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Emerging zoonotic viral diseases and preventive strategies with Islamic perspectives of *halal* foods

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REVIEW

Abstract

There are several emerging zoonotic viral diseases associated with wildlife or non-wildlife food that arise with the passage of time. Different pathogenic strains with advanced mutational changes results in severe pathogenicity in respective hosts either animals or humans. The viability in human host employs the certainty of transmission from animals. Most of the viral diseases in humans caused by direct close contact between animals or indirectly through intermediate hosts. Many of the coronaviral diseases spread by bats specie and its reservoirs. Moreover, the consumption of other wildlife animals common in certain regions of world escalate the potential risk for gaining various zoonotic viral ailments. On the other hand, the Islamic norms for food consumption remarkably reduces the risk of these diseases by devouring the Halal (lawful) or Tayyab foods. The xenobiotic transformations in animals also illustrates the prohibition of haram (unlawful) food consumption. Humans with compromised immune system in elderly or suffering from chronic diseases can easily adopt these viral diseases and thus may prone to lethality. One of the emerging zoonotic viral diseases involve COVID-19 caused by novel β-coronavirus (nCov) transmission has been suspected in Wuhan wildlife market that also have origin of bat reservoirs as natural host based on virus genome sequencing results and evolutionary analysis. Measures to prevent or reduce transmission should be especially implemented in populations at greater risk.

Keywords: Halal, Zoonotic, COVID-19, Bats, Food Safety

Introduction

The term zoonosis comes from Greek words; zoon (animal) and nosos (disease) and is defined as those infections that are transmitted from animals (wild and domestic) to humans or vice versa via multiple routes either by direct contact, through intermediate vectors like mites or mosquitoes and through infections caused

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by water and food (Hubálek, 2003). For a long time, the substantial number of recognized human pathogenic viruses existed in the ecosystem as well as among different population groups. The evolution of viruses with time has been strongly linked with human evolution or vice versa, with subsequent shift for rebalancing in which they both can coexist. However, certain species of the pathogens crossing the barrier can elicit catastrophic consequences in terms of infection, population health as well as mortality. Numerous factors significantly affect global dissemination of these viral zoonoses. Growing globalization, increased mobility, demographic transitions, environmental determinants such as ecological and climatological effects and intensive harvesting have multiplied the potential for pathogenic viruses to be transmitted between animals and humans (Kuiken *et al.*, 2005). Populations of humans and livestock have risen globally, causing close and direct interactions between animals and humans.

Most of the human infectious diseases (61%) result from zoonosis and wildlife one of the main drivers of infectious disease dissemination (Daszak, Cunningham, & Hyatt, 2001). Most of the newly detected human viral infections in the past era showed a zoonotic history (like SARS-Coronavirus, MERS-Coronavirus and avian influenza), suggesting animals being a major factor in increasing infections rate and has continue to evolve (Menachery, Yount Jr, *et al.*, 2016). SARS story is among those examples in history illustrating the smooth evolution of newly emerged bat virus responsible for one of the most serious global pandemics in modern human history. Normally, wildlife reservoir animals or associated pathogens remain asymptomatic until they spill over into humans or domestic animals and cause disease. Conventional response interventions to outbreaks, including those measures implemented throughout SARS outbreaks, are all still effective but early diagnosis with other supportive measures in preventing the massive outbreaks of other infectious diseases are the need of 21st century (Menachery *et al.*, 2015). With advanced molecular techniques like PCR, sequencing technologies or high -density microarrays of viruses, the wildlife surveillance has become much practical and efficient (Briese *et al.*, 2015). After the outbreaks of SARS epidemic due to CoVs in bats, there has been a substantial upsurge in international attempts for coronavirus surveillance in wildlife. Just 10 coronaviruses with full sequenced genomes existed before the SARS pandemic. Owing to the active surveillance work done globally, this figure has grown more than six-fold (Drexler *et al.*, 2010; Lau *et al.*, 2010). Yet it seems to be the beginning of knowledge about coronavirus presence in wildlife species but still much more than last 50 years knowledge only made possible owing to viral analysis in response to outbreak of different diseases. On the basis of available phylogenetic analysis of the huge number of bat coronavirus sequences (Figure 1). It is believed that notably the diseases spread through coronaviruses have or had bat strains origin (Yang *et al.*, 2016). Unfortunately, this theory was proven with the emergence of Middle East Respiratory Syndrome (MERS) outbreak, caused by MERS-CoV, which also supposed to originate from bats. Although MERS-CoV found in bats are not the direct ancestor of MERS-CoV's, yet showed the similarity with SARS-CoV revealing the high genetic diversity in these bat specie viruses (Zaki, Van Boheemen, Bestebroer, Osterhaus, & Fouchier, 2012). Now, the nCoV-19 's emergence that is now considered as SARS-CoV2 has a significant influence on global health and the economic situation. It also serves an alert that it may occur in humans from bats or any other wildlife species. Simultaneously, the experience accrued from the previous epidemics like SARS or other viral outbreaks and their subsequent in-depth studies provide valuable information and guidance. From these valuable insights, the main emphasis is on the understanding of genetic diversity of viruses with reference to their specie reservoir. Along with these, several other factors including virus-host equilibrium disturbance can potentially aggravate the situation and spillover any major epidemic.

Transmission of CoVs between different species

Formerly SARS-CoV was identified in humans and other CoVs were known in birds and mammals to be causative factors of respiratory tract infections, encephalomyelitis, hepatitis and gastroenteritis. The first two human CoVs discovered i.e. HCoV-229E and HCoVOC43, mainly induced self-limiting infections of the upper respiratory tract such as common cold (Lau, Huang, & Yuen, 2009). Thereby, SARS-CoV considered as the overturning point in history of CoV research that regenerated the researcher's interest in it owing to its significant social, medical and economic impact globally. Identification of bats as a main reservoir for it is one of the important finding that also explains the civets intermediate host in amplifying SARS-CoV (Lau *et al.*, 2005). Such findings reinterpreted the CoVs classification owing to advanced research and their revised phylogeny basis that demonstrates the vital role of bats in inter- and intra-species transmission of CoVs. Thereby after SARS outbreak, the Coronavirus study group of the International committee for Virus Taxonomy on the basis of new CoV phylogeny modified the classification into four genera namely Alphacoronavirus, Betacoronavirus, Gammacoronavirus and Deltacoronavirus (Table.1) by replacing the conventional antigenic groups of these CoVs. The extraordinary biodiversity among these viruses in different species and variation in hosts clearly depicts the facile interspecies

