Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1291 - 1306
Received 15 April 2020; Accepted 23 June 2020.

Pakistan & Covid-19 Pandemic: An Epidemiological & Public Health Approach

Muhammad Ishtiaq[1], Nadia Qazi[2], Rashid Ahmad[3], Faqir Ullah[4], Adeela Mustafa[5*], Haseeba Mukhtar[6], Syed Shahmeer Raza[7], Farhad Ali Khattak[8], Muhammad Nasir Khabir[9], Said Akbar Khan[10], Jawad Ali[11]

[1]Muhammad Ishtiaq-Professor & HOD, Department of Community Medicine & Public Health; North West School of Medicine; Hayatabad Peshawar, Pakistan

[2]Nadia Qazi-Assistant Professor; Department of Community Medicine & Public Health; North West School of Medicine; Hayatabad Peshawar, Pakistan

[3]Rashid Ahmad-Assistant Professor, Medicine, Lady Reading Hospital, MTI Peshawar Pakistan

[4]Faqir Ullah-Assistant Professor, Forensic Medicine Department, Northwest School of Medicine, Peshawar, Pakistan

[5*]Adeela Mustafa-Assistant Professor, Department of Community Medicine & Public Health; Khyber Medical College, Peshawar, Pakistan

[6]Haseeba Mukhtar-Demonstrator, Department of Community Medicine & Public Health; North West School of Medicine; Hayatabad Peshawar, Pakistan

[7]Syed Shamir Raza-Lecturer, Department of Physiology, Khyber Medical College, Peshawar, Pakistan

[8]Farhad Ali Khattak-Assistant Professor, Khyber College of Dentistry, Peshawar Pakistan

[9]Muhammad Nasir Khabir-PhD Scholar, Department of Zoology, University of Peshawar, Peshawar, Pakistan

[10]Said Akbar Khan-Associate Professor, Department of Earth & Environmental Sciences, Bahria University, Islamabad, Pakistan

[11]Jawad Ali-Assistant Professor, Environmental Science, Faculty of Life Sciences & Informatics, BUITEMS, Balochistan, Quetta, Pakistan

Correspondence Author

[5]*Adeela Mustafa-Assistant Professor,
Department of Community Medicine & Public Health; Khyber Medical College, Peshawar, Pakistan; +92-345-2909019; adeelaamir17@gmail.com

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1291 - 1306
Received 15 April 2020; Accepted 23 June 2020.

ABSTRACT

Background: The zoonotic infections have posed a significant risk to the public health security. Initially the Covid-19 outbreak started as a zoonotic infection, in Wuhan, in December 2019, but later on due to human to human transmission resulted in Covid-19 pandemic.

Objectives: To identify the Covid-19 pandemic trends in Pakistan and to compare with global Covid-19 Statistics.

Study Design: A Comparative Cross-Sectional Study

Place and Duration of Study: This study was conducted by the Department of Community Medicine North West School of Medicine, Hayatabad, Peshawar, with collaboration of Lady Ready Hospital, and Khyber Medical College, Peshawar, Khyber Pakhtunkhwa Pakistan; from March 2020 to May 2020.

Methodology: In this study, the secondary data available online was retrieved on 5th April 2020 from the WHO and Pakistan websites for identification of Covid-19 infections trends. Moreover, comparison of monthly statistics of five provinces of Pakistan i.e. Baluchistan, Punjab, Sindh, Khyber Pakhtunkhwa, and Gilgit-Baltistan; and its two territories i.e. Islamabad Capital Territory, and Azad Jammu & Kashmir, were analyzed and compared with epidemiological parameters of Covid-19.

Results: Globally, the number of new confirmed cases of Covid-19 is increasing and the Covid-19 pandemic is spreading with full zeal. The current Covid-19 pandemic proved more fatal due to high infectivity and deaths as compared previous zoonotic pandemics; and thus may be attributed to relaxation in the smart lockdown and opening of institutions, which favors the transmission of Covid-19.

Conclusion: The number of new confirmed cases throughout the globe and Pakistan is increasing and poses a significant risk to the public health security. The current Covid-19 pandemic resulted in public health insecurity and thus a holistic and comprehensive strategy regarding development of health policy and planning is needed to contain and halt such pandemics in future.

Keywords: Covid-19, Pandemic, Public Health Security, Policy, Planning, Pakistan

INTRODUCTION

Globally the Covid -19 pandemic posed significant threat to public health and as of 5th May 2020, there are cumulative 131, 548, 086 confirmed cases, affecting 192 countries, and with

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1291 - 1306
Received 15 April 2020; Accepted 23 June 2020.

approximately 2, 856, 237 human deaths (1). In Pakistan as of 5th June 2020, there are cumulative hundreds of confirmed cases, with recoveries, and deaths (2).

