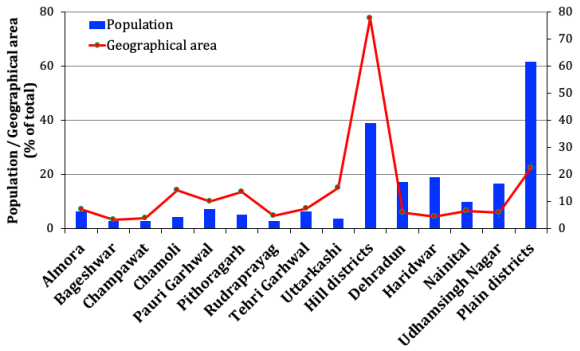

Figure 3. Population and geographical area of the constituent districts of Uttarakhand
(Data source: Census of India 2001)

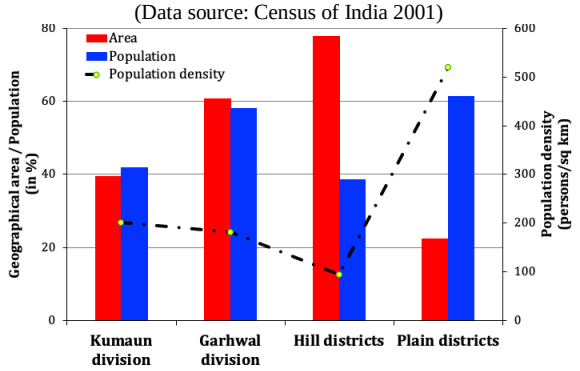

Figure 4. Comparison of population and geographical area of Garhwal and Kumaun divisions as also hill and plain districts of Uttarakhand.
(Data source: Census on India, 2001)

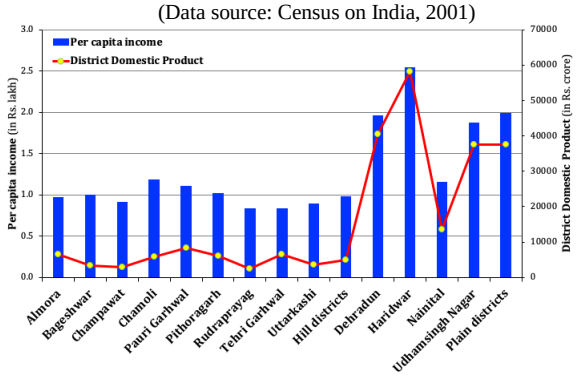

Figure 5. Diagram depicting per capita income and district domestic product for the constituent districts of Uttarakhand state.
(Data source: Directorate of Economics and Statistics, Government of Uttarakhand, https://des.uk.gov.in/files/Statistical__Diary_2018-19.pdf)

Connectivity being important for access to market as also ease of transportation of raw material, the plain districts are better industrialised and the same is reflected in their higher per capita income and district domestic product; per capita income of the plain districts being 103% more than the hill districts with their district domestic product being 653% more (Figure 5).

Uttarakhand: Healthcare Status

COVID-19 being a health emergency it is pertinent to have an overview of the healthcare related benchmarks for the province. In 2015-16 infant mortality rate was reported as being 40 deaths per 1,000 live births and only 58% children in the province were fully immunized with only 9 and 16% pregnant women in rural and urban areas respectively receiving full ante-natal care. Similarly, 64 and 79% deliveries in rural and urban areas respectively took place in medical institutions (IIPS 2016, Annual Health Survey 2017).

According to National Family Health Survey under-nutrition amongst women (indicated by a Body Mass Index < 18.5 kg/m^2) was 18% in 2015-16 with 16% men being underweight. Anaemia was identified as being a major problem with 60% children in the age group 6-59 months together with 45% women being anaemic (IIPS 2016, Annual Health Survey 2017). According to Annual Health Survey, 2012 arthritis has been the most frequently reported illness (2019 diagnosis per 1,00,000 persons) in the province, with diabetes, TB and asthma being diagnosed more amongst men and arthritis and hypertension amongst women (Annual Health Survey 2014).

In the year 2012 State Health Society listed difficulties in providing services in remote, sparsely populated areas and the shortage of health professionals was cited as being a major constraint inhibiting improvement in health outcomes (Joe et al., 2012). The province faces severe shortage of healthcare workers and this fact is substantiated by the fact that the density of doctors, dentists, nurses and midwives in the state in 2009 was 0.39 per 1000 persons (Hazarika 2013) which was the third lowest amongst the provinces in India and critically below the threshold of 2.28 recommended by the World Health Organization for high coverage of essential health services (WHO 2006). In 2009, the density of doctors in the state was sixth lowest amongst provinces in India (0.31 per 1000 population) with density of nurses and midwives (0.08 per 1000 people) being the lowest (Hazarika 2013).

According to a 2012 study problems being faced by people in accessing healthcare services were related to more than 58% approved posts for medical officers, 27% of auxiliary nurse midwives (ANMs) and 35% of staff nurses being vacant. This study indicated that deliveries were being conducted by community health workers and nurses in most public health facilities and out of 18 district hospitals (DHs) and 55 community health centres (CHCs) in the province, only 11 DHs and 6 CHCs had the capacity to conduct caesarean sections and abortions in the first and second trimesters (Annual Health Survey 2014).

Introduced in the province in 2008 Rashtriya Swastha Bima Yojana (RSBY) with Rs. 30,000 (~ 429 US$) worth of annual coverage for a family of 05 intended to provide health insurance for poor families. Studies however suggest that RSBY has not been successful in providing significant financial protection for inpatient care (Karan et al., 2017) and (i) inability of public hospitals to provide care due to a dearth of medical professionals, and (ii) some medical procedures not being covered by RSBY have been highlighted as difficulties associated with the implementation and expansion of RSBY, especially in the hill districts of the province (Rajasekhar et al., 2011, Devadasan et al., 2013, Karpagam et al., 2016, Nandi et al., 2016, Karan et al., 2017).

Review of the healthcare facilities of the province in March, 2020 clearly shows that the province was not prepared to face the pandemic and provide required isolation and ICU facilities to COVID-19 patients. At that time there existed only 1,200 isolation beds, 673 oxygen supported beds and 216 ICU beds in the entire state. To add

to it there existed only 01 facility for undertaking COVID-19 tests and reports were therefore not received promptly. This added to the misery and trauma of the masses besides severely overburdening the limited healthcare facilities.

