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COVID-19 LOCKDOWN RELATED DEPRESSION AND IMMUNE SUPPRESSION: IMPACT ON HUMAN RESOURCE AND INDIAN ECONOMY

Goutam Dutta[1]✉

Abstract:

Unanimously lockdown is the most scientific way to flatten the curve of COVID-19. But, lockdown has the negative influence on social, psychological, physiological and economical aspects of life as well. Under this health emergency situation, the depression is playing its role as silent killer on immune suppression. Physiologically the immune suppressed people are more prone to any viral infection like COVID-19. Moreover, there are so many adverse effects of depression on our health. Therefore, it is a challenge to minimize the depression related immune suppression caused by the pandemic of Covid-19. The Government of India should admit the truth of physiology in the light of depression related immune suppression during the lockdown period. Without the sweat of healthy human resources, money cannot reform Indian economy. Therefore, many anti-depressant strategies have to be taken by the Government to minimize the psychological depression linked directly with the health of human resources. Therefore, this is the high time to think positively about the anti-depressant strategies to minimize and flatten the curve of COVID-19 in future.

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1.0 Introduction:

The novel coronavirus (COVID-19) disease emerged in China in December 2019 (Wenwu et al., 2020). On 3rd January, 2020, Chinese officials provided information to WHO on the cluster of cases of 'viral pneumonia of unknown cause' identified in Wuhan (www.who.int/covid-19/ information). The first case of death from the novel Corona virus was reported by the Chinese media on 11th January, 2020. On 4th April, 2020, WHO reported that over 1 million cases of COVID-19 had been confirmed worldwide (www.who.int/covid-19/information). On 4th April, 2020, WHO reported that over 1 million cases of COVID-19 had been confirmed worldwide (www.who.int/covid-19/information). In the meantime, COVID-19 has achieved the status of the pandemic, leading to an urgent need for the world to take joint action to combat against COVID -19 globally. The high communicable property of coronavirus makes it more dangerous and mysterious. The COVID-19 virus structural protein strikes to the heme part of hemoglobin and displaces the oxygen. As a result, there are free iron ions responsible for toxicity and inflammation. Many developed countries are trying to develop the therapeutic treatments based

1 [Author] ✉ [Corresponding Author] Assistant Professor, Dept. of Physiology, Prabhat Kumar College, Contai, West Bengal, India.E-mail: emailgdutta@gmail.com

on the symptoms.

This type of highly communicable disease is always dangerous for the densely populated countries like India. But from the experience of the rest of the world, India has taken a bold step of complete lockdown from 25th March, 2020. Unfortunately, India cannot afford a prolonged period of lockdown with the major percentage of poor Indians who live on hand to mouth. The lockdown period may have some direct or indirect effect on depression on our society, especially on the migrant workers, employees of unorganized sectors, labors of small factories, employees of private sectors and people living on daily wages. We have deep concern for them because they are the backbone of the financial crisis-management strategies of India in the post-lockdown period.

In physiology, the immunity and depression are closely related to each other. Immunity can be defined as a complex biological system with the capacity to protect us from the foreign pathogens. There is cross talk between the immunity and depression to maintain the homeostasis of the human physiology. Immunosuppression is a reduction of the activation or efficacy of the immune system. There are enough evidences on the basis of the effect of depression on immunomodulation (Bartorp et al., 1977; Cappel et al. 1978; Helsing et al., 1981; Schleifer et al., 1983). Physiologically there are so many reasons behind immune suppression, but the lockdown-based psychological depression-related immune suppression is the enlightened point in this present circumstance. In the upcoming days, these immune suppressed people of India may be the major issue behind the reconstruction of the Indian economy. The chance of unavailability of non-COVID-19 healthy human resources will increase due to this immune suppression.

The Government of India already has taken different financial initiatives to minimize the adverse effects of lockdown in term of allocated funds and ensured credit guarantees to various sectors, including real estate, rural employment, Covid-19 vaccine research, and Atma Nirbhar Bharat Rozgar Yojana (Ministry of Finance, Government of India, 12th May, 2020). The Ministry of Ayush, Government of India is also concentrating on immune-boosting strategies on ethno-pharmacological basis (Guidelines for Ayurveda practitioners for COVID 19, Ministry of Ayush, Government of India). But the Government of India has to admit the reality of physiology in the light of depression-related immune suppression caused by the lockdown of COVID-19. Because this culprit (depression-related immune suppression) has started playing its role behind the curtain from the beginning of the lockdown.