A new strain of SARS-COV was identified during the investigation of infectious pneumonia cases of a zoonotic origin in Hubei province, China (3). The WHO named this as novel corona virus (n-CoV) on 12th January 2020 (4), and declared as Public Health Emergency of International Concern on 30th January 2020 (5), and then this novel corona virus was named as Covid-19 on 11th February 2020, and declared as Covid-19 pandemic on 11th March 2020 (6, 7). Initially clusters of infectious pneumonia evidenced the Hunan seafood market as the primary origin and evidences confirmed a zoonotic infection (4). But after closing of wild and domestic pets market, the infectious pneumonia cases were still reported from the China and internationally across the boarders and thus also revealed the human to human transmission (8).

The corona virus, a single stranded RNA virus (9), causing zoonotic disease but due to its transmission and spread it undergoes mutations and thus a new genome has developed just like the avian influenza which undergoes continuous mutations and the mutant virus shows resistance and this is difficult to treat and can be very fatal (10). Many international studies have revealed that SARS-CoV2 is transmitted without the development of symptoms i.e. in the pre-symptomatic and asymptomatic periods and spreads Covid-19, which results in covert infections and thus causing re-infections and creates panic among the general public (11, 12).

The coronavirus infects and spreads diseases among animals and during their close interaction with humans during favorable conditions, develops mutant strains and is thus becoming difficult to control and manage. The current pandemic of Covid-19 is affecting the whole world in waves and thus having many consequences. Research revealed that Covid-19 causes fever, cough, fatigue, respiratory, GIT tract problems, and chest radiographic changes along with central nervous system, liver and renal manifestations (13, 14).

The Covid-19 pandemic is spreading exponentially, with high infectivity and intensity and utilizes feco-oral and respiratory routes for its transmission (15). The emerging and re-emerging of different zoonotic infections has posed a huge risk to the public health security (16). Currently, Pakistan as of 1st June 2020 has increase incidence of cases during the 1st curve of Covid-19 pandemic. It's of alarming situation as compared to previous zoonotic pandemics (2).

The Covid-19 pandemic has resulted in threat and panic and causing adverse impacts and thus a holistic and comprehensive strategy is needed to curb and halt the Covid-19 pandemic (16), otherwise the world will face a risk from other endemic infections due to weak and ineffective

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1291 - 1306
Received 15 April 2020; Accepted 23 June 2020.

global public health response and preparedness (17). Currently the pandemic needs to halt at this stage via a two prong strategy i.e. to treat the infected ones, and to avoid spread & further transmission among individuals (18). Therefore this study was planned to identify possible agent, possible modes of transmission and to suggest control measures along with future recommendations.

EPIDEMIOLOGY OF COVID-19 PANDEMIC

Currently Covid-19 has spread to the developed and developing countries throughout the globe due to ineffective surveillance and monitoring strategies and thus poses greater risk to global public health security (11). The causative agent of Covid-19 is corona virus but the routes of transmission of SARS-Cov2 are different due to different strain of beta corona virus. Moreover, thus Covid-19 transmission and infectivity is more as compared to previous epidemics (19).

The SARS-CoV2 requires ACE2 receptor for cell entry, having 10-20 times high affinity and susceptibility to human ACE2, and causing mild to severe Covid-19 infections (12, 17). Research revealed that SARS-Cov2 had 3% mortality; whereas SARS-COV has proved 10% fatal, MERS-CoV proved 37% fatal, but the point is that MERS and SARS didn't resulted in pandemic and were confined to few territories, whereas Covid-19 has resulted in pandemic and has affected many countries around the globe and is still evolving and spreading like a forest fire (20). Earlier studies identified the zoonotic nature of Covid-19 and thus no focus was put regarding the human to human transmission and finally led to global pandemic (5).

The serial interval for Covid-19 is estimated as 4.0 days and is less than the median incubation period and indicated that rapid transmission cycles are taking due to pre-symptomatic and asymptomatic individuals (21). Moreover, the prevalence and incidence of Covid-19 will observe variations as there are undetected, untraced, asymptomatic cases or due to lack of effective surveillance system or health management information system (3, 8). Furthermore, the fomites play an important role during the transmission of infectious diseases and similarly in case of Covid-19 pandemic, fomites retained infectious agents for long time as compared to other type of viruses (14).

During the Covid-19 pandemic, it is believed that if birds played a role in direct or intermediate hosts then we might experience 50% mortality as reported during 2007-2009 avian influenza epidemics due to virome resistance (7). The respiratory droplet infections and exposure to close contacts are considered as the main determinants for Covid-19 transmission. Moreover, the virus

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1291 - 1306
Received 15 April 2020; Accepted 23 June 2020.

was also isolated from stool and urine samples, and thus the oro-fecal route can't be rule out and thus strict preventive measures are needed to halt the pandemic (15, 17). The Covid-19 infection proved less fatal among children as compared to adults and aged individuals and may be attributed to the recurrent and past infections of bronchiolitits and croup (14). Furthermore, research is needed to investigate, is there any chance of transmission of Sars-CoV2 from humans to animals, after a case was reported of Covid-19 in a big cat (22).