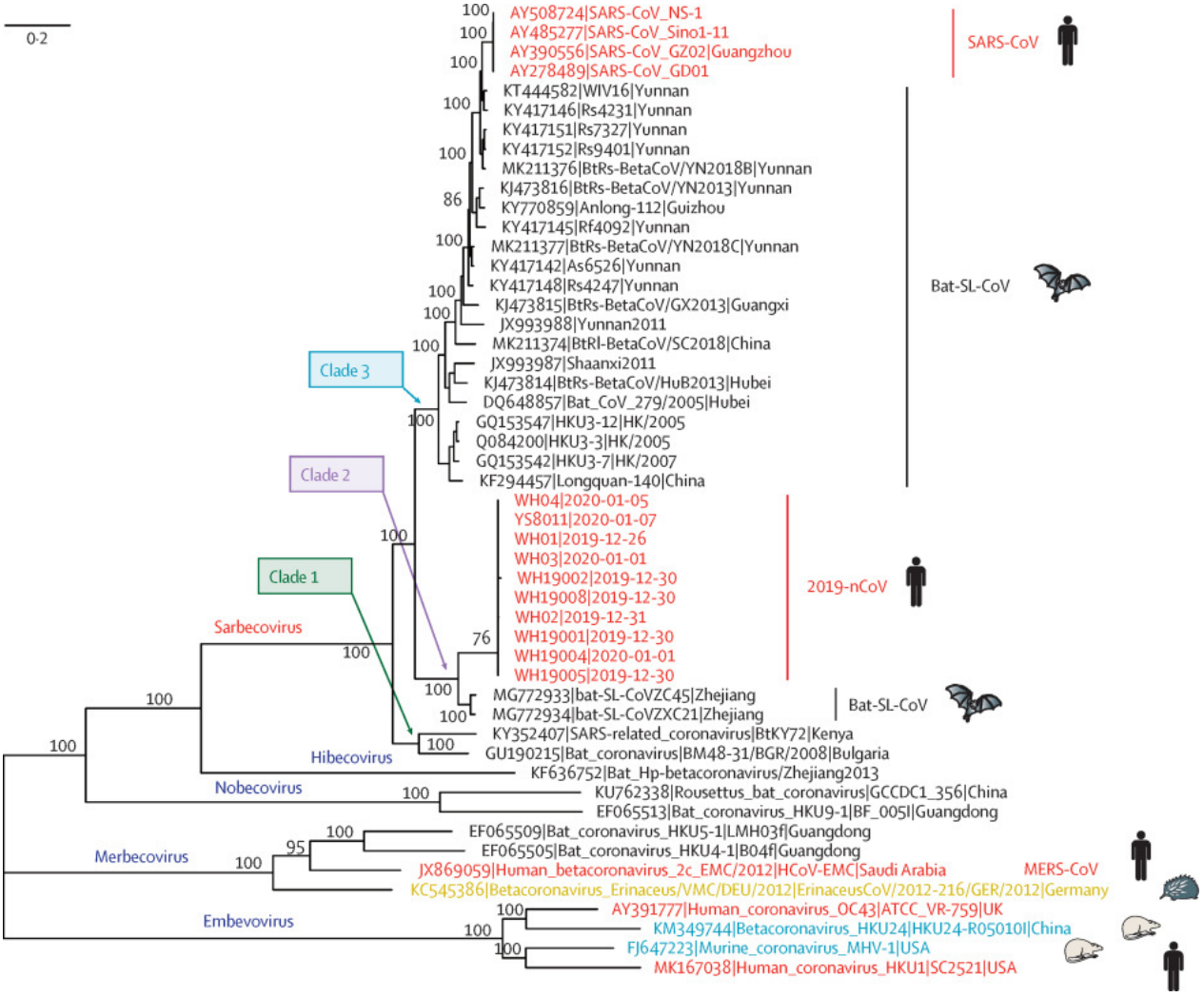

Figure 1. Phylogenetic analysis of full-length genomes of 2019-nCoV and representative viruses of the genus Beta coronavirus.

transmission and adaptability pattern is the product of environmental, viral, and host factors.

In accordance with interspecies transmission of viruses between humans and animals, scientists have suggested several potential behaviors or events in the last decade that have contributed to effective interspecies CoV jumping. One of the most pronounced examples of major epidemic like SARS showed that very first cases occurred in a cook from Heyuan that had daily contact with wildlife (including bats) during his work in Shenzhen restaurant. As in Southern China and other Southeast Asian countries bats (unlawful in Islam) are used as food, thereby live bats available in southern China's wildlife wet markets and restaurants become the potential source of spreading the CoV like viruses due to possible bat-animal and bat-human encounters (Zhao, 2007). Soon afterwards, the SARS-CoVs were also isolated from the caged Himalayan palm-trees from Guangdong 's wild live markets. There are several different bats predators and what they might consume, varies based on their locations. Many flying species are natural predators of birds, such as owls and hawks. Owls can be active in the evening when the bats are out. So the owls can grab bats without warning while they're in flight (Lima & O'Keefe, 2013). Weasels and raccoons have also been reported in some areas as bat predators and are often hiding around areas where mostly bats live and so on SARS-CoV has also been reported in Chinese wet market found in a raccoon dog. All these interactions between different animal species and humans satisfied possible required conditions to promote CoVs jumping (Wenhui Li *et al.*, 2006). Likewise, On 31 December 2019, an epidemic of cases with anonymous low respiratory infections detected in Wuhan, the main metropolitan area in province of China named Hubei, was first informed to the WHO Country Office in China. On 11 February 2020, Dr Tedros Adhanom Ghebreyesus, Director-General of the WHO, proclaimed that the illness caused by this new CoV was a "COVID-19," that is the name of "coronavirus

Table 1. Genetically diverse species of coronaviruses and their respective hosts (bats, humans and other animals).