In this pandemic, situation researchers are engaged to produce the specific antiviral drugs and vaccines to fight against COVID-19. Governments are looking forward to different economic packages for a better economic India in post COVID period. However, in this pandemic lockdown period, there are lots of causes behind the depression among all, which are not highlighted seriously. In the presentreview, the author has tried to highlight the probable causes of depression related to pandemic lockdown and some antidepressant strategies to overcome that depression.

2.0 Antiviral (COVID-19) Mechanisms of Human Body:

Viruses are obligate intracellular microbes that are capable of infecting various cell types by means of the attachment to cell-surface receptors**.** Viruses are classified on the basis of some primary and secondary characters. The primary characters are the chemical nature of nucleic acid, the structure of virion, and site of replication. The secondary characters are the host range,

mode of transmission, and specific surface structure. COVID-19 is minute in size (65 -125 nm in diameter); it contains a single-stranded RNA (26 to 32kbs) as a nucleic acid. COVID-19 possesses the typical coronavirus structure with spike protein (the spike protein of coronavirus contains a 3-D structure) and also expressed in other polyproteins, nucleoproteins, and membrane proteins, such as RNA polymerase, 3-chymotrypsin-like protease, papain-like-protease, helicase, glycoprotein, and accessory proteins (Chen et al., 2020).

In our body, once the viruses have penetrated a target cell, it altered the cellular mechanisms towards the diverse ways. The viral proteins are synthesized at the expense of host cell proteins. But our body is always ready to protect the damage against microbial infections by some pathways like innate and adaptive immunity, effective elimination, and fighting against the antigenic shift. In humans, the anti-COVID-19 strategies are of two types, i.e., innate immune responses and adaptive immune responses (Chen et al., 2020).

On the one hand, the innate immune response is protecting us by the following processes:

- By releasing the type 1 IFN (Interferon type 1) by the infected cells
- Killing the infected cells by Natural Killer (NK) cells

On the other hand, the adaptive immune response is fighting against the COVID-19 by the following two ways:

- By producing the antibody that blocks the entry of the virus into the host cells by binding the surface envelope proteins (spike proteins). This occurs in the extracellular stages of the viral life cycle. In this antibody-mediated viral immunity, the complement system is also activated and may promote phagocytosis or causing the lysis of the virus.
- Once the viral infection has become established, the CTLs (Cytotoxic T Lymphocytes) are involved in the elimination of the COVID-19 virus.

3.0 Emotion and Immunity- the Crosstalk:

From very basic examples of our daily life, we can easily understand the crosstalk pattern between psychological emotion and immune modulation. In our daily life we are facing different types of emotional stresses caused by unemployment, family life, political unrest, and bereavement. There are scientific evidences on the basis of immune modulation in such situations of our life (Pan and Long, 1993; Devi et al., 1993). According to the American Psychological Association (APA), emotion is defined as "a complex reaction pattern, involving experiential, behavioral and physiological elements." There are six basic aspects of emotions, i.e., Sadness, Happiness, Fear, Anger, Surprise, and Disgust. The limbic system of the brain is the controller of these aspects of emotion. In the neuroimmunomodulation study, the scientists are engaged to find the specific role of limbic system (amygdala, hippocampus, septum, bed nucleus of stria terminalis (BNST), hypothalamus, and cerebral cortex) on immune modulation (Table 1). The responses after lesion or stimulation (electrical/chemical) of limbic areas on immune modulation support this context (involvement of emotional regulatory centers of brain on immunity) (Fig. 1).

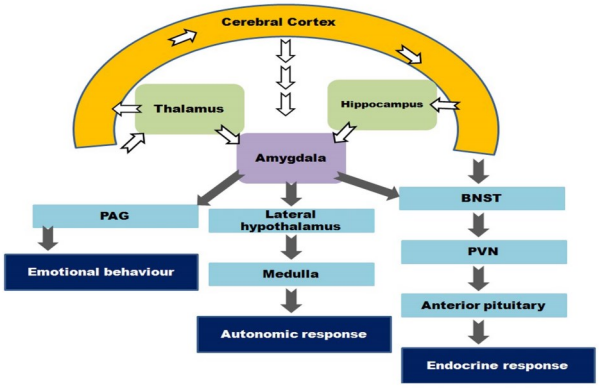
Table 1: Examples on the basis of the effect of the lesion (L) or stimulation (S) of discrete brain areas on immune responses in animals.