Spread of COVID-19 in Uttarakhand

The first case of COVID-19 in Uttarakhand was reported from Dehradun on March 20, 2020. The infected person had travelled from Madrid, Spain via New Delhi. During the lockdown period (March 25 – May 31, 2020) COVID-19 cases were recorded sporadically and just 5 deaths were attributed to it in the entire province, of which 03 were in Dehradun and 01 each in Pauri Garhwal and Nainital districts.

The spread of the contagion was rather slow during the lockdown period and only 465 cases were reported till May 31, 2020. This is attributed to low testing rate with only 22,244 persons being tested in this period and 75.6% of these restricted to 04 plain districts. High positivity rate in the beginning is attributed to the fact that only persons showing COVID-19 symptoms were tested in that period. There is however a marked difference in the spread of COVID-19 in the hill and plain districts of the province.

Low positivity rate in the hill districts in the beginning (Table 3) is attributed to limited number of tests carried out till May 17, 2020 and restrictions on travel. With increase in the testing rate towards the end of the lockdown positivity rate registered an increase and stabilised around 3.9. Case fatality rate (dead / confirmed cases) in the hill districts has been less than 1.0.

Table 3. Progressive impact of COVID-19 in the hill districts of the province between March and December, 2020*

S	Head	Pre lockdown	Lockdownn			Unlock			Total
			Phase I[2]	Phase II[3]	Phase III[4]	Phase IV[5]	Phase V[6]	Phase VI[7]	
1	NC	0	1	2	2	161	603	26,623	27,392
2	NT	0	98	217	445	4,666	15,079	6,76,812	6,97,317
3	ND	0	0	0	0	1	10	200	211
4	NR	0	1	1	0	5	950	24,946	25,903
5	PR	0.0	1.0	0.9	0.4	3.5	4.0	3.9	3.9
6	CFR	0.0	0.0	0.0	0.0	0.6	1.7	0.8	0.8
7	RT	0.0	100.0	50.0	0.0	3.1	157.5	93.7	94.6

*Data source: www.covid19india.org; S: Sl. No.; NC: Number of cases; NT: Number of tests; ND: Number of deaths, NR: Number of recoveries, PR: Positivity rate (%); CFR: Case fatality rate (%); RT: Recovery rate (%); [2]March 25– April 14, 2020; [3]April 15- May 3, 2020; [4]May 4– 17, 2020; [5]May 18-31, 2020; [6]June 1– 30, 2020; [7]July 1– December 15, 2020

Table 4. Progressive impact of COVID-19 in the plain districts of the province between March and December, 2020*

S	Head	Pre lockdown	Lockdown			Unlock			Total
			Phase I[2]	Phase II[3]	Phase III[4]	Phase IV[5]	Phase V[6]	Phase VI[7]	
1	NC	9	30	27	17	208	634	60,531	61,456
2	NT	47	470	3,570	3,048	9,484	16,219	9,65,372	9,98,210
3	ND	0	0	0	0	4	26	1,277	1,307
4	NR	0	8	29	15	43	1,179	57,979	59,253
5	PR	19.1	6.4	0.8	0.6	2.2	3.9	6.3	6.2
6	CFR	0.0	0.0	0.0	0.0	1.9	4.1	2.1	2.1
7	RT	0.0	26.7	107.4	88.2	20.7	186.0	95.8	96.4

*Data source: www.covid19india.org; S: Sl. No.; NC: Number of cases; NT: Number of tests; ND: Number of deaths, NR: Number of recoveries, PR: Positivity rate (%); CFR: Case fatality rate (%); RT: Recovery rate (%); [2]March 25– April 14, 2020; [3]April 15- May 3, 2020; [4]May 4– 17, 2020; [5]May 18-31, 2020; [6]June 1– 30, 2020; [7]July 1– December 15, 2020

Table 5. District wise impact of COVID-19 in the province between March and December, 2020*

S	Unit considered	Dead	Infected	Samples	Recovered	Positivity rate (%)	Case fatality rate (%)	Recovery rate (%)
1	Almora	24	3,004	65,387	2,755	4.6	0.8	91.7
2	Bageshwar	18	1,455	41,846	1,327	3.5	1.2	91.2
3	Champawat	8	1,703	79,692	1,521	2.1	0.5	89.3
4	Chamoli	24	4,304	80,956	3,177	5.3	0.6	73.8
5	Pauri Garhwal	57	4,958	1,12,452	4,752	4.4	1.1	95.8
6	Pithoragarh	38	3,188	80,879	2,736	3.9	1.2	85.8
7	Rudraprayag	10	2,202	46,936	2,111	4.7	0.5	95.9
8	Tehri Garhwal	16	3,998	94,482	3,732	4.2	0.4	93.3
9	Uttarkashi	16	3,543	94,688	3,292	3.7	0.5	92.9
10	Hill districts	211	28,355	6,97,318	25,403	4.1	0.7	89.6
11	Dehradun	845	26,684	3,13,246	24,559	8.5	3.2	92.0
12	Haridwar	147	13,013	2,52,736	12,729	5.1	1.1	97.8
13	Udhamsingh Nagar	109	10,789	2,62,886	10,713	4.1	1.0	99.3
14	Nainital	206	10,976	1,69,587	10,102	6.5	1.9	92.0
15	Plain districts	1307	61,462	9,98,455	58,103	6.2	2.1	94.5
16	State	1518	89,817	16,95,773	83,506	5.3	1.7	93.0

*Data source: www.covid19india.org

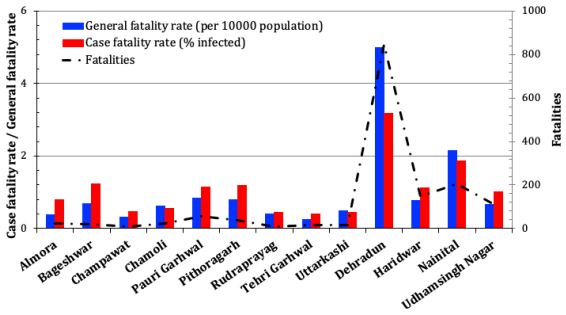

Figure 6. Diagram depicting COVID-19 related death rate both as a function of infected persons and population together with number of deaths.
(Data source: www.covid19india.org)

In the plain districts of the province (Table 4) testing rate was relatively high from the beginning. The positivity rate however registered a decline after an initial high and the same is attributed to the restrictions on the movement of persons during the lockdown period. Positivity rate however showed a sharp increase with the relaxation in movement norms in Phase IV of the lockdown (May 18 – May 31, 2020). The same however stabilised around 6.2. High case fatality rate is a cause of concern for the plain districts and has witnessed sharp rise in the post lockdown phase.