POSSIBLE AGENT RESPONSIBLE FOR COVID-19 PANDEMIC

The history of zoonotic infections can be traced back to 1960s when corona viruses caused common flu (13). The important zoonotic outbreaks were SARS, H1N1, H5N1, MERS-CoV and now Covid-19 showed strong links with animals being the origin of or intermediate host (6). The corona viruses belongs to subfamily Corona Virinae, family Corona Viridea and order Nidoviralis and are of Alpha, Beta, Gamma and Delta corona viruses. Moreover, the alpha and beta infects mammals while gamma and delta infects birds (7). Furthermore, n-Covid-19 is 96% identical to bat SARS-COV, and thus throws light on the possible host (23).

Bats acts as a reservoir and host for both SARS-CoV and MERS-CoV and in order to cause disease among humans, the bats use other intermediate hosts (4). Moreover, we cannot exclude the possibility of two different SARS-CoV multiplication or genetic mutations. In wild animals i.e. snakes, marmots, bats and poultry, are infected by CoVs and then through intermediate hosts, the virus mutated and caused zoonotic diseases (14). The pangolins CoV showed identity to CoV2 and thus revealed pangolins as an intermediate host in Covid-19 infections (18). Furthermore, amino-acids sequence studies confirmed that Sars-CoV2 belong to the same animal species of bats (17). Moreover, the danger is that due to more and more secondary cases, the chances of mutant strain of Covid-19 are increasing (13), and there is also the probability that the world might experience more waves of the same CoVs strains or with mutant strains of other subtypes (6).

MODES OF TRANSMISSION OF COVID-19 PANDEMIC

The analysis of the epidemic curve revealed human to human transmission responsible for Covid-19 pandemic. Initially the Covid-19 outbreak started as a zoonotic infection but later on due to human to human transmission resulted in Covid-19 pandemic (8)**.** The Covid-19 virus efficiently transmitted through respiratory route like SARS-CoV. The outer shell of sars-CoV2 is

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1291 - 1306
Received 15 April 2020; Accepted 23 June 2020.

hardest and thus can remain outside the body for longer duration, as compared to SARS and MERS. Moreover, the SARS-CoV2 shows resistance to different bodily fluids and effectively transmits via respiratory route. The SARS-CoV2 is highly contagious and only few particles outside the body can start and progress to a new infection and the immune system is unable to destroy CoV and thus it might be reason of its high infectivity even before the development of symptoms (19).

Due to its unique behavior and protein structure of genome with high infection rate, the asymptomatic cases can effectively transmit Covid-19 (9). Moreover, research has identified that Covid-19 spreads via direct and intermediate hosts like bats, cattle's, avian, bovines, camels, canines, civets, murines, pangolins and felines (4). In a research published by Rui Dong et al revealed that Beta-CoV is similar to COVs found in civets and pangolins (7).

Although the Covid-19 started in December 2019, but due to travel, the asymptomatic and incubatory cases led to epidemic in Wuhan, then spread to whole china and finally resulting in Covid-19 pandemic (7). Initially Covid-19 was due to animal contact, but eventually during pandemic, its transmission is directly from human to human (14). The Covid-19 pandemic is highly contagious as evident from health care workers who harbors the infection during provision of services to infected individuals and revealed that during respiration, cough and sneezing, the CoV2 is transmitted (24). Moreover, the role of conjunctive and mother to child transmission of Covid-19 during current pandemic also needs appropriate consideration (17). The SARS-CoV and SARS-CoV2 lowers the ACE2 levels and thus showed that other factors also played role beside ACE2 enzymes (12), and thus virus shedding and transmission occurs via feces and respiratory route (14). In a study conducted by wrap et al found that sars-cov2 had 10-20 times more affinity for ACE2 receptors, as compared to SARS-CoV and thus having high human to human transmission as confirmed by the secondary cases among the health care workers (4, 17).

METHODOLOGY

A comparative cross-sectional study was carried out with an aim to identify the Covid-19 pandemic trends in Pakistan and to compare it with global Covid-19 statistics. For analysis and comparison, the total confirmed cases globally and in Pakistan were retrieved on 1st June 2020. In this study, the secondary data available was retrieved on 1st May 2020 from the online websites of Corona Virus Resource Center of John Hopkins University of Medicine & Real time

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1291 - 1306
Received 15 April 2020; Accepted 23 June 2020.