Brain Area	L/S (animals)	Immune Response	Reference
Anterior Hypothalamus (AH)	L (rat)	Reduced antibody production and NKCC	Tyrey and Nalbandov, 1972. Cross et al., 1984
Paraventricular nucleus (PVN)	L (rat)	Decreased phagocytic activity of neutrophils and leukocytes	Hefco et al., 2004
Medial Hypothalamus (MH)	L (rat)	Decreased thymus weight	Devi and Namasivayam, 1996
Ventromedial Hypothalamus (VMH)	S (rat)	Reduced spleen NKCC and LGL number	Wrona and Trojniar, 2005
Lateral Hypothalamus (LH)	L (rat)	Biphasic change in blood NKCC	Wrona et al., 1994
Amygdala (AMYG)	L (rat)	Increased thymocyte and splenocyte number	Brooks et al., 1982
Hippocampus (HIP)	L (rat)	Increased antibody response	Nance et al., 1987
Medial Septum (MS)	L (rat)	Decreased NKCC	Dutta et al., 2011
Medial Septum	S (rat)	Increased/ decreased NKCC	Dutta et al., 2013 and 2016
Bed Nucleus of Stria Terminalis (BNST)	L (rat)	Suppression of NKCC	Jurkowski et al., 2001
Cerebral Cortex (CC)	S (rat)	Increased T lymphocyte circulation	Moshel et al., 2005

(Source: Compiled by the author)

There are bilateral circuits between the central nervous system and the immune system. The central nervous system communicates with the immune system via the sympathetic outflow to the lymphoid organs and endocrine outflow from the central nervous system (Fig. 1). Current research also indicates that pathogens have the ability to trigger innate immune responses. There are 'Immunoactive' brain areas that include the hypothalamus, limbic structures, cortex, midbrain, cerebellum, and vagal complex. It seems that emotional stress may regulate the immune responses significantly. Therefore, the psychological depression related to COVID-19 lockdown and immune suppression has a scientific basis.

Fig. 1: The probable pathway behind the role of the limbic nucleus on the physiological responses



4.0 Emotional Aspects of Lockdown:

During this pandemic lockdown situation, we are experiencing the struggle between life and death. Our emotion is very closely related to this struggle. Different unwanted situations during the lockdown period are enough to create depression in many of us. In this segment of review, the author has tried to highlight the probable causes of depression related to lockdown.

Probable Causes of Depression Related to Lockdown:

- Chance of unemployment
- Balance between earning capital and family expenditure
- Scientific Terminology (Corona virus, Quarantine center, COVID hospital, PPE)
- Treatment facilities of COVID-19
- Occupational health care protection
- Mandatory work in adverse COVID-19 situation
- Chances of unavailability of life care medicines
- Non-COVID-19 related hospitalization and medical facilities in the present situation
- Unwanted pregnancy and effects of contraceptive pills
- Child depression due to the confinement within four walls
- Unrestricted posts in social media
- Role of electronic and print media

Table 2 (a, b, c, d): The probable causes of depression during COVID-19 lockdown on the basis of their occupation and reality of present situation with some antidepressant strategies for those depressed human resources.