Genetically diverse coronavirus species			Zoonotic infections 
Alpha corona virus	Sc-BatCoV 512	HCoV-229E [APN]	TGEV (Pigs)
	Rh-BatCoV HKU2	HCoV-NL63 [ACE2]	PRCV (Pigs)
	My-BatCoV HKU6		PEDV (Pigs)
	Mi-BatCoV HKU7		FIPV (Cats)
	Mi-BatCoV HKU8		CCoV (Dogs)
	Hi-BatCoV HKU10		TGEV (Pigs)
	Ro-BatCoV HKU10		PRCV (Pigs)
Beta corona virus	SARSr-Rh-BatCoV HKU3	HCoV-OC43 [ASA]	MHV (Mice)
	Ty-BatCoV HKU4	HCoV-HKU1	BCoV (Cows)
	Pi-BatCoV HKU5	SARS-CoV [ACE2]	AntelopeCoV (Sables)
	Ro-BatCoV HKU9	n-COV	GiCoV (Giraffes)
	SARSr-Rh-BatCoV		RCoV (Rats)
			RbCoV HKU14 (Rabbits)
			ECoV (Horses)
			PHEV (Pigs)
			SARSr-CiCoV (Civets)
			SARSr-CoV-CFB (Chinese ferret badgers)
Gamma corona virus			IBV (Chickens)
			DCoV (Ducks)
			GCoV (Geese)
			PCoV (Pigeons)
			PhCoV (Pheasant)
			TCoV (Turkeys)
			BWCoV-SW1 (Beluga whales)
Delta corona virus			BuCoV HKU11
			ThCoV HKU12
			MunCoV HKU13
			WECoV HKU16
			SpCoV HKU17
			MRCoV HKU18
			NHCoV HKU19
			WiCoV HKU20
			CMCoV HKU21
			PorCoV HKU15 (Pigs)

outbreak 2019". Different scientists' panels after numerous monitoring experiments have shown that bats are a significant source of alpha CoVs and beta CoVs. The vast bat species diversity with their persistent flight capabilities let them to inhabit a large ecosystem globally. It is necessary to identify the routes of transmission either direct or indirect between donor as well as the receiver hosts. There are also limited records of close interaction with bats and human or other species, with the exception of bat predators or ingestion of bats by humans (Lima & O'Keefe, 2013; Pan *et al.*, 2017). Yet, one should not ignore the risk of spillover incidents. The spillover of bat CoVs is believed to occur mainly through host viral shedding (an indirect route) by which interspecies transmission may be accomplished. While considering viral spillover cases, CoV tissue tropism is a significant determinant. A high rate of genetic mutation enables the evolution of CoVs and leads to high genetic diversity having

the potential for adaptation of host receptors (Lau *et al.*, 2010; Widagdo, Sooksawasdi Na Ayudhya, Hundie, & Haagmans, 2019). The receptor profile of so many CoV organisms has been examined in detail to differentiate the target mechanism behind each, for example, dipeptidyl peptidase-4 (DPP4) for MERS-CoV, aminopeptidase-N (APN) for HCoV 229E, HCoV NL63 or TGEV and PRCV, angiotensin-converting enzyme 2 (ACE2) for SARS-CoV as well as carcinoembryonic antigen-related cell adhesion molecule 1 (CECAM1) for MHV and BCoV sugar receptor (Pöhlmann *et al.*, 2006; Raj *et al.*, 2013; Wang *et al.*, 2013). Though, the profile of the bat CoV receptor is generally acknowledged. A few proteomic experiments on many Merbecovirus and Sarbecovirus CoV organisms have indicated potential use of DPP4 and ACE2 receptors, respectively, but inclined to binding affinity for specific host receptors (Menachery, Yount, *et al.*, 2016; Y. Yang *et al.*, 2014). Still, except for a few SARS-like CoV varieties, most of these bat CoVs have never been effectively isolated or pathogenically examined. It is uncertain if most of these bats have pathogenic capacities in humans. Anyhow, the available evidence shows that recipient hosts who share a similar human receptor identity are potential candidates as intermediate hosts for interspecies jumping events (Lau *et al.*, 2018). A similar phenomenon found in both SADS-CoV and SARS-CoV outbursts is that the outbreaks involved caged or farmed animals confined to specified areas with bats living around them. In the case of SARS-CoV, wild civets have been found to be free from infection (Lau *et al.*, 2018). Correspondingly, human actions promoted viral spillover events by bringing vulnerable receiver hosts closer to viral origins. Various examples of pathogens having zoonotic origin have been mentioned in Table 2. Interspecies transmission monitoring will be imposed around wet markets, farms and slaughterhouses to shield humans from novel zoonotic diseases.

All human CoVs may be of zoonotic origin and bats are most likely the natural hosts for all presently known CoVs. Moreover, it is evident that bat habitats are at distant from human activity areas unless available in certain wet markets. Thereby it essentiate the possibility of another source involved in causing pathogenicity in humans. Likewise, animal hosts of MERS-CoV and SARS-CoV are the camel and civet respectively (Figure 2) before transmission to humans. As far as the intermediate animal host of the recently emerged SARS-CoV-2 is concerned, it has been reported that the sequence identity between pangolin origin CoVs and SARS-CoV-2 is 99%, indicating that SARS-CoV-2 may be of pangolin origin. Many studies in China are tracking other potential animal hosts of SARS-CoV-2, which is of great significance for the prevention and control of COVID-19 (Jin *et al.*, 2020; Petrosillo *et al.*, 2020).

Pathogen population dynamics

Epidemiological theory has a well-developed conceptual framework for assessing the spread of infection through a host population. The primary cases of infection determine the expected size of any outbreak as well as the transmission potential of pathogen. The potential for pathogen transmission can be expressed in terms of the basic reproduction number (R_0), and pathogens that enter a new host population via a species jump can be placed in two categories depending on its value. The key

Table 2. Paragon of different pathogens that have emerged via zoonotic virus species.

Zoonotic pathogen	Original host	New host	References
Canine/Phocine distemper virus	Canids	Seals	(Cleaveland, Haydon, & Taylor, 2007)
Hendra virus	Bats	Horses and humans	(Mackenzie & Field, 2004)
Australian bat lyssavirus	Bats	Humans	(Mackenzie & Field, 2004)
H5N1 influenza A	Chickens	Humans	(K. Li et al., 2004; Mackenzie & Field, 2004)
Nipah virus	Bats	Pigs and humans	(Mackenzie & Field, 2004)
SARS coronavirus	Palm civets	Humans	(Consortium, 2004)
Monkeypox virus	Prairie dogs	Humans	(Guarner et al., 2004)
Myxoma virus	Brush rabbit/Brazilian rabbit	European rabbit	(Fenner & Fantini, 1999)
Ebola virus	Unknown	Humans	(Morvan, Nakoune, Deubel, & Colyn, 2000)
FPLV/CPV	Cats	Dogs	(Parrish, 1993)
SIV/HIV-1	Primates	Humans	(Hahn, Shaw, De, & Sharp, 2000)
SIV/HIV-2	Primates	Humans	(Hahn et al., 2000)
MERS coronavirus	Bats	Human	(Petrosillo, Viceconte, Ergonul, Ippolito, & Petersen, 2020)
SARS coronavirus 2	Bats	Human	(Petrosillo et al., 2020)