In the initial phase the returnees of the hill districts were restricted to the border districts and allowed to travel only after completing the stipulated quarantine period. This accounts for low rate of COVID-19 testing in the hill districts during the lockdown period. As in the plain districts positivity and case fatality rates increased after travel norms were relaxed in the last phase of the lockdown.

As is expected from the number of samples collected as also majority of the suspected returnees being restricted to the plain districts, the positivity and case fatality rates in hill districts remained significantly lower than plain districts (Table 5). With the end of the lockdown the province however witnessed large ingress of returnees and with this the number of COVID-19 cases started to increase.

Average positivity rate for the province (5.3%) is however lower than national average (6.4%). Higher case fatality rate of 1.7% as against national average of 1.5% is however a cause of concern. The number of COVID-19 deaths as also death rate, both as a function of infected persons and population, have been the highest in Dehradun as compared to other districts of the province (Figure 6).

Initiatives of the Provincial Government

With increase in the number of COVID-19 infected persons the provincial government and district administration initiated a number of proactive measures for restricting mass propagation of the virus. The details of these measures are summarised in the sections below.

Lockdown and the Stranded Persons

Economic activities of various sort, particularly in the plain districts, routinely support livelihood of large number of persons. With the COVID-19 induced lockdown this population, working largely in unorganised sector was rendered without means of livelihood. Even though shops of essential items were operational for limited hours during the day, it was realised that many families thriving on daily income lacked purchasing power to procure even the essential food items. Moreover, many requests were received for home delivery of essential items including medicines and drugs from the persons belonging to the upper strata of the community, particularly with co-morbid health condition.

Dedicated 24X7 COVID-19 helpline was quickly started in all the districts to get to know the problems of various sections of the community and address these, so as to avoid mass discontent and unrest. For this assistance and support of civil society groups and nongovernmental organisations was mobilised. Measures were also put in place for the delivery of cooked food as also dry ration together with other items of daily requirement to the persons identified by the helpline. Arrangements were also put in place for the distribution of dry ration through Police Stations. The demand of the persons requesting medicines, drugs and other essential items were recorded by the helpline and these items were delivered by the volunteers on payment basis.

As all the hotels and restaurants were closed during the lockdown period the authorities ensured that the persons engaged in the transportation and supply of essential items are provided food and resting space. Dedicated mobile vans were also operated for this.

Diagnostic Facilities

Being highly infectious the COVID-19 positive persons have to be quickly detected and restrained from intermingling with other persons. In March, 2019 there existed only one COVID-19 testing and diagnostic facility in the state at Dr. Susheela Tiwari Government Medical College at Haldwani in Nainital district and thus there was general delay in receiving the reports that increased to the burden of isolation facilities besides adding to the trauma of the persons being tested and their family members.

Efforts were therefore made to create COVID-19 testing and diagnostic facilities in both in government and private sector. At present COVID-19 related tests of the samples collected by various agencies of the provincial government are thus being carried out at 11 facilities of the government and 08 of the private sector. Apart from this, many other facilities of the private sector have been allowed to undertake COVID-19 related tests. Rates for these tests have been decided by the state for the private diagnostic facilities that are also providing sample collection service on request basis. For the state run facilities samples of high risk groups are regularly being collected from different places across the state and random sampling is being resorted to from places with high footfall. Reports of the tests are being provided through internet and WhatsApp. Augmentation of testing facility has helped in early detection and isolation of the infected persons in accordance with the state policy of test, trace and treat.

Public Awareness

Spread of COVID-19 being associated with human behaviour and personal hygiene the risk of fast transmission of the infection was high in India as physical contact in various forms is a customary, social and ritualistic requirement. Moreover people generally gather

in large numbers on various familial celebrations as also religious and ritualistic occasions. The norms of COVID-19 appropriate behaviour not being a habit for large proportion of the population, the state therefore started a massive awareness drive to communicate (i) the threat posed by COVID-19, (ii) likely symptoms of COVID-19, (iii) ways of minimising the risk of infection, and (iv) course of action in case of symptoms.

In this context, a strategic communication approach was adopted and multi-pronged campaign was carried out by the Information and Public Awareness Department of the provincial government using various tools to ensure voluntary compliance of various safety measures.

Print media: Information on health advisories, do's and Don'ts for COVID-19 prevention, government guidelines, management protocols for pandemic situation, and arrangements being made by the state were regularly disseminated through advertisements in both English and vernacular newspapers and magazines.

Outdoor media tools: Outdoor media tools including hoardings and others carrying messages on various aspects of COVID-19 infection were installed at prominent locations, cross roads, highways, near malls and other places having high footfall.

Electronic media: Innovative and engaging radio jingles, video spots, short films on COVID-19 appropriate behaviour and safety protocols were prepared and disseminated through radio, community radio, FM radio and cable/satellite channels.

Social media: Various social media platforms were utilised for disseminating health advisories, government guidelines, COVID-19 protocol and related information.

Printed material: Leaflets, pamphlets, and guidelines both in English and vernacular were prepared on health advisories, government guidelines, COVID-19 protocol and others and disseminated throughout the province with the engagement of civil society groups and nongovernmental organisations.

Health bulletin: Lack of access to authentic and reliable information often causes misinformation and panic amongst the masses and the chances of the same have increased by manifold with the advent of social media. Health bulletins depicting the actual situation were therefore issued by the State Control Room and the same were disseminated through media.

Contact Tracing

The nature of COVID-19 warrants speedy tracing, surveillance and testing of all persons who have come in physical contact of the person who has been tested positive. Dedicated unit was therefore established in the province for (i) preparing repository of persons who have been tested COVID-19 positive, (ii) gathering movement details of COVID-19 positive persons, (iii) identifying persons who might have come in physical contact of COVID-19 positive person, (iv) ensuring home isolation of these suspected persons, (v) keeping track of the health condition of home isolated persons, and (vi) testing of persons who show COVID-19 symptoms. Mobile phone records are also being utilised for verifying the movement history of the COVID-19 positive persons and tracing persons who have been in their proximity during previous some days.