2(a) Health Workers	
* Mandatory work without satisfactory personal protection. * Anxiety over the chances of their family infection. * Medical professionals and patients ratio. * Physical exertion and mental retardation. * Biomedical waste related to COVID-19. * Only earning member-related depression.	
Antidepressant Strategies for Human Resources	• Shifting duty (preparation for self-protection) with compulsory quarantine • Compulsory health checkup related to COVID-19 • Separate facilities for the treatment of COVID-19 for them and for their family members • Transport facilities with separate staying facilities (Home environment to minimize the psychological depression) • COVID-19 service-related extra remuneration to all and possibilities of Income Tax exemption. • Installation of automatic COVID-19 related biomedical waste decomposer
Allotted amounts in 'Atmanirbhar Package' may have direct relation with this point: Emergency Health Response Package:15000 Crores	
2(b) Security Workers (Police)	
* Not possible to work with Personal Protection- equipment. * Compulsory occupational dress code. * Sweat may provide the suitable environment for COVID-19 * Have to work with gathering. * Mind game as a Government servant.	
Antidepressant Strategies for Human Resources	• Available numbers of dresses during duty for regular change • Government of India should think about the special PPE for them under the surveillance of DRDO-like institutions (Not as conventional medical PPE) • Compulsory quarantine after duty under contaminant zone • Separate facilities for the treatment of COVID-19 for them and for their families • COVID-19 service-related extra remuneration to all and provision for tax exemption
2(c) Migrants Workers and Daily Earning People	
* Uncertainty of earning sources. * Larger number of family members with single earning member. * Starving situation and disheartened attitude by the distributors. * Nutritional deficiency of family. * Have to work with diverse types of workers from different locations of the country.	

Antidepressant Strategies for Human Resources	• Declaration of economic support strategies by the department of Finance, Govt. of India • Announcements of the policies reading the golden chances of foreign investments on the basis of the availability of human resources of our country • Advertisements in local language on the basis of upcoming earning possibilities • Special facilities for the COVID-19 testing/ health related issues • There should be long term 'food security related information' to all from the Govt. of India • The quality of ration should be improved on the basis of nutritional aspects, specially on protein and antioxidant • Special emphasis on the low-cost yet balanced diet planning for immune boosting and distribution of the same through proper channel • The Governmental supervision over the distribution system of cooked food to minimize the disheartened attitude by the distributors • Financial support to all the voluntary non-Govt. organizations to serve proper nutritive food • Occupational health related medical facilities and nutritional guidelines for all the work places
Allotted amount in 'Atmanirbhar Package' may have direct relation with this point: PM Garib Kalyan Package + Support to Migrant Workers + Street Vendors + Emergency Funds to Farmers: 170000 + 14502 + 30000 = 214502 Crores Other Facilities for the Business and People	
2(d) Employees of Unorganized Sectors	
* Tough target-oriented workload and job insecurity. * Alteration of salary structure. * Occupational health safety. * To maintain the earning and expenditure ratio. * Have to work with diverse types of workers from different locations of the state/country. * Loan installments. * Post lockdown negative effect on business. * Have to work with high population density markets.	
Antidepressant Strategies for Human Resources	• Announcement related to job security by the Govt. of India in the light of Honorable Supreme Court • Declaration of economic support strategies by the department of Finance, Govt. of India • Advertisements in local language on the basis of upcoming earning possibilities • Announcements related to the positive aspect of the financial growth of India in the upcoming days. • Announcements of the policies regarding the golden chances of foreign investments on the basis of the availability of human resources of our country • Government may adopt the policy like "Support economically to human resources during COVID-19 outbreak to get healthy Indian economy in future" • Should stop the unemployment related news in electronic and print media
Allotted amount in 'Atma Nirbhar Package' may have direct relation with this point: EPF Contribution + Other supports to Business like MSME support and TDS rate reduction (may have indirect relation): 2500 + 20000 + 50000 = 72500 Crores.	

(Source: Compiled by the author)

Table 2 represents some antidepressant strategies that may be adopted by the Government and non-Government sectors to minimize the depression related to pandemic lockdown. These strategies may help us to fight against COVID-19 psychologically and physiologically.

5.0 Psychological Depression and COVID-19: The Biofeedback System:

The questions may arise that why this psychological depression will be the influencing factors in the upcoming future. The unavailability of non-COVID-19 healthy Indians may be the answer. The depression-related immune suppression may increase the susceptibility of COVID-19 in the near future (Fig. 2). Depression is not only responsible for the susceptibility of COVID-19, but also it may severely attack the homeostasis of human physiology. Table 3 may explain the effect of depression on human health in different aspects.