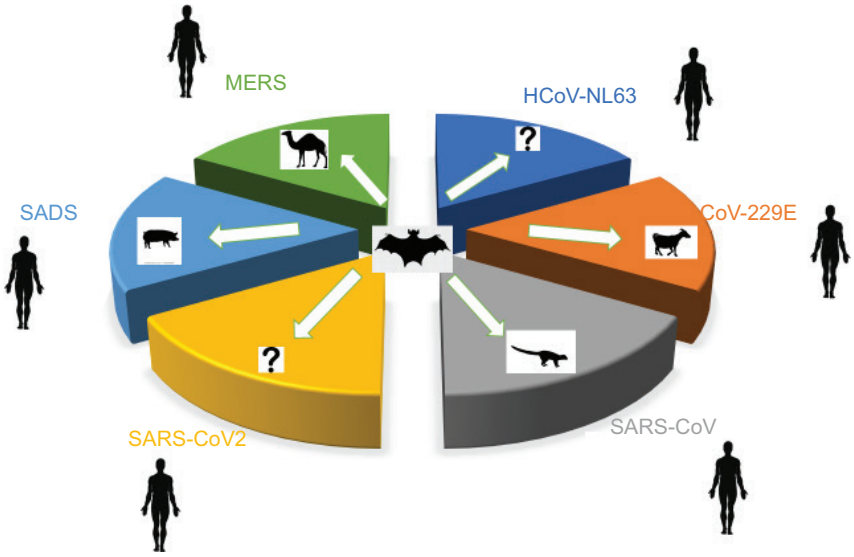

Figure 2. Examples of bat coronaviruses and their transmission to humans through different animal routes.

difference between the two categories lies in the origin of infections within the new host population: if R_0 is !1, then a large proportion of infections will be acquired directly from the original source host population. This category of emerging pathogen is unlikely to constitute the greatest disease threat; examples in humans comprise the Ebola, monkeypox and avian influenza viruses and the vCJD agent. If R_0 is O1 and the outbreak takes off, then most infections will be attained from within the new host population, the resulting positive feedback potentially fueling a major epidemic. This category is likely to produce the greatest disease threat; examples in humans include HIV, influenza type A virus and SARS coronavirus. Regarding COVID-19, the basic reproductive number (R_0) is still controversial. However, the World Health Organization (WHO) suggested the reproductive number (R_0) of the novel infection is between 2 and 2.5 that is much more than that for MERS (<1) and SARS (1.7–1.9) revealing SARS-CoV-2 has a higher pandemic potential. However, the current estimate can be biased by insufficient data and the short onset times of the diseases since the estimation of R_0 depends on the estimation method used (Petrosillo *et al.*, 2020).

Evolution of emerging zoonotic viruses within human host

Although DNA viruses are considered to evolve and diversified for millions of years, yet for some thousands of years most RNA viruses are likely to have recent evolution and human-adaptation as well (Kitchen, Shackelton, & Holmes, 2011). It is important to understand the complex "host-pathogen-environment" link to curtail the emergence/ re-emergence of novel viruses. Although the advent of infectious ailments in naive areas is largely triggered by the transmission of pathogens through trade and transport, different environmental and social change (probably local emergence). Notably, the rate of transmission of viruses in large populations is much higher than in scattered populations, and air transport or migration also significantly facilitates the spread. Infectious diseases in naive regions often produces devastating outbreaks due to social changes and depraved land use that typically exhibit persistent increase with time. ZIKV's arrival in Brazil in 2015 is another example (Abushouk, Negida, & Ahmed, 2016). Phylogenetic research indicated that ZIKV in 2013/2014 from the Pacific Islands epidemic was possibly imported into Brazil during the FIFA World Cup or the auto racing series of the 2014 FIA World Endurance Championship. The dissemination of virus in Brazil led to an unprecedented Zika fever outbreak due to frequent travel to other nations. While most human pathogens are believed to have zoonotic roots, it is likely that environmental variations are a significant but totally overlooked aspect due to industrialization and urbanization. Many of the human viral diseases are attributed to high host persistence that's why classified as crowd diseases (Simmonds, 2001). In fact, recent H1N1, hCoV, Hendra virus, Nipah virus, and MERS-CoV, SARS-CoV, SARS-CoV2 outbreaks affirmed Asia-Pacific region as the hot spot area for the introduction of new RNA viruses. However, the occurrence of 1 such event per 100 years is generally consistent with the human demographic history (Wolfe, Dunavan, & Diamond, 2007). The dynamics of such pandemic events in history with advancement in medical technology can be efficiently used to forecast likelihood of alike events. Recent case-clusters of the SARS-CoV2 epidemic is a true example and the resulting global expansion including the distribution of individual

cases vary by nation. Recent inquiries have assessed the broadcast dynamics of SARS-CoV2 infection using mathematical models (Hufnagel, Brockmann, & Geisel, 2004; Kucharski *et al.*, 2016). We cannot overlook the fact that wild animals are one of the poorly understood reservoirs of different human pathogens (together with viruses). In fact, the probability of direct or indirect close contact between human and animal species plays a key role in aggravating the zoonotic infections. Undoubtedly all the factors (such as socioeconomic and ecological variations) responsible in human-animal interactions vary geographically and show different pattern of exasperating.

Prevention from zoonotic diseases and Islamic laws

Regarding these animals or birds, the food intake pattern discussed above remains a major source of viral infections as the primary agents. Within this paper the primary focus is on the dissemination and prevention from these epidemics of major zoonotic viral diseases. Eating behavior is one of the main prevention points and Islam is one of the dominant sects that prioritize consuming Halal and Tayyab. Life protection is one of the components of Islamic law's main goals, which should be stressed given the increasing concern for public safety and unhealthy practices that occur in communities at large. All foods are considered halal except those mentioned in the Quran as follows:

> "Forbidden to you (as food) are: dead meat, blood, the flesh of swine, and that on which hath been invoked the name of other than God. That which hath been killed by strangling, or by violent blow, or by headlong fall, or being gored to death; that which hath been (partly) eaten by a wild animal; unless ye are able to slaughter it (in due form); that which is sacrificed on stone (altars); (forbidden) also is the division (of meat) by raffling with arrows; that is impiety." The Quran (5:3).