Containment Zone Management

In order to ensure that the persons living in the proximity of COVID-19 positive persons do not intermingle with others and contain themselves within the specified limits, containment zones were notified by the authorities in accordance with the guidelines of the Ministry of Home Affairs, Government of India, for a duration of 10 days under Uttarakhand Epidemic Diseases, COVID-19 Regulations 2020 and Epidemic Diseases Act 1897. Barricading was resorted to at all entry points to the notified containment zone and police personnel were deputed on 24X7 basis to ensure compliance of the restrictions and no trespassing. Punitive measures are accordingly initiated against violators (Table 6 and 7).

Surveillance of the health condition of persons living in the notified containment zones and in the buffer zones around these was resorted to. Besides testing of persons showing COVID-19 symptoms random samples were also collected both from containment zone and buffer zone.

Appropriate measures were put in place by the authorities to rule out unreasonable discomfort to the residents of the containment zone and routine supply of medical, health and essential items was maintained.

Mandatory Provisions

Wearing of mask in public places and ensuring social distancing has been made mandatory by invoking relevant provisions of Disaster Management Act 2005, as also Uttarakhand Epidemic Diseases, COVID-19 Regulations 2020 and Epidemic Diseases Act 1897 and penal provisions have been put in place for violators. With the opening of business establishments the responsibility of ensuring COVID-19 appropriate behaviour within the business premises and ensuring thermal screening and hand sanitization facility at the entrance has been entrusted upon the management of the business establishments.

Fines are being imposed against persons violating the norms of COVID-19 appropriate behaviour. Till December 31, 2020 fines have accordingly been imposed against 1,61,860 persons for the violation of social distancing norms while 5,65,478 persons have been fined for not wearing mask (Table 6). Those fined for not wearing mask are being provided masks free of cost and thus 9,39,565 masks have been distributed amongst the defaulters and the same amounts to 9.32% of the population of the province. 994 persons have been fined for violating norms of quarantine while 86,331 persons have been fined for various other violations and 4,712 persons have been fined for violation of lockdown norms. Penal action against 8.12% of the population; 9.57% of the plains and 5.83% of the hills shows that strict action is being taken against violations of any kind.

A total of Rs. 2672.36 lakh (~US$ 3.82 million) has thus been recovered in the province from violators of COVID-19 norms; Rs. 246.49 lakh (US$ 0.35 million) for violation of Police Act, Rs. 1387.44 lakh (US$ 1.98 million) for violation of Motor Vehicle Act, and Rs. 1038.43 lakh (US$ 1.48 million) for violation of Epidemic Act (Table 7).

Table 6. District wise details of punitive measures imposed on the violators of COVID-19 norms (March – December, 2020)*

District	Violation					Total	Total (% of population)
	Social distancing	Mask	Quarantine	Lockdown	Others		
Almora	8,241	17,884	34	23	3,239	29,421	4.73
Bageshwar	3,667	13,942	60	164	2,058	19,891	7.65
Champawat	1,677	16,069	59	199	836	18,840	7.26
Chamoli	2,156	8,342	15	40	2,784	13,337	3.41
Pauri Garhwal	14,208	27,027	20	152	3,147	44,554	6.48
Pithoragarh	2,790	9,555	90	141	5,888	18,464	3.82
Rudraprayag	2,224	6,736	39	13	290	9,302	3.84
Tehri Garhwal	24,443	32,554	51	150	1,360	58,558	9.46
Uttarkashi	2,276	11,027	60	125	1,256	14,744	4.47
Hill districts	61,682	1,43,136	428	1,007	20,858	2,27,111	5.83
Dehradun	20,022	1,87,999	50	817	7,584	2,16,472	12.76
Haridwar	52,415	94,536	214	1,002	9,580	1,57,747	8.34
Nainital	22,416	73,554	90	708	27,758	1,24,526	13.04
Udhamsingh Nagar	5,325	66,253	212	1,178	20,551	93,519	5.67
Plain districts	1,00,178	4,22,342	566	3,705	65,473	5,92,264	9.57
State	1,61,860	5,65,478	994	4,712	86,331	8,19,375	8.12

*Data source: State Emergency Operations Centre, Government of Uttarakhand

Table 7. District wise details of fine imposed (in Rs. lakh) on persons violating COVID-19 related norms (March – December, 2020)*

District	Fine imposed (in Rs. lakh)			Total (in Rs. lakh)
	Police Act	MV Act	Epidemics Act	
Almora	11.2	77.35	41.06	129.61
Bageshwar	6.92	35.71	27.32	69.95
Champawat	5.42	45.31	23.38	74.11
Chamoli	6.98	41.7	18.45	67.13
Pauri Garhwal	6.28	83.72	64.13	154.13
Pithoragarh	21.16	83.96	14.37	119.49
Rudraprayag	6.02	25.27	14.72	46.01
Tehri Garhwal	4.21	36.38	11.2	51.79
Uttarkashi	10.5	35.7	17.54	63.74
Hill districts	78.69	465.1	232.17	775.96
Dehradun	22.7	135.55	319.31	477.56
Haridwar	25.26	197.4	225.24	447.9
Nainital	37.87	361.52	156.2	555.59
Udhamsingh Nagar	81.97	227.87	105.51	415.35
Plain districts	167.8	922.34	806.26	1896.4
State	246.49	1387.44	1038.43	2672.36

Data source: State Emergency Operations Centre, Government of Uttarakhand

Surveillance

For early detection and prevention of community spread of COVID-19 infection telephonic and door to door physical surveillance of the health condition of the individuals is also being resorted to throughout the province. Serological surveillance that is a long term goal of the state, is being resorted to through antibody testing for herd immunity and vaccine efficacy.

Treatment Facilities for COVID-19 Patients

Due to highly infectious nature of COVID-19 dedicated treatment facility is required for the patients. Moreover, serious patients have to be provided intensive care with ventilator support. 11 dedicated COVID-19 hospitals (DCH) and 27 dedicated COVID-19 health centres (DCHC) have accordingly been set up throughout the province and the capacity of these has been adequately enhanced in all the districts and the same is evident from the details summarised in Table 8. Major proportion of these facilities; 359 ICU beds (42.9%) and 273 ventilators (39.3%) are however in Dehradun district alone. Nevertheless, as compared to facilities available in the province in March, 2020 there is a marked improvement in the facilities that reflects the magnitude of effort put in.