Pakistan and Worldwide Covid-19 Situation (1, 2). The Covid-19 statistics of five provinces of Pakistan i.e. Baluchistan, Punjab, Sindh, Khyber Pakhtunkhwa, and Gilgit-Baltistan; and its two territories i.e. Islamabad Capital Territory, and Azad Jammu & Kashmir, were analyzed and compared with epidemiological parameters of Covid-19 pandemic globally. After data entry and interpretation, Pakistan statistics along with its provinces and territories were compared with global statistics, and finally a public health perspective on the epidemiology, routes of transmission, suggestions, recommendations and a way forward was put forwarded in order to contain and halt the current Covid-19 pandemic and its impacts.

RESULTS & DISCUSSIONS

The 1st case of infectious pneumonia, latter on labeled as Covid-19 was reported in December 2019; in Hubei, Hunan Province of China; whereas in Pakistan, the 1st confirmed case was reported on 26th February, 2020, from the Sindh province, Pakistan. According to the Pakistan statistics of Covid-19, on 1st April 2020, the total confirmed cases increased to 2289, approximately after thirty four (34) days of the 1st confirmed case (Table 1; Figure 1). Moreover, in mid of March 2020, the Government of Pakistan has closed all the educational institutions and imposed complete lockdown and that proved helpful as there was great chance of Covid-19 transmission. The Covid-19 resulted in 1st epidemic wave peak in Pakistan during June, July and August 2020, and may be attributed to early spread, travel, contact with cases & asymptomatic, and pre-symptomatic cases during early days of pandemic (Table 2). In Pakistan, due to various preventive strategies; in which most people were confined to their homes and thus ban on social contacts and gatherings, resulted in smoothness of the epidemic curve.

According to the monthly reports of March, April, & May 2020; with 57.75% of total new cases attributed to the national Covid-19 burden (Table 1; Figure 1).

Currently, as of 1st June 2020, at 10 am, the Pakistan statistics showed, total of 546428 confirmed cases, out of which the highest prevalence was from Sindh (45.25%), followed by Punjab (28.88%), Khyber Pakhtunkhwa (12.30%), Islamabad Capital Territory (7.58%), Baluchistan (3.44%), and lowest number of cases from Azad Jammu & Kashmir (1.65 %), and Gilgit Baltistan (0.9%) respectively (Table 2; Figure 1).

Moreover, after the re-opening of educational institutions, relaxation in the smart lock down; and incompliance to the standard operating procedures, resulted in further spread of Covid-19, thus as the new confirmed cases reported in May & June 2020, resulted in epidemic in Pakistan

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1291 - 1306
Received 15 April 2020; Accepted 23 June 2020.

(Figure 1).

According to the Pakistan statistics, 1st 50,000 cases took 86 days, 100, 000 took 17 and 150, 000 took 9 days (Table 3); and is alarming for a developing country like Pakistan with limited resources and a weak health infrastructure in order to contain and halt the 2nd wave of epidemic. According to Pakistan Coivd-19 reports; first 150,000 cases took 109 days and thus threw light on the 1st epidemic curve of Pakistan (Table 3). Thus the world and Pakistan is currently in Covid-19 pandemic and needs stringent strategies and measures in order to control and contain the pandemic. Furthermore, it is unpredictable to say whether the curve will move downward or upward in the next coming months. Moreover, from the analysis of Covid-19 quartiles; it was stated that the summer and winter seasons has no role in the transmission or control of Covid-19 infection, and thus was mostly attributed to increase in social contacts and social gatherings (Figure 1).

PUBLIC HEALTH SUGGESTIONS

Firstly, during this Covid-19 pandemic, the world is in panic and there is threat to public health security. The outbreaks are still occurring and put a question mark on the effectiveness of surveillance and monitoring systems. Moreover, the Covid-19 pandemic has exposed the weaknesses of health systems. It is known that SARS-CoV took more than a year, and thus Covid-19 pandemic might take two to ten years or a decade for effective control and containment.

Secondly, the health system should have monitoring of Covid-19, its trends, along with emergency measures for effective control and management. In order to contain and end the Covid-19 pandemic, an effective surveillance system is the need of the day as zoonotic infections possess a threat to public health and emerge and re-emerge in the human populations (6). Moreover, the quarantine also helps a lot in the containment and control and thus effective quarantine be imposed and followed according to standard protocols (11).

Thirdly, needs alterations of timings for job activities with limited and reduced exposure to halt the human to human transmission. It is also important to identify those individuals who are infected by SARS-2003 or MERS-CoV in 2015, and information be collected regarding their Covid-19 status, and might prove helpful regarding Covid-19 epidemiology (9). Moreover, strict measures are needed to contain and isolate the infected and recovered individuals, as their interactions with healthy individuals proved fatal and led to mutant strain development (20). The

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1291 - 1306
Received 15 April 2020; Accepted 23 June 2020.