Specific diseases are caused by pork intake, among others: artery hardening, elevated blood pressure , chest pain that has seized (angina pectoris), inflammation (pain) in body joints (Denner, 2014). Actually, pathogens mostly of pork origin comprised of viruses, bacteria, worms, and other pathogenic parasites that can easily transmitted to humans. Another hazardous virus found in pigs is retrovirus which is involved in causing cancer (Denner, 2014). In 1968, the Hong Kong Flu (H3N2) epidemic, which resulted in nearly 34,000 deaths in the United States, triggered an influenza pandemic by virus H3N2 (Hong Kong flu) from pigs. The Hong Kong influenza pandemic firstly detected in Hong Kong in early 1968. During the following two winters, it spread globally, causing greater morbidity in some countries in the first winter and others in second winter season. The epidemic of different types of modified virus continues to this day and has caused many deaths in some countries. Among the viruses that are often endemic, namely are the H1N1 (swine flu), H5N1 (Avian Flu) (Mujoriya, Dhamande, & Ramesh, 2011; Tuggle, Wang, & Couture, 2007). Fanged animals and prey birds produce enzymes that show wild and ferocious character, when people consume these things also make them wild and ferocious. Animals contain not only proteins that are useful to humans but also xenobiotic compounds that are harmful to humans (especially xenobiotic compounds in the blood). If the animal is slaughtered in an improper manner, then the blood will not come out perfectly and will harm human health.(Murray, Granner, Mayes, & Rodwell, 2014). Animals and what is produced in the world by Allah Almighty is to humans. Therefore, if we are to destroy the creation of God, then we must ask the creator's permission and slaughter according to the creator's Sharia provisions, so that we can obtain mercy and grace, and avoid harmful things. So, Islam set the slaughter by Allah Almighty 's provisions. In Sharia Islam, in order to receive meat halal, animals must be slaughtered in acquiescence with the requirements laid down by Allah Almighty. If the intention of slaughtering animals according to Islamic teachings is to maintain the composition of proteins and enzymes as well as the composition of other chemical compounds in the animal's body in order to remain in a state of homeostasis or healthy, because enzymes are proteins and consist of amino acids, these chemicals can affect the taste and the human body will use protein compounds from these animals to build the body of people who eat them and to create anticorps in the human body. Besides the fact that animal enzymes can also influence the temperament and character of a human, so Islamic teachings control slaughter, so that animal proteins are very useful to the body and make good conduct for the sake of the people who eat them, and slaughtered animals are not tormented or in welfare. As we've seen in many countries, like Indonesia, there's still a lot of people drinking the blood, including some Muslims who don't understand, like; Saren or Marus. Culinary blood is a common sight in Java which is obtained from animal blood, combined with water and salt to freeze and then fry. People who are eating it said, the taste is very good. Several other blood products, among others: blood sausage, blood bread, and cooking goulash and blood food to get a savory taste, are also available. On the other hand, there are people who consumed a snake's raw blood (cobra) to increase body strength (Murray *et al.*, 2014; Yousofshahi, Manteiga, Wu, Lee, & Hassoun, 2015). Ulema does not understand the meaning of the Al Quran emphasizing the blood that flows is prohibited in the Quran to be consumed, while blood was frozen as Saren / Marus or blood sausage does

not flow as it is halal. That's totally false. Since blood is halal only if it is the remaining blood in meat and other animal organs which cannot flow when slaughtering. Though Saren / Marus and blood products are foods made from the flowing blood. Saren / Marus and foodstuffs made from blood are also forbidden. Islam precludes blood intake because of the risks of blood intake (Schulz & Schmoldt, 2003; Sears, Kerr, & Bray, 2012).

Xenobiotic transformations

As Allah Almighty's Word in the Al Qur'an at Surah Sad, verse 29:

> (This is) a Book (the Quran) which We have sent down to you, full of blessings that they may ponder over (conduct research) its Verses, and that men of understanding may remember.

Based on the above verse, if we carry out scientific work in the field of medical knowledge on the commands of Allah Almighty, in Al Quran, Surah Al Baqorah verse 168, that is:

> O mankind, eat from whatever is on earth [that is] lawful and good and do not follow the footsteps of Satan. Indeed, he is to you a clear enemy.

Allah Almighty calls not only Muslims but all humanity to eat food that is halalan thoyyiban. (Legal and good) This proves that Islam is a grace to all the worlds (Rahmatan lil Alamin). The suitability of Islamic technique with medical science on the risk of consuming haram foods and drinks on physical and spiritual health can be observed based on the above state verses of the Al Quran. The human body, according to Biochemistry, is a series of chemical compounds whose chemical compounds are very complex and consist of millions of chemical compounds, a cycle of reaction chemical compounds of the body can react with chemical compounds of food and they are called metabolism (Murray *et al.*, 2014). This metabolic cycle is divided into, namely the cycle of breaking down food compounds into simple molecules, which is called the Catabolism reaction. The results of this catabolism will react with chemical compounds of the body to form compounds that the body needs and Xenobiotic compounds are compounds that the body does not need and can jeopardize the balance of chemical compounds in the body or interfere with the chemical homeostasis in the body. Examples of xenobiotic compounds include alcohol, poisons, unsuitable drugs, enzymes that have bothered the human body's chemical systems, particularly those found in wild animals, pigs, repulsive animals and homeostasis disorders are caused not only by Xenobiotic compounds but also by excess or lack of other compounds in the body such as excess and shortage, oxygen, water, carbohydrates protein vitamins and minerals (Murray *et al.*, 2014; Yılmaz, Ergun, Şanver Çelik, Yigit, & Bayizit, 2019). One example can be seen with the naked eye that is a product of the body's chemical compounds that most react with food, while food also works to take enzymes and hormones in the body. Effects of enzymes and hormones interacting with food decide a person's physical body shape and psychological and character. In this case, people who regularly eat wild