Isolation of COVID-19 Patients and Suspects

Despite acknowledging the importance of isolating both COVID-19 positive and suspected persons, authorities were finding it difficult to accommodate all positive and suspected cases in designated DCHs and DCHCs with the increase in COVID-19 cases. Separate isolation facilities have therefore created and at present these can accommodate 31,540 patients. The COVID-19 positive persons are being given the option of choosing unpaid institutional or paid isolation facility. The persons opting for paid isolation facility are being provided food and accommodation at the rate of Rs. 1,500 (~ US$ 21) per day.

With most educational institutions being closed the authorities facilitated the support of their management and most institutional isolation facilities were established in their premises.

With the designated isolation facilities becoming overwhelmed the authorities created 422 additional COVID-19 Care Centres (CCCs) for accommodating asymptomatic and suspected persons. A nodal officer was designated for the management of every isolation facility and CCCs and medical and paramedical staff were deputed in these for regularly monitoring health condition of the inmates.

Registration / Travel Assistance

Having traumatized by the COVID-19 induced lockdown and ensuing economic uncertainty large population was awaiting relaxation in movement norms so as to move to their native places. With large population of migrants the authorities in the province realised the challenges in store for them well in advance and entrusted the responsibility of organising planned and accounted movement of persons to Dehradun Smart City Limited. This initiative later helped the authorities in tracing travel and contact history of COVID-19 positive persons.

Online registration on the web portal of Dehradun Smart City Limited together with travel pass issued online were therefore made mandatory for all inter-state and inter-district movement of persons. This measure helped the authorities in restricting the movement of persons in accordance with available transportation, screening, testing and quarantine capabilities. This together with quarantine of the persons in the border districts delayed the spread of COVID-19 to hill districts of the province.

Travel Arrangement for Stranded Persons

With the federal government easing travel restrictions the migrants stranded in the district as also those coming from adjoining districts were getting impatient to initiate their travel. With public transport not fully operational required travel arrangements for these persons were made by the provincial government.

The Returnees

Uttarakhand has a large population of persons working in various states across the country, largely in unorganised sector. Many of these were rendered jobless on the aftermath of COVID-19 induced lockdown and ensuing economic uncertainty. These persons were therefore left with no option but to return to their native places. According to a report of the Migration Commission, Government of Uttarakhand 2,15,85 persons returned to their native places till the end of June, 2020 due to COVID-19 related situation (Table 9) and 82.37% of the returnees were from outside the state. Of these 59,360 returned in the first phase till the end of March, 2020.

Most of these persons entered the state through the plain districts where arrangements were made for their screening, testing, quarantine, isolation and treatment before sending them to their respective destinations.

Table 8. Details of some of the facilities available for COVID-19 related treatment.

Sl. No.	Facility	As in March, 2020	As in December, 2020	% increase
1	Isolation beds	1,200	31,540	2528.3
2	Oxygen supported beds	673	3,535	425.3
3	ICU beds	216	836	287.0
4	Ventilator beds	116	695	499.1
5	Oxygen cylinders	1,193	9,917	731.3
6	Oxygen concentrators	275	1,275	363.6
7	Ambulances	214	364	70.1
8	Oxygen generation plant	1	8	700.0

Table 9. District wise details of persons returning to Uttarakhand. (Data source: Report of the Uttarakhand Rural Development and Migration Commission, www.uttarakhandpalayanayog.com)

Sl. No.	District	Number of returnees
1	Almora	43,784
2	Bageshwar	1,925
3	Champawat	15,097
4	Chamoli	5,877
5	Pauri Garhwal	60,440
6	Pithoragarh	5,451
7	Rudraprayag	7,656
8	Tehri Garhwal	19,242
9	Uttarkashi	19,405
10	Dehradun	2,254
11	Haridwar	3,136
12	Nainital	9,650
13	Udhamsingh Nagar	21,958
	Total	2,15,85

Screening at the Border

As per the directions of the provincial government all the persons entering its geographical limits were quarantined at a place close to the state border for specified duration of 7 days before they could intermingle with others or continue their onward journey. Dehradun, Haridwar, Udhamsingh Nagar and Nainital districts being major entry points for persons travelling to other districts facility for screening, testing and quarantine were created by the authorities in these districts.

Inter-state and inter-district boundary Police check points were activated together with the ones at inter state bus terminals, railway stations and airports on 24X7 basis to register the details of the persons entering the state, undertake preliminary thermal screening and direct them to the nearest quarantine centre. Medical teams were deputed to at these check points for sample collection and isolation of suspected persons. Random sampling of inbound persons was also resorted to at these check points.

Quarantine of The Returnees

Quarantine centres were organised by the authorities for the returnees, largely in the plain districts. Paid quarantine facilities were also created whereby hotels were acquisitioned under relevant provisions of the Disaster Management Act, 2005. The persons opting for paid quarantine facility were charged Rs. 1,500 (~US$ 21) per day.

Many instances were reported from across the state whereby the local residents fearing spread of COVID-19 did not allow returnees to enter the village boundary and intermingle with the residents. The village headmen (Gram Pradhan) were therefore provided resources for organising quarantine facilities for the returnees in the community owned facilities in and around the village for the stipulated duration and were entrusted responsibility of reporting COVID-19 symptoms to the health authorities.

Home Quarantine

Certain category of persons coming to the province were exempted from institutional quarantine and permission was accorded for their home quarantine. A system was put in place to monitor movement details, health condition and compliance of COVID-19 appropriate behaviour by home quarantined persons through COVID-19 helpline with the support of citizen groups, housing societies, civil society and nongovernmental organisation and volunteers, apart from ASHA workers. Movement of the home quarantine persons was also tracked using the location of their mobile phone and the defaulters were penalised.

Home Isolation

With increase in active COVID-19 cases the provincial government has allowed home isolation of asymptomatic patients in case they have adequate facilities at home to abide by social distancing norms. These persons are being provided a home isolation kit containing (i) a finger tip pulse oximeter, (ii) a thermometer, (iii) 50 triple layer masks, (iv) 100 ml hand sanitizer, (v) 15 tablets of Vitamin C, (vi) 2 tablets of Vitamin D3, (vii) 10 tablets of paracetamol, 500 mg each, (viii) 01 red BMW bag, and (ix) COVID-19 related awareness material. The authorities are regularly monitoring movement details and health condition of the home isolated persons through COVID-19 helpline and have mobilised support of citizen groups, housing societies and civil society and nongovernmental organisation and volunteers for the same. The movement details of the home isolated persons is also being tracked using the location of their mobile phone and the defaulters were penalised.

Comorbidity Surveillance Centre

With high risk of COVID-19 to comorbid persons data pertaining to these was collected from the chemists as also state treasury. Health condition of the persons so identified is being regularly monitored over telephone and medical advice and assistance is being provided as and when required.