Covid-19 pandemic will either end as SARS (2003), which ended after a short time, or like MERS-CoV (2015-16), which took years to end or will remain for decades or mutant strains will develop as Covid-19 is still evolving (14). In case of Covid-19, only supportive treatment is needed as these viruses one starts multiplication then it becomes difficult to treat and prevent its transmission. Furthermore, there is also the possibility that all the individuals and communities has exposed to SARS-CoV2, and only those individuals develop Covid-19, whose immune system was compromised. There is also the probability that Covid-19 has taken many years for its complete transformation and thus effective prevention and control measures, along with reduces contact with wild and suspected animals are needed to control the pandemic (5, 25).

Fourthly, the animal meat, wild or domestic, should be properly inspected and cooked before consumption (24). Thus it's of utmost importance that we should comply with basic preventive strategies i.e. at primary level, mass awareness of community is needed and strategies be planned to develop vaccine which can harbors immunity to all or to most of the CoVs, then during secondary level, the laboratory facilities be strengthened to improve the Covid-19 case management, isolation, detection measures of confirmed and suspected cases, to halt the pandemic (26). Therefore, safe hygiene practices, well developed protection measures, tracing of close contacts, suspected cases assessment, and laboratory and management measures are the cornerstones of infectious diseases control and containment strategies at local, regional and international levels (20). Moreover, we should avoid close contacts, social gatherings, and public travels to reduce further spread and transmission (17, 27). Furthermore, it's the responsibility of each and every one to correctly use face masks, reduce contact with wild animals, and show compliance with personnel protective strategies (11).

Fifthly, the Covid-19 pandemic requires an immediate response from all the stakeholders of health against a common enemy and thus requires a comprehensive strategy regarding development of health policy and health planning along with human resource planning and training regarding the Public Health Emergencies of International Concerns (7, 28).

Lastly, although it's a global and general issue, thus requires due consideration from all sectors i.e. health, IT experts, public health specialists, agriculture, epidemiologist, statisticians, environmentalists, geologist, educationists, nutritionists etc. to study the epidemiology of Covid-19, the animal model of Covid-19 pandemic and to incorporate animal surveillance in the health surveillance (27). Moreover, there is dire need of coordination, cooperation, assistance and research among countries to effectively control and prevent such pandemics (5).

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1291 - 1306
Received 15 April 2020; Accepted 23 June 2020.

PUBLIC HEALTH LESSONS LEARNT FROM COVID-19 PANDEMIC

Firstly, that everyone is susceptible to Covid-19 and no is one immune to it (18). The human to human transmission in close contacts, and with infected and asymptomatic cases had occurred during Covid-19 pandemic, and thus all the possible routes of transmission be prioritized to strengthen the health surveillance system (4). Moreover, the infected and close contact individuals should be isolated, and healthy people should be quarantined till the maximum incubation period in order to break the chain of transmission (11). Secondly, it's also important to investigate the reports of animals and birds, reports from Wuhan or Hubei province of China, as there is still possibility that birds might play a role for transmission of Covid-19 from bats to humans as both belong to terrestrial environment. Moreover, the Sars-CoV2 reservoir is linked to bats and other wild animals and thus need measures regarding pet and wild animal's surveillance to be implemented in the health system (26). The health system should be strengthened enough to detect epidemics and to identify the host, as zoonotic infections for the 3rd time has posed a significant threat to the public health security. Moreover, the animal surveillance data is crucial to identify that how many types of animals were present in the seafood market of Wuhan and thus possibility of identification of host and thus renders important to develop the vaccine or medicine accordingly (13). The animals acted as intermediate hosts and human as the final terminal hosts in most of the zoonotic diseases, but we must also keep in mind the possibility that the SARS-COV2 present in humans can infect wild and pet animals and can re-start and or initiate the development of new strains of mutant COV epidemics and pandemics (6). Thirdly, the prioritizations of monitoring and surveillance system are needed to be strengthened, and can help in effective epidemic and pandemic control strategies. Moreover, research and comprehensive surveillance helps in identification of epidemiological trends; future expected trends, and microbial parameters (17). Furthermore, the timely and correct host identification will help to design and formulate policies accordingly and will help to reduce the chances of any new strain outbreaks and pandemics. There is also need of proper case definitions with updated scheme for prevention and control along with epidemic/ pandemic notifications for effective prevention (3, 25). Moreover, there is also the possibility that SARS-CoV 2 has entered the host (human), and has adopted itself to the host factors and has escaped the immunological host response and finally resulted in Covid-19 pandemic. Furthermore, there is also need of medical professional surveillance as they are the front line workers against the Covid-19 pandemic (26). Furthermore, regarding Covid-19, we can't exclude the nonliving characteristics of corona virus

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1291 - 1306
Received 15 April 2020; Accepted 23 June 2020.