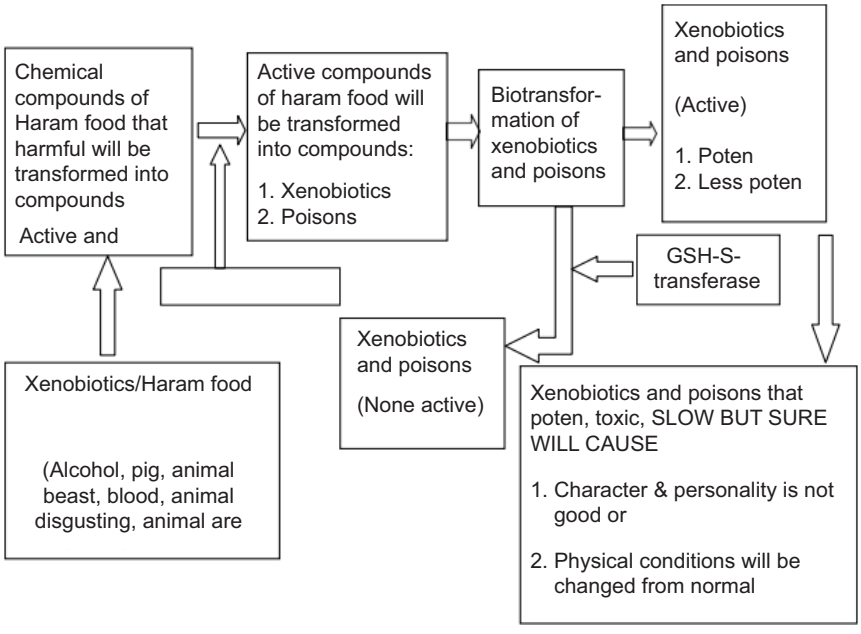

Figure 3. The process of biotransformation of xenobiotic compounds.

animals appear to be ferocious like wild animals, since wild animals enzymes form enzymes in the human body that make a person's character ferocious like wild animals (Murray *et al.*, 2014). The system for bio transforming xenobiotic compounds into haram food and drink in the human body based on which biochemistry (Figure 3).

Reasons for prohibition of unlawful foods

The reasons for the prohibition need to be explained before embarking on the kinds of banned foods. We cannot provide all the explanations here in full, but we can merely note that it has always been a propensity to rationally and scientifically view the banned foods. The objective of the prohibition from unlawful foods is to maintain the dignity of the human body in spite of engaging in disgraced activities. This phenomenon principle of eating has been accepted in modern times by various medical doctors who agreed to this concept that objects are prohibited simply when found dangerous to human beings. Likewise, Islamic law permits things, as if foods are good (tayyib) for humans or not. Allah (s.a.w) says:

> "O you who believe! forbid not (yourselves) the good things which Allah hath made lawful for you and transgress not. Surely Allah loveth not the transgressors." (Al-Ma'idah (5):87).
>
> "O you who believe! Eat of the good things wherewith We have supplied you and render thanks to Allah if you are (indeed) His worshippers." (Al-Baqarah (2):172).

He again declares:

> "Say: Who hath forbidden the beautiful (gifts) of Allah, which He hath produced for His servants, and the things, clean and pure, (which He has provided) for sustenance? say they are, in the life of this world, for those who believe, (and) purely for them on the Day of judgment. Thus do We explain the Signs in detail for those who understand. Say: The things that my Lord has indeed forbidden are: Shameful deeds, whether open or secret; sins and trespasses against truth or reason; assigning of partners to Allah for which He has given no authority; and saying things about Allah of which you have no knowledge." (Al-'Araf (7):32-33).

It is interesting to understand that the word "al-Tayyibat" is derived from taba, means good, pleasant, pure delightful, clean and delicious. So, all the impure and unclean items are prohibited for eating in Islam. All the things under the umbrella of word "al-tayyibat" are not only pleasant or good in taste but also provide substantial health benefits to human body along with our spiritual health. Thereby consuming unlawful foods would render injurious health impact with spiritual culpability upon man as it often leads to corrupt deeds affecting our social, behavioral and moral character. Verily, our control on food consumption by following the Islamic principles of eating would enable us to endorse virtues. Our creator asks all the creatures to follow His imposition and eat what is wholesome, pure, clean, nourishing and pleasing to the taste. Additionally, the benefits of Islamic laws to human beings are as vast as revealed on us from various research perspectives that add beauty in their follow-up. The prohibition helps in the prevention from various diseases especially the recent zoonotic viral epidemics substantiates this concept of Halal eating. All the foods or drinks that are forbidden in Islam have been found wholesome and improve health from medical perspective as well. From the various examples of viral pathogenicity incidents discussed above, it is concluded that we must follow the principles of Halal eating to achieve the goals of healthy life without any adjusted years of life. Moreover, the nature or the effect of the use of prohibited things can be harmful to the human body, human self-development, human judgment or a combination thereof (Haq, 1996). Undoubtedly, there are no such foods in Islamic laws that are Halal and do harm to human body until or unless consumed in unethical way and vice versa. Only those things are considered as haram or unlawful that may cause immediate death or gradually provides harm to human body (containing any poisonous or toxic substances) and we must prevent from such sources. Consuming large quantities of anything that may also cause illness also not permissible in Islam as for Muslims there is a trustworthy relationship between man and his creator that must not be diminished that Allah has bestowed upon him (Nurdeng, 2009).

Association between hygiene, halal and safe food supply chain

The concept of halal comprehends all quality aspects of a good or healthy food and provide overall guidelines of what we eat, drink and use daily for human safety. Therefore, for Muslims, food should be halal rather than only of good quality, safe and hygienic (Muhammad, Maheran, Md Isa, & Kifli, 2009; Talib, Ali, Jamaludin, & Rijal, 2008). It shows that except for those specified as Haram in the Quran, all food is halal. The legal, hygienic, nutritious and decent food, beverages, and goods as laid down in the Holy Quran and Shariah are only permitted by Islam to followers. Hygienics, health and integrity are emphasized by halal in Islam. This includes all elements of personal health, clothes, equipment and grounds, under which food is stored or cooked. Halal's sanitation

and wellbeing are basically the foundation (Zailani, Arrifin, Abd Wahid, Othman, & Fernando, 2010). Its aim is to certify that the foods, drinks and products that people consume, or use are completely clean and not harmful to human health. In this case, Muslim communities should be mindful of the packaging of food or beverage ingredients, handling process and consumable products. The raw materials and ingredients used are halal but processed foods and beverages and products are halal only and it is fully compatible with Islamic guidelines (Ambali & Bakar, 2014). The most meaningful protocol for Muslim customers is the Halal food protocol. For most food sectors for Islamic countries, this definition is widely recognized. The value of enabling food to be eaten is stressed by Muslims. It is a reality that food is produced for the good of man and should be used by man, even though man does not realize its meaning in other items. The foodstuffs are treated as lawful (halal) under this general law, unless their prohibitions are explicitly defined in the Quran, or the practice of the Prophet Muhammad (S.A.W). This phenomenon has particularly grown in recent times where jurists and medical doctors have concluded that it is just when products are dangerous to humanity they are banned. At the other side, if they are nice (tayyib), actions are justified under Islamic rule. Allah (SWT) says:

> O you who believe! forbid not (yourselves) the good things which Allah hath made lawful for you and transgress not. Surely Allah loveth not the transgressors. (Al-Ma'idah (5):87).