Travel Arrangements for Returnees

After completing the stipulated quarantine period arrangements were made by the authorities for the onward journey of the returnees. For this staging area was set up at a suitable place in the plain districts. Public transport not being operational, authorities mobilised vehicles for the onward journey of these persons.

Corona Warriors

In view of high risk to which medical and paramedical personnel, particularly those engaged in various COVID-19 related duties, are exposed the federal government has provided special insurance cover to them. On its part the provincial government has declared all personnel engaged for various COVID-19 related duties as Corona Warriors and pledged to cover the entire cost of their COVID-19 treatment, if required, together with an assistance of Rs. 10 lakh (~US$ 14,286) to their next of kin in case of death out of Chief Minister Relief Fund.

Treatment expenses of all Corona Warriors infected by COVID-19 are being quickly reimbursed while next of kin of Corona Warriors who loose their lives are being provided the pledged assistance.

Medical and Paramedical Staff: Logistics Support

The medical and paramedical personnel engaged in COVID-19 related duties often desist intermingling with their family members due to the fear of possible transmission of COVID-19. Taking cognizance of their concern the authorities are arranging logistic facilities for medical and paramedical personnel. Hotels have been accordingly directed under relevant provisions of Disaster Management Act, 2005 to resume operations and cater to the logistics requirements of the medical and paramedical personnel. This decision of the authorities has boosted the morale of the health practitioners and motivated them to undertake their duties with full dedication.

Sanitisation of Public Places and Offices

Regular sanitisation of all public places including government offices and private establishments, particularly in all urban areas is being ensured on weekly public holiday. Urban local bodies have been specifically instructed to undertake dedicated sanitization drives on regular intervals and separate financial assistance has been provided for the same.

Last Rites

Last rites of an individual, particularly amongst Hindus that constitute the majority in India, hold special ritualistic and religious significance. However, due to lacking conclusive data on survival time of virus in the dead body the SOPs do not allow family members and close relatives of COVID-19 infected persons to attend the last rites. To add to it the management of the cremation sites also resists last rites of the COVID-19 patients.

Taking cognizance of this situation the authorities have notified sites for the last rites of COVID-19 persons and are ensuring compliance of customary religious rites and rituals in case relatives of COVID-19 persons are not present. All protective measures are being ensured and all persons engaged in last rites are being provided protective gear.

Vulnerable Population

In view of high risk of COVID-19 to certain group of persons, particularly children, aged, pregnant women and ones suffering with co-morbid conditions, the authorities have issued special advisories appealing these group of persons to stay indoors to the extent possible, follow COVID-19 appropriate behaviour and not intermingle with other persons. The provincial government has also exempted this category of persons, where engaged in service, from attending the office and continue working from home.

Challenges Faced in the Province

With no formal record of economic status and means of livelihood of persons, identifying persons requiring assistance during the initial lockdown phase and ensuring home delivery of ration and other essentials to them was a major challenge faced by the authorities.

During the lockdown phase large number of persons routinely approached the authorities for travel concessions citing different reasons. Verifying authenticity of the reasons so put forth was another challenge faced by the authorities.

The persons put under quarantine were physically fit and had no symptoms of COVID-19 or any other disease. They therefore perceived being detained as their harassment and did not cooperate with the management of the quarantine centres. Catering to the demands of these persons and keeping them engaged was thus a major challenge. The authorities therefore resorted to preparing weekly menu of food to be served and sought their advice for improving the same. The inmates were also engaged in various productive pursuits and motivated to attend physical training and Yoga sessions that were regularly organised in quarantine centres. Sports and television facilities were also provided to the inmates of the quarantine centres.

With fear psychosis attached to COVID-19 and its highly infectious nature management of isolation facilities has been a major challenge for the authorities. It has been hard to motivate persons to provide services of various sort in these facilities. In such a condition ensuring hygiene, regular cleanliness and disposal of waste material has became a challenge for the facility management. Use of disposable utensils and bed sheets is thus being resorted to, so as to minimise the burden of cleaning and washing. To add to it personal protective gear is being provided to all personnel providing various services in isolation facilities and their COVID-19 test is being done at regular intervals.

Restricting the spread of COVID-19 requires abidance of norms of physical distancing and sanitisation. Apart from mass awareness and punitive measures the authorities are resorting to free distribution of hand wash, sanitizer and mask. All business establishments, and service providers have been instructed not to undertake any transaction unless the customers abide by COVID-19 appropriate behaviour.

Ensuring norms of social distancing in public transport has been a major challenge as the service providers deny operations with reduced passenger capacity and the ones availing the service do not agree to pay more for empty seats. The authorities are therefore ensuring wearing of masks in public transport together with regular sanitisation of the vehicles.

Ensuring dignified last rites of the COVID-19 positive persons maintaining norms of physical distancing and also abiding by ritualistic requirements has been a major challenge as neither civil society organisations nor religious groups volunteer to participate in this. Moreover both the local community and management of the cremation grounds object to last rites of COVID-19 persons. The authorities have therefore notified separate cremation grounds at appropriate place for COVID-19 persons and provided personal protective gear for those engaged in last rites.

Discussion

The COVID-19 infection trend in the hill districts (Figure 7) shows a threshold towards the end of August 2020 and thereafter it has been hovering around the same. COVID-19 trend in the plain districts (Figure 8) has been similar to the province and one can logically conclude that the trend of the plain districts has shaped the overall trend of the province. Daily positive cases in the plain districts peaked around the middle of September 2020 and registered a gradual decrease thereafter till the end of October, 2020 after which the COVID-19 cases witnessed another wave of increase.

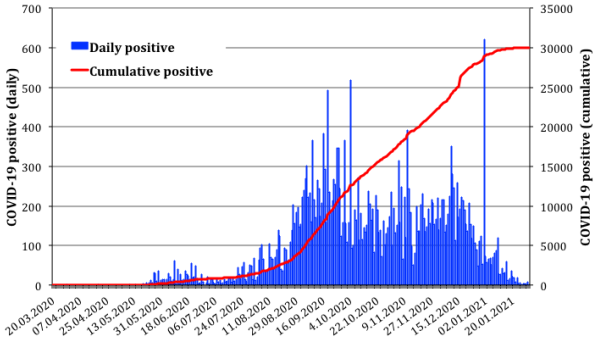

Figure 7. COVID-19 infection trend in the hill districts of Uttarakhand for the period March 20 to January 31, 2021. (Data source: www.covid19india.org)

The first peak is attributed to ingress of the returnees while the second is attributed to the festival season in India; Dushehra and Deepawali being celebrated respectively on October 25 and November 14, 2020. This period also

coincided with marriage season in India and it is customary for friends and relatives to gather on these occasions.