Fig. 2: The schematic diagram on the basis of the relation among the COVID-19 lockdown, psychological depression, and immune suppression

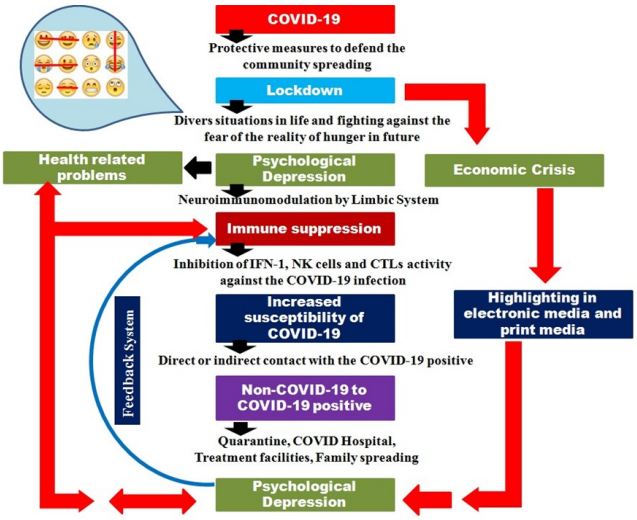


Table 3: Summary of the effect of COVID-19 related depression on different physiological systems of the human body and their physiological basis of the probable outcome of a disease or disease-related symptoms.

Physiological System	Physiological Basis	Probable Disease/Symptoms
Nervous system	Negative mood, fear, sadness, anger, disgust, surprise, anticipation, effect on cognitive processes	Anxiety, depression, hyperreactivity, chronic fatigue, mental retardation, uncontrolled emotional outbreak, loss of concentration
Immune system	Inflammation, alteration of different immune components, effects on autonomic outflow to immune glands	Immune suppression, increased susceptibility to viral communicable diseases
Digestive system	Excess secretion of HCl and pepsin, disturbed intestinal mortality	Irritable bowel syndrome, gastric ulcer/ peptic ulcer, decreased appetite, chronic weight loss, diarrhea, constipation
Cardiovascular system	Alteration of autonomic regulation, vasovagal reflex	Increase/ decrease blood pressure and heart rate
Respiratory system	Shortness of breath	Low blood O_2 saturation, nausea, headache
Reproductive system	Irregular menstrual cycle, pregnancy, lactation, autonomic and voluntary control over sex organs	Excessive menstrual pain, loss of libido dyspareunia, early parturition, may affect the cognitive development of baby, low birth weight, lactating problem, decreased interest in sex, infertility
Endocrine system	Hormonal disbalance, effect on long loop/ short loop feedback system	Type 2 diabetes, hypo and hyper secretion related symptoms on different organs and metabolism
Excretory system	Abnormal sympathetic, parasympathetic and somatic nerve control	Excess urination, pain due to abnormal micturition
Sleep	Loss of coordination between sleep and wake centers of brain	Insomnia, lake of deep sleep (good sleep), excessive dream sleep (bad sleep), oversleeping, headaches

6.0 Psychological Depression Related Immune Suppression: Impact on Indian Economy:

The COVID-19 pandemic breaks the heart of human resources more than their physical health. The economic status of India, the role of political parties, and the role of electronic and print media are the inflecting factors behind these heart-breaking situations. A majority of India's human resources are set to think about their future planning of earning during this health emergency situation. The Government of India has announced the package of 20 lakhs crore under the project of 'Atma Nirbhar India'. There are three break-ups to cover the Indian economy and human resources, i.e., Part A: Government to Business, Part B: Government to People, Part C: Government to the Banks and Financial Institutions.

These financial packages have no magical power to create a stable economy without the direct physical help of human resources. There must be some coordination between the financial facilities and physical labor of human resources. The depression during lockdown has enhanced the susceptibility of viral diseases like COVID-19 (Fig. 2). It may play an adverse role on the human physiological system in the name of diseases (Table 3). Therefore, for the proper utilization of 20 lakh crores, healthy human resources will be the influencing factor in the near future. So, the future of the Indian economy is dependent on the health of the human resources of India. Some antidepressant strategies, either related to finance or related to psychology, are the key to success behind the utilization of Atma Nirbhar Package. Therefore, on the basis of physiology, the Government should give special emphasis on making the 'Healthy India' by using the 'Atma Nirbhar Package'. Otherwise, India will have no enough human recourse in the near future to make it successful.