The Islamic Sharia's general rule is that Muslims are must not to ingest any food or drink that may results in demise, either immediately or slowly because of the poisonous or toxic substances that threatens the safety of their own bodies. The ban on Maytah (the dead animal's meat or carrion), swine flesh, flowing blood and meat devoted to everyone but God (SWT) is meant to protect the safety of man in this way. Not only in Islamic laws but medical laws also stress upon prevention rather than medical care. This designates that Islamic rule specifically adopted the dictum "prevention is better than cure." (Nurdeng, 2009). Halal goods are now becoming a global debate as they are accepted as an alternate standard for health, hygiene and the quality of what we drink or eat every day. Goods and products manufactured in compliance with Halal guidelines are therefore readily accepted for both Muslim and other religious consumers. For Muslims, Halal food and beverage goods are those which have fulfilled the criteria of Shariah law, while it reflects the health, quality and safety emblem for a non-Muslim market while exclusively processed under the Holistic Halal Assurances Program (Ambali & Bakar, 2014). Overall, Quran stress on devouring tayyeb (good quality), halal (healthy) foods proposing a diverse or balanced nutritious diet. Apparently, the key recommendations found in Quran about eating involve fruits or vegetables, dairy and animal protein as opposed to popular assumptions that Quran's focus on vegetarianism. Compared with previous data, the strengths points of the current knowledge in relation to Halal foods are in line for the prevention of many zoonotic diseases emergence: (1) comparing contemporary nutritional recommendation with Quranic recommendation (2) clear and systematic methods (3) explanation about lawful and unlawful foodstuffs and (4) including foods from both animal and plant-origin. However, more research is required to align modern nutritional science with the food recommendation of Quran in the regard of lawful and unlawful foodstuffs (Tarighat-Esfanjani & Namazi, 2016). A halal food supply chain begins with the procurement and processing of different approved raw materials (such as proper halal slaughter and no haram cross contamination). It is important that food will, at all stages of halal development, be legally processed without corruption, dishonesty or malicious purpose. A farm to fork chain is concerned not only with food but also with food descent, openness, fraud and adulteration potential, increasing consumer trust, traceability (traceback and track forward) and quality issues (Kennedy, 2012). (Manning & Soon, 2014). The word food integrity should be used to describe foods that are properly represented for what they are Manning and Soon suggested (2014). Halal validity will therefore be another direct indicator of the halal status of the drug and the fulfillment of the requirements for halal as stated. Food protection is a aspect of the dignity of halal as wholesomeness (Tayyab) is an essential part of Halal 's necessity. (Zulfakar, Anuar, & Talib, 2014) suggested a functional structure for the quality of the halal food supply chain that involves defensive and preventive food resources that stay halal before they come into touch with the customer. Halal's credibility would also demonstrate that the drug stays halal in the supply chain, and free of any practices that could infringe (intentionally or unintentionally) its halal status. Specific halal control points, halal poultry slaughter and a critical control point for halal compliance are further proposed for the various production systems. The obstacles to maintain halal quality in the food supply chain are definitely present, since various entities at different rates need output, refining and transport (Shahdan, Regenstein, Shahabuddin, & Rahman, 2016). (Alqudsi, 2014) stated that the preservation of the halal quality of the whole supply chain is a daunting challenge, because it requires continuous supervision and funding for money and skilled staff. Nevertheless, demand for halal food goods from customers and the trend towards a philosophy of faith on the supply side (i.e., extension of the halal markets as a consequence of the initiative on the production sides to manufacture more halal foodstuffs) would reinforce the need to retain a halal food status. Halal certification bodies play a significant role in halal food and

service regulation, while governments as accrediting bodies can play an active role in the activity of the halal food chain, or have independent approval to track it in order to preserve halal credibility in the supply chain, irrespective whether the chain resides in a single nation or in many countries, one needs an accountability of the global halal supply chain. If Halal Quality is upheld in the supply chain regardless of whether the chain is in one or more nations, the global supply chain for Halal is essential.

Convergence of food systems (Muslims, Jews, Christens)

Human health is one of the foremost priorities regardless any discrimination in different religions. Food pattern may vary geographically but commercialization of natural resources is endangering our health, food security and environment. The emphasis on sustainable food resources utilization and moving from a meat-based diet towards a wide variety of vegetables is essential. Moreover, minimizing the meat intake put a large impact on food supplies, since the bulk of our agricultural services are used for meat production. Source of meat used for consumption also matters as evidence supports the fact that by replacing porcine with bovine sources is not only essential for Muslims, Jews and Old Testament abiding Christians but also advantageous for health. Likewise, these days with an unsustainable food environment the pact between Jews, Christians and Muslims on fasting is just a significant factor in plummeting the demand for meat. It may also be claimed that the value of fasting and the avoidance of some forms of meat (such as pork meat) are of considerable significance for religious leaders to encourage no-meat days and eliminate food wastage. It can also be recognized that many current activities of food industry are impractical and do not adhere to the Jewish, Christian and Islamic scriptures. Judas, Christian and Muslim diet related principles include a variety of commonalities in banning certain livestock (e.g., pigs) and blood. Such scriptures include the greatest degree of reverence for animal life, preferential usage for herbal goods in contrast with meat-based foods, and the replacement of porcin by bovine suppliers. Meeting these religious requirements is not only important for the agriculture and food industry but also improves the protection of our food, safety and environmental structures. Actual religious food logos (like the Cosher and Halal logo) provide a clear picture of religious compliance. Though it alone does not fulfill all the dietary requirements and ensure optimum health. Another so-called traffic light system used to direct consumers used so far is if the product is a key building block of a healthy diet (green); a product with low levels of salt, sugar and fat (orange); or a product with high levels of salt, sugar and/or fat (red). (Sonnenberg *et al.*, 2013; Thorndike, Riis, Sonnenberg, & Levy, 2014) According to the extensive research on sustainable healthy diet by (Macdiarmid, 2013) the key components of a healthy diet are foodstuffs like plain oats, vegetables, fruits, seeds, beans, olive oil fish, white meats and plant-based milk and yoghurts. Current eating practices involve high sugar, fat and salt content in dishes suppressing the effect of raw foods and directly or indirectly promoting non-communicable diseases (Moss, 2013). Integrating the nutrient profiling along with religious logo could better inform the consumer in making a healthier food choice.