The measures put in place by the authorities to restrict and discourage free movement of perons and quarantining the returnees in the district of their entry for a specified duration delayed the spread of COVID-19 to hill districts and the same is evident from the time lag observed in the spread of COVID-19 to the hill districts of the province (Figure 9).

With first COVID-19 cases being reported from the province on March 20, 2020 there was a distinct time lag in the spread of COVID-19 to the hill districts of the province. Amongst the hill districts it was Pauri Garhwal that shares a long and porous border with Uttar Pradesh where the first COVID-19 case was reported relatively early on March 29, 2020, i.e. within 10 days of the first case being reported in the province. However no COVID-19 case was reported from any other hill district for more than a month and the spread of COVID-19 was largely restricted to the plain districts of the province.

It was on May 10, 2020; i.e. on 52nd day of the first case being reported in the province that a COVID-19 case was reported from any other hill district, i.e. Uttarkashi. As for other hill districts the time lag was more than two months. COVID-19 was reported from Bageshwar and Chamoli on May 19, 2020 (61st day), from Pithoragarh and Almora on May 20, 2020 (62st day) and from Rudraprayag on May 29, 2020 (71st day).

Except for Tehri Garhwal and Almora districts the spread of the contagion in the province was rather slow and took significant time but after the initial threshold, the spread was relatively fast, particularly in the plain districts.

Being transmitted from outside and largely contained at the border districts geographical remoteness delayed the spread of the contagion. This provided time to the health department authorities to gear up their preparedness for facing the situation. This is substantiated by the very fact that despite witnessing relatively high rate of infection Champawat, Chamoli, Rudraprayag, Tehri Garhwal and Uttarkashi districts have recorded a low case fatality rate.

As regards the returnees (2,15,875), hill districts account for 82.86% of which Pauri Garhwal and Almora respectively have 33.79% and 24.48%. Of the 17.14% returnees to the plain districts Udhamsingh Nagar and Nainital account for 59.35% and 26.08% respectively (Figure 10).

Infection rate as a function of the population is observed to be slightly higher in the plain districts (Figure 10); 0.99% as against 0.73% for the hill districts. Uttarkashi (1.07%) and Chamoli (1.10%) however show relatively higher infection rate amongst the hill districts. Amongst the plain districts Dehradun has the highest infection rate of 1.57% followed by Nainital (1.15%). High infection rate in the plain districts of the province is attributed to the fact that almost all the returnees, except for a proportion of those coming to Champawat and Pauri Garhwal, travelled through the plain districts which resulted in higher exposure level of the population of these districts to the contagion.

Despite healthcare infrastructure being better developed in the plain districts case fatality rate in these is observed to be significantly high (2.13%) as compared to hill districts (0.74%).

Case fatality rate being an indicator of the success of the measures taken by the authorities and shows different trend for hill and plain districts of the province (Figure 11). After an initial peak in the middle of June 2020 both in plain and hill districts, there is a gradual decrease, particularly in the hill districts. Case fatality rate trend for the plain districts remains above 1.5 all through and shows two phases of resurgence at the end of July and September, 2020. The first peak as also first resurgence in the plain districts is attributed to the ingress of the returnees.

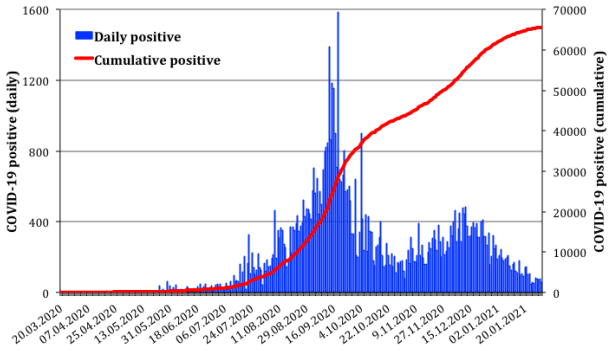

Figure 8. COVID-19 infection trend in the plain districts of Uttarakhand for the period March 20 to December 31, 2020. (Data source: www.covid19india.org)

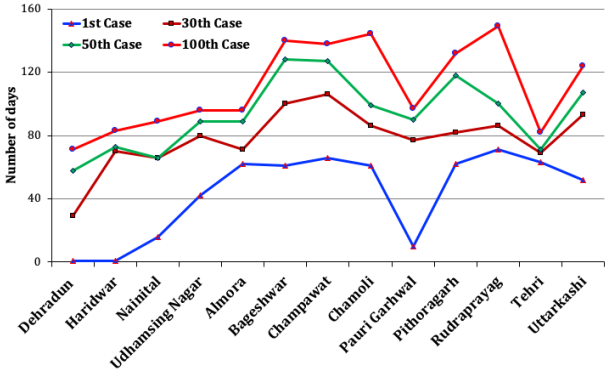

Figure 9. Time lag in reporting of COVID-19 cases in the districts of Uttarakhand.
(Data source: www.covid19india.org)

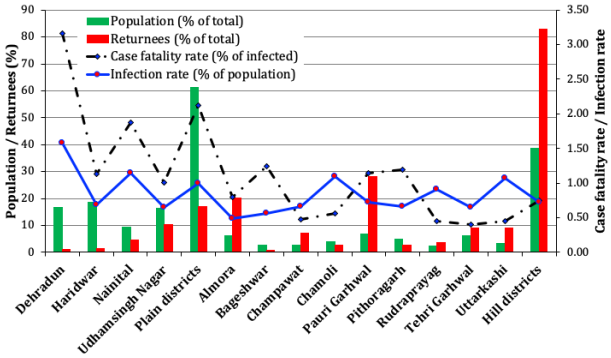

Figure 10. COVID-19 infection (infected/population) and case fatality rate (dead/infected) along with population and returnees.
(Data source: www.covid19india.org)

The case fatality rate in the plain districts correlates positively with infection rate (confirmed cases/population) but that same does not hold good for hill districts (Figure 10). Bageshwar (1.24%), Pithoragarh (1.19%) and Pauri Garhwal (1.15%) show relatively high case fatality rate amongst the hill district and the same is comparable to

Udhamsingh Nagar (1.01) and Haridwar (1.13) districts in the plains. In the plains Dehradun (3.17%) and Nainital (1.88%) have the highest case fatality rate as also general fatality rate (death /population) despite having relatively better healthcare facilities. This is a cause of concern and reasons thereof are required to be probed in detail.