(24). Fourthly, in order to avoid any future epidemics and pandemics, the identification of new strains is of great importance, and thus research be prioritized at national and international levels and information be shared to improve the surveillance system and to strengthen the health system both in developed and developing countries. Thus a strong infectious disease surveillance system helps in early detection, outbreak verification, confirmation, and monitoring of effective public health interventions, which are considered as the key components of a strong health system (16). Moreover there is also need of human as well financial resources with effective training services from public health point of perspectives. Therefore mobilization of resources is of immense significance as the pandemic affects the health system, environment, social, economic, and psychological aspects of public health. Moreover, there is dire need of rehabilitation services in the best interest of public (20). Fifthly, the adaptation of the cost effective approaches like health promotion through awareness and health protection interventions proved helpful. During Covid-19 pandemic, we should strictly follow SOPs recommended by WHO for infectious disease prevention and control. The Covid-19 outbreak analysis and the effects of travel restrictions in China proved effective and thus open windows for national and international public health specialists for effective and comprehensive prevention and containment models (27). Moreover, due to identical incubation period and serial interval, it was concluded that early transmission occurred before the onset of symptoms and thus stringent infectious disease preventive measures are needed to contain and halt pandemic (29). Furthermore, it's difficult to develop vaccine as vaccine can't be tested or trial on humans as there is difference in the infectivity and immunological characteristics of vaccination process among animals and humans, and thus hampers the development of vaccines (13). Lastly, as SARS-CoV2 showed strong link with people having co-morbidities like diabetes mellitus, hypertension, respiratory diseases and cardio-vascular diseases; thus during flu vaccine interventions, those individuals with such co-morbidities be given high priority due to their higher risk of susceptibility to Covid-19 infection (23).

CONCLUSIONS

From the results it was concluded that the number of new confirmed cases throughout the globe and Pakistan, is increasing and poses a significant risk to the public health security. Although screening for symptomatic and suspected cases was conducted but we still don't know the exact epidemiology of Covid-19, and thus asymptomatic and pre-symptomatic cases exaggerated the

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1291 - 1306
Received 15 April 2020; Accepted 23 June 2020.

impacts of Covid-19 pandemic. Moreover, Pakistan being a developing country with scarcity of resources and infrastructure is currently facing Covid-19 epidemic and thus resulting in public health insecurity and thus requires strict policies, coordination and assistance from the international stakeholders in order to halt the Covid-19. Furthermore, during the Covid-19 pandemic, SARS-CoV2 is still spreading with a higher rate and thus effective continuous surveillance along with mobilization of resources, and coordination and cooperation from all sectors of health are of paramount significance to halt and contain the current Covid-19 pandemic.

THE WAY FORWARD

We can't rule out all the possible modes of transmission of the communicable and infectious diseases as the current knowledge regarding Covid-19 is unclear. Moreover, may be in future we may again observe its variant phylogenetic virus and thus needs extensive research and development in the field of infectious diseases prevention. It is difficult to control Covid-19 pandemic and thus posed a global public health security threat and research showed that the world will experience more and more pandemics of same or its mutant types (5). Therefore epidemic planning, readiness and preparedness at this moment are of utmost significance from public health point of perspective regarding epidemics and pandemics. The RNA viruses exhibits high mutations and thus prove fatal as primary cases were easy to handle but the secondary cases poses a greater public health security, as evident from the asymptomatic to aggressive cases with gastro-intestinal, respiratory, central nervous system, renal and liver manifestations during Covid-19 infection (6). Another important and public health concern is that, those who are infected or recovered from Covid-19 infection, can they transmit the infection back to animals and similarly can again zoonotic infections undergo mutations and re-infect humans in future? Although at this time, we don't know is it possible or not but the implications of such variant and transformed virus will be highly fatal.

Due to its transformed, genetically mutated SARS-CoV2, we can't rule out the chances of re-infection, and thus posing difficulty in effective management and vaccine development. There is also a possibility that the Covid-19 virus persisted in our environment and when the time is favorable, the virus becomes active and starts infecting humans or animals. There is also the probability that the virus has infected the entire world, and now requires adequate time and or environment to infect communities, and this second epidemic curve may be due to its initial

infection. Furthermore, the Covid-19 has exposed the health systems of the countries and the whole world needs strengthening and planning for public health issues and emergencies.

The common signs and symptoms of Covid-19 infection explain the infectivity and transmissibility of Covid-19 i.e. respiratory complaints, deranged coagulation profile, deranged liver and renal profile etc. Moreover, regarding plasma donation from the recovered individuals should be stopped and banned as the plasma might be a source of further virus genetic mutations and thus will be beyond the domain of public health with new challenges and implications.