One health approach

Most zoonoses are well established from wildlife such as avian influenza and rabies whereas others emerging from wildlife species reservoirs still emerges with novel characteristics. Ebola is one of the exemplary infectious disease attributed to African cave-dwelling bats. Likewise, SARS has lost more than 800 lives as well as cost more than $ 60 billion worldwide, eventually evolved from bats to civettes in wet markets and restaurants in southern China before affecting humans (Wendong Li *et al.*, 2005). Although the current emergence of COVID-19 requires awareness in public sector from prevention of this deadly pandemic due to zoonotic agents. As wildlife is recognized as a key cause for developing zoonotic ailments, thereby there is a need to understand the One Health approach for better disease research and prevention. The One Health Initiative (www.onehealthinitiative.com) defines One Health as 'the collaborative efforts of multiple disciplines working locally, nationally and globally to attain optimal health for people, animals, plants and our environment'. In the context of emerging zoonoses from wildlife, the disciplines that must work together are those of human and veterinary medicine. Emerging transboundary zoonoses require improved collaboration between these sectors to develop control strategies and implement surveillance and response activities at the animal–human interface (Figure 4). But, just as importantly, to establish control strategies we must also consider the interactions of humans and animals with ecosystems and the environment. With the increasing recognition of wildlife as a major source of emerging zoonotic diseases, more and more attention is being directed to the One Health approach for disease investigation and prevention.

Other possible control measures

Effective prevention and control measures for most zoonotic viral diseases can be accomplished by means of adopting healthy lifestyle and eating Halal foods along with adequate diagnoses and prophylaxis. The first step in control of any disease is surveillance. The characteristics and transmission patterns of the virus, along with

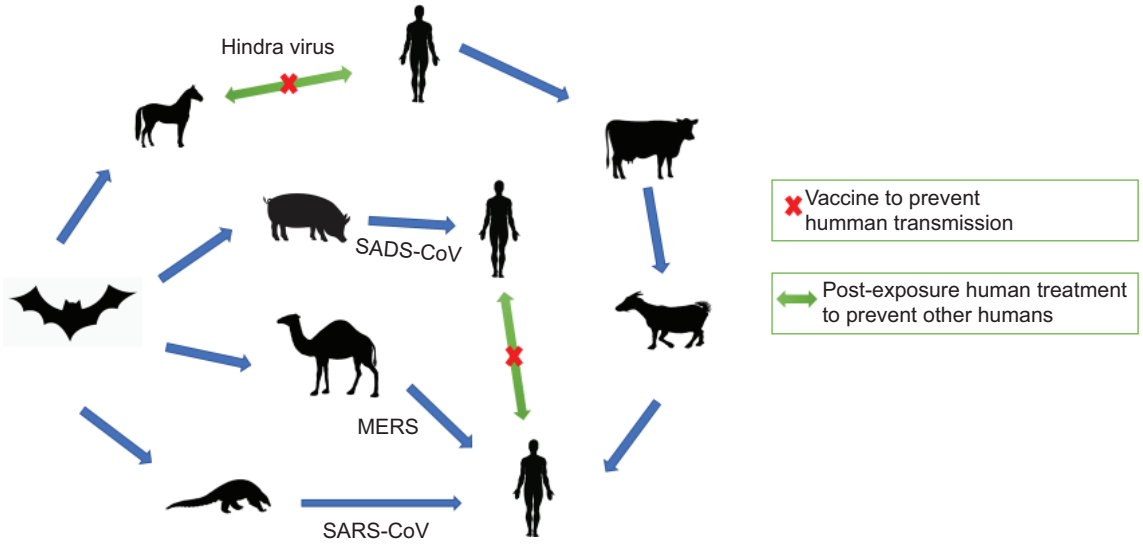

Figure 4. One health strategy to control and prevent transmission routes for zoonotic pathogens.

the understanding of vectors and animal reservoirs, and the environment and epidemiology of the disease, have to be fully considered when control and prevention measures are defined. A better understanding of the epidemiology of the diseases associated with wildlife as reservoirs, including the virulence of the agents and their routes of transmission, would contribute to improving eradication measures for such scourges. In addition, better sanitary conditions, including proper treatment and release of human waste, improvement in public water supplies, proper personal hygiene methods and sanitary food preparation, are of extreme importance in control measures. Improved diagnostics and prophylaxis require research deep inside the molecular biology of each virus. A clear knowledge of the migration pattern of birds and the diseases they transmit would help to prevent outbreaks of emerging viruses such as H5N1 HPAI. The emergence and re-emergence of viral zoonoses must unite the efforts of two scientific fields that are currently working separately: public health and veterinary studies. Better, highly sensitive and faster detection techniques, including molecular biology methods such as genomics and proteomics working side-by-side with more conventional methodologies, would enable identification of emerging or re-emerging viruses. Rapid detection would facilitate the timely application of therapeutic/prophylactic/preventive measures. Proper vaccination campaigns can help decrease the incidence and spread of infectious diseases. Travelers should obtain information from the appropriate institutions, such as government medical advisory bodies and local health authorities, about the risks they incur, the prophylactic treatments available and the do's and don'ts while visiting a different country with a different environment and potential hazards. Medical institutions and the media should work together to disclose more knowledge on emerging or re-emerging diseases, the transmission routes, and the prophylactic measures available. Public awareness regarding the handling of wild animals in exotic markets and better food handling and cooking procedures would also help prevent outbreaks from occurring.

Conclusion and Future aspects

The emerging spillover events of zoonotic diseases in human and domestic animals necessitate the active surveillance of wildlife animals as part of an integrated infectious disease prevention and control strategy. In this review, the authors have presented the increasing trend of zoonotic virus emergence in the last few decades and demonstrated the role of Islamic teachings regarding food consumption in prevention from any serious outbreak. It is also imperative that governments, health workers and scientists at every level and in every nation work together to further nurture and maximize One Health practices so that we can be more effective in our future fight against emerging and re-emerging zoonotic diseases. One of the major lessons is that we need to pay much more attention to the reservoir species in understanding the genetic diversity of different viruses, the intricate interplay at the virus host interface, and the major factors responsible for the disturbance of viruses host equilibrium, which in turn trigger spillover events leading to disease outbreaks.

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