7.0. Non-Financial Long-Term Strategies Should be Taken by the Government: Special Emphasis on Human Resources

Proper nutrition is important for better immunity, and this relationship becomes more important during the pandemic lockdown period. Arrangement of community kitchen to serve healthy nutritious food may be one way to polish the above relationship. In this segment of the review, Diet Planning is proposed for the heavy worker. This diet planning or diet chart should be followed by the government or non-government organizations that are distributing cooked food through the community kitchen model for the locked-down people. It can be followed by the canteen of different industrial sectors also (Table 4).

Table 4: The proposed low-cost community kitchen diet chat (menu planning) for the heavy worker [RDA 2400 kcal, Carbohydrate: 420 (70%), Protein: 60 (10%), Fat: 53.3 (20%)].

Serving Time	Recipe	Ingredients	Amount (gm)	Serving portion
Early Morn-ing (7.00 AM)	Raw tea Biscuit	Water + Sugar Wheat flower	3 gm 14 gm	1 Cup 2 Piece
Breakfast (8.00 -9.00 AM)	Mashala Muri	Puffed rice + Potato fry + Onion + Carrot + Oil	60 + 40 + 10 + 40 + 5 gm	1 Bowl (big)

Serving Time	Recipe	Ingredients	Amount (gm)	Serving portion
Lunch (12.30 - 1.00 PM)	Boiled rice	Rice parboiled milled	200 gm	2 Bowl
	Dhal	Lentil	10 gm	1 Bowl (small)
	Saag fry	Amaranth leaves	100 gm	1 Bowl
	Mix Veg	Brinjal + Pumkin + Potato + Papaya + Sweet potato + Pumkin seed pest oil	70 + 50 +50 + 60 + 50 + 7 gm	1 Bowl (medium)
	Peel pakora/ vada	Potato skin + Green gram dhal + Black cumin seed + Garlic + Onion + Oil	50 + 5 + 3+ 3+ 5+2 gm	2 Piece
	Egg curry	Egg + Potato + Onion + Oil	45 + 50+ 5 + 2 gm	1 Bowl
Evening (6.30 -7.00 PM)	Flattened rice and Bengal gram	Flattened rice + Bengal gram	45 + 20 gm	1 Bowl
Dinner (10.00 PM)	Boiled rice	Rice parboiled milled	100 gm	1 Bowl (medium)
	Pumpkin curry	Pumpkin + Potato + Oil	50 +25 + 2 gm	1 Bowl (small)
	Soyabean Curry (Jhol)	Soyabean + Potato + Oil	20 + 25 +2	1 Bowl

Besides the healthy balanced diet through the community kitchen model, there should have some other strategies for the preparation of fighting against this type of unwanted pandemic situation in the future. In this segment of the review, a few suggested long-term strategies are highlighted below.

- Reduction of the intra state migration of worker
- More focus on the reduction of distance between the workstations and residence
- Special emphasis on the availability of hygienic government hospital facilities for all
- Reduction of the cost of treatment facilities
- Scientific patient-doctor ratio in government hospital
- More scientific occupational health safety guidelines
- More research fund for high class biomedical research
- Special emphasis on the basic science-based education from school level
- More and more awareness programme related to health and hygiene from the grass root level (compulsory for all educational sector)
- Strategies to reduce the density of population

8.0 Conclusion:

In India, the lockdown has been started on 26th March, 2020. After few scientific phases of lockdown, there is still alarming number of transmission or positive COVID-19 cases in India. Physiologically, immune suppressed people are more prone to any viral infections. In the present review, the author tries to explore the link or relation between immune suppression and lockdown related depression. Several antidepressant strategies have been highlighted in the present review in the flavor of economic, social, and nutritional aspects. The Government and many non-government organizations have already taken many damage-controlling steps to minimize the effect of COVID-19. However, they have to focus on the antidepressant strategies while fulfilling their goal because this is one of the ways to defend our immune suppression. The depression due to the different causes during the lockdown period may invite the second wave of Covid-19 under the dark cloud of depression-related immune suppression. Therefore, this is high time to think about different antidepressant strategies for all to have COVID-19 free India in the near future. We have enough time to think about the protective measures because we are still far away from the therapeutic medicines or vaccines. There is a lot of scope for the researchers to find the specific immune components responsible for the crosstalk between depression and immune suppression. From the point of view of economic research, there are also scopes to establish the specific strategies to reduce the depression related to lockdown.

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