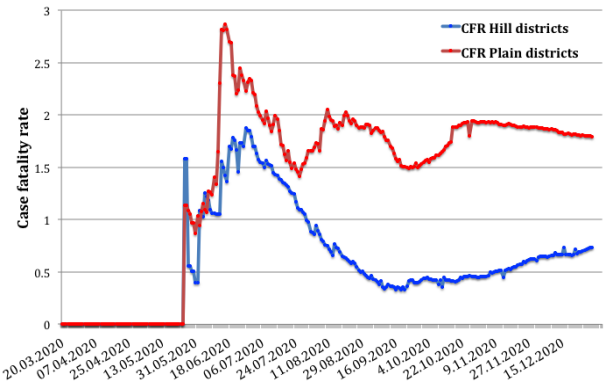

Figure 11. Case fatality rate in the hill and plain districts of the province.
(Data source: www.covid19india.org)

Case fatality rate is observed to be lower than infection rate in Champawat, Chamoli, Rudraprayag, Tehri Garhwal and Uttarkashi. Together with all the plain districts death rate is higher than infection rate in Almora, Bageshwar, Pauri Garhwal and Pithoragarh districts.

Though the returnees are often blamed for the spread of COVID-19 to the remote hilly districts there exists no correlation to prove the same. Almora and Pauri Garhwal with maximum number of returnees do have relatively high infection rate and case fatality rate but this does not hold good for all the districts.

Way Forward

Civil administration as also various service providers thereof have neither been trained nor have the experience of handling emergencies for a prolonged duration. It has been almost nine months and one is still counting. With time required both for mass delivery of the vaccine and establishing efficacy, potency and longevity of the vaccination, spread of a more infectious mutant variety to different countries is a cause of concern and there seems no logical end in near future. The fatigue is sure to take its toll and lower guards of the concerned authorities and their service providers, as also general public. This might result in the resurgence of the contagion. It is therefore a must that Covid Warriors are efficiently managed by way of (i) optimised short duties, (ii) regular rotation, (iii) regular breaks, (iv) skill enhancement opportunities, (v) motivation and destressing sessions, (vi) additional incentives, and (vii) development of a secondary cadre capable of seamlessly replacing them at a short notice.

The efforts of the authorities have so far managed the situation well but high case fatality rate particularly in Dehradun and Nainital districts is certainly a major cause of concern. Early detection by way of mass testing and intensive care, particularly for comorbid persons, is therefore advised. Analysis of COVID-19 infection trend shows resurgence after the festive season in October – November, 2020 which is attributed to relaxation provided to the public. It is therefore advised not to relax the norms of safety and ensure strict compliance of COVID-19 appropriate behaviour in all public places at all times and impose stringent penalties on defaulters, particularly during the upcoming Holi festival in March end that is traditionally celebrated by Hindu population in a particularly physical form. Together with this stringent measures are recommended during forthcoming Kumbh Mela (April 1-17, 2021) and Assembly Elections in five provinces (March 27 – April 29, 2021). Lowering of guard during these is sure to result in the resurgence of the contagion.

The phase of mass movement of persons being over, the quarantine centres are not being organised presently but whenever required these should have adequate facilities for productively engaging the inmates. Lessons learnt in managing quarantine centres should be applied by the authorities in more efficient management of relief camps that are often organised on the aftermath of most major disaster incidences.

The situation has brought forth the need of having robust disaster management plans and SOPs, as also mechanism for coordination with civil society groups, nongovernmental agencies and other stakeholders. Till now it has been a routine practice to prepare plans and SOPs just to fulfil customary requirements and these were often not consulted while managing the disaster situation. The evolutionary nature of the present emergency has however changed the situation. This has made not only the authorities but also public habitual of locating, going through and abiding by the latest guidelines issued by the state. On their part, authorities have mastered the skill of preparing brief and practical SOPs and instructions. This skill should now be utilised for preparing afresh plans and SOPs for efficient management of disasters.

The community at large has learnt to abide by laid down protocols and procedures. In the changed situation people have started to reprogram even their familial functions to suit the prevailing guidelines of the state. The authorities should ensure that this habit does not die out and for this it should continue mass propagation of new or changed rules together with strict compliance of these.

The systems put in place for contact tracing, quarantine and treatment would certainly be helpful in efficient and speedy delivery of the vaccine as it becomes available. This would rule out the possibility of another phase of the pandemic. This experience should also be utilised by the administration for better and coordinated management of disasters in times to come.

In the present situation authorities have recognised the importance of voluntary compliance of COVID-19 appropriate behaviour and therefore major emphasis is being given on public awareness relating to ways of containing the spread of the virus. There is however clear repetition of efforts resulting in wastage of resources. Adequate attention is at the same time not being paid on preparing, programming, designing, quality control, branding, promotion and propagation of the product that is resulting in monotonous and unattractive outputs that fail to put across a lasting message. It is therefore required that all resources allocated by different agencies for public awareness be pooled centrally and dedicated towards aggressively launching an entertaining, appealing, educative, attractive and impactful public awareness campaign. The awareness

drive should also utilise the appeal to little tradition, local context and customary rules of the target audience. The authorities can therefore design a customised awareness program for the tribal people of the province in vernacular with a distinct appeal to their little tradition and culture. Likewise another campaign can be branded around some celebrity with an appeal to the urban population.

COVID-19 has brought the medical professionals to the centre stage of disaster management. Moreover the federal government's decision to allow 50% allocation of State Disaster Response Fund for upgrading various healthcare facilities has helped in augmenting the health infrastructure. It is required that the authorities ensure close and continuing involvement of the medical fraternity during all phases of the disaster management cycle.

The experience gained in managing COVID-19 situation is sure to strengthen the disaster management framework in the country. It is however required that the lessons learnt are authentically documented and analysed and put forth with appropriate recommendations for the consideration of National and State Disaster Management Authorities for innovatively planning various disaster risk reduction initiatives.

Acknowledgements

Besides colleagues, the authors thank officials of Disaster Management and Health Departments of the Government of Uttarakhand together with USDMA, SEOC, and DDMAs of all the districts for support, cooperation and data sharing.

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