Research Funding

This work had no financial support

Ethical Approval

The study does not require ethical approval as the data was already available online and the original data are anonymous

Declaration Of Competing Interest

The authors declared that they have no competing interest regarding this research work

REFERENCES

1. The Corona Virus Resource Center JHUoM. Covid-19 dashboard by the center for systems science and engineering at John Hopkins University of Medicine. https://coronavirus.jhu.edu/map.html (accessed on 5th June 2020).
2. Situation. R-tPaWC-. Government of Pakistan. https://covid.gov.pk/ (accessed on 5th June 2020).
3. Nishiura H, Jung S-m, Linton NM, Kinoshita R, Yang Y, Hayashi K, et al. The extent of transmission of novel coronavirus in Wuhan, China, 2020. Multidisciplinary Digital Publishing Institute; 2020.
4. Sahin AR, Erdogan A, Agaoglu PM, Dineri Y, Cakirci AY, Senel ME, et al. 2019 novel coronavirus (COVID-19) outbreak: a review of the current literature. EJMO. 2020;4(1):1-7.
5. Zhang Y, Xu J, Li H, Cao B. A novel coronavirus (COVID-19) outbreak: a call for action. Chest. 2020;157(4):e99-e101.
6. Ibrahim NK. Epidemiologic surveillance for controlling Covid-19 pandemic: challenges and implications. Journal of infection and public health. 2020.
7. Wang Z, Duan Y, Jin Y, Zheng Z-J. Coronavirus disease 2019 (COVID-19) pandemic: how countries should build more resilient health systems for preparedness and response. Global Health Journal. 2020.
8. Baloch S, Baloch MA, Zheng T, Pei X. The Coronavirus Disease 2019 (COVID-19) Pandemic. The Tohoku Journal of Experimental Medicine. 2020;250(4):271-8.
9. Lai C-C, Shih T-P, Ko W-C, Tang H-J, Hsueh P-R. Severe acute respiratory syndrome coronavirus 2

(SARS-CoV-2) and corona virus disease-2019 (COVID-19): the epidemic and the challenges. International journal of antimicrobial agents. 2020:105924.

10. Helmy YA, Fawzy M, Elaswad A, Sobieh A, Kenney SP, Shehata AA. The COVID-19 pandemic: a comprehensive review of taxonomy, genetics, epidemiology, diagnosis, treatment, and control. Journal of Clinical Medicine. 2020;9(4):1225.
11. Khan S, Siddique R, Ali A, Xue M, Nabi G. Novel coronavirus, poor quarantine, and the risk of pandemic. Journal of Hospital Infection. 2020;104(4):449-50.
12. Matheson NJ, Lehner PJ. How does SARS-CoV-2 cause COVID-19? Science. 2020;369(6503):510-1.
13. Ng LF, Hiscox JA. Coronaviruses in animals and humans. British Medical Journal Publishing Group; 2020.
14. Ahmad T, Khan M, Haroon THM, Nasir S, Hui J, Bonilla-Aldana DK, et al. COVID-19: Zoonotic aspects. Travel Medicine and Infectious Disease. 2020.
15. Elrashdy F, Redwan EM, Uversky VN. Why COVID-19 transmission is more efficient and aggressive than viral transmission in previous coronavirus epidemics? Biomolecules. 2020;10(9):1312.
16. Shanmugaraj B, Malla A, Phoolcharoen W. Emergence of novel coronavirus 2019-nCoV: need for rapid vaccine and biologics development. Pathogens. 2020;9(2):148.
17. Liu Q, Xu K, Wang X, Wang W. From SARS to COVID-19: What lessons have we learned? Journal of infection and public health. 2020.
18. Zhang X-Y, Huang H-J, Zhuang D-L, Nasser MI, Yang M-H, Zhu P, et al. Biological, clinical and epidemiological features of COVID-19, SARS and MERS and AutoDock simulation of ACE2. Infectious diseases of poverty. 2020;9(1):1-11.
19. Goh GK-M, Dunker AK, Foster JA, Uversky VN. Rigidity of the outer shell predicted by a protein intrinsic disorder model sheds light on the COVID-19 (Wuhan-2019-nCoV) infectivity. Multidisciplinary Digital Publishing Institute; 2020.
20. Lee A. Wuhan novel coronavirus (COVID-19): why global control is challenging? Public health. 2020;179:A1.
21. Nishiura H, Linton NM, Akhmetzhanov AR. Serial interval of novel coronavirus (COVID-19) infections. International journal of infectious diseases. 2020.
22. Lakdawala SS, Menachery VD. The search for a COVID-19 animal model. Science. 2020;368(6494):942-3.
23. Yang J, Zheng Y, Gou X, Pu K, Chen Z, Guo Q, et al. Prevalence of comorbidities and its effects in patients infected with SARS-CoV-2: a systematic review and meta-analysis. International Journal of Infectious Diseases. 2020;94:91-5.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1291 - 1306
Received 15 April 2020; Accepted 23 June 2020.

24. Ashour HM, Elkhatib WF, Rahman M, Elshabrawy HA. Insights into the recent 2019 novel coronavirus (SARS-CoV-2) in light of past human coronavirus outbreaks. Pathogens. 2020;9(3):186.
25. WU T, HU E, ZENG W, ZHANG H, XUE X, MA J. Unprecedented action has been taken to contain the epidemic of coronavirus disease 2019 in China. Zhong nan da xue xue bao Yi xue ban= Journal of Central South University Medical sciences. 2020;45(3):334.
26. Wei X, Li X, Cui J. Evolutionary perspectives on novel coronaviruses identified in pneumonia cases in China. National Science Review. 2020;7(2):239-42.
27. Chinazzi M, Davis JT, Ajelli M, Gioannini C, Litvinova M, Merler S, et al. The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak. Science. 2020;368(6489):395-400.
28. Qian X, Ren R, Wang Y, Guo Y, Fang J, Wu Z-D, et al. Fighting against the common enemy of COVID-19: a practice of building a community with a shared future for mankind. Infectious Diseases of Poverty. 2020;9(1):1-6.
29. Zhang J, Litvinova M, Wang W, Wang Y, Deng X, Chen X, et al. Evolving epidemiology and transmission dynamics of coronavirus disease 2019 outside Hubei province, China: a descriptive and modelling study. The Lancet Infectious Diseases. 2020.

Table 1. Showing total number of confirmed and new cases reported globally & Pakistan as of 1st June 2020

Month	Total Confirmed Cases				New Confirmed Cases			
	Global		Pakistan		Global		Pakistan	
	n	%	n	%	n	%	n	%
2020 Jan	282	0.0003	NR	NR	282	0.0003	NR	NR
Feb	11953	0.01	NR	NR	11671	0.01	NR	NR
Mar	87137	0.08	NR	NR	75184	0.07	NR	NR
April	823626	0.8	2289	0.42	736489	0.72	2289	0.42
May	3175207	3.08	18114	3.31	2351581	2.28	15825	2.9
June	6057853	5.88	76332	13.97	2882646	2.8	58218	10.65

Table 2. Showing Total Confirmed Cases Reported From Five Provinces & Two Territories of Pakistan as of 1st June 2020

Province	Total Confirmed Cases (%)	2020 Mar	Apr	May	Jun
Sindh	247249 (45.25)	743	6675	29647	86795
Punjab	157796 (28.88)	845	6733	27850	77740

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1291 - 1306
Received 15 April 2020; Accepted 23 June 2020.

Baluchistan	18823 (3.44)	169	1136	4448	10608
Gilgit Baltistan	4909 (0.90)	187	340	738	1511
Khyber Pakhtunkhwa	67214 (12.30)	274	2799	10485	26938
Azad Jammu & Kashmir	9019 (1.65)	9	66	271	1135
Islamabad Capital Territory	41418 (7.58)	62	365	2893	13082
Total Confirmed Cases	546428 (100)	2289	18114	76332	217809

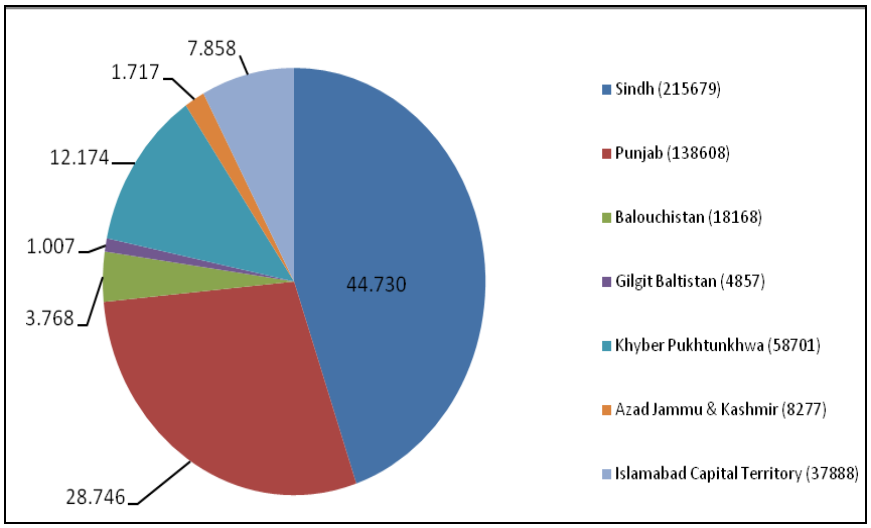

Figure 1. Pie graph showing total confirmed cases reported from five provinces and two territories of Pakistan as of 1st June 2020