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NIPAH VIRUS: A COMPREHENSIVE REVIEW OF VIRAL GENOME, GLOBAL BURDEN OF DISEASE EPIDEMIOLOGY, ANTI-VIRAL, NANO-TECHNOLOGY, VACCINE TECHNOLOGIES AND ARTIFICIAL INTELLIGENCE AND SMALL INTERFERING RNA BASED ADVANCED THERAPEUTICS

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ABSTRACT

Nipah virus (NiV) is a zoonotic virus that may infect both humans and animals and may cause serious diseases. NiV can spread from one person to another by respiratory droplets or contact with bodily fluids that are contaminated. In Bangladesh, India, Malaysia, and Singapore, NiV epidemics have been observed. Over 100 people died in Malaysia during the first NiV outbreak, which happened in 1999. Since then, Bangladesh and India have experienced a number of minor NiV outbreaks. The NiV virus can be targeted by new antiviral medications made using nanotechnology, novel vaccinations can be created using artificial intelligence, as well as novel diagnostic tests for NiV infection. Small interfering RNAs can be utilised in treatments to suppress the NiV virus. The prevention and treatment of NiV infection could be greatly enhanced by these new technologies. To improve these technologies and introduce them into clinical practise, more study is necessary. Although the burden of NiV infection is still quite low worldwide, there is a real danger that the virus could spread widely. To reduce this danger, new tools for the diagnosis, treatment, and prevention of NiV infection must be developed. There is an urgent need for more research into NiV infection, and for the development of new technologies to prevent and treat the disease.

KEYWORDS: Nipah Virus, Epidemiology, Prevalence, Global Burden of Disease, Artificial Intelligence, Anti-Viral, Small interfering RNA.

INTRODUCTION

Viruses are the cause of infections that is a serious threat to public health. Different viruses such as Marburg, coronaviruses: Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome Coronavirus 1 (SARS-CoV-1), Human Immunodeficiency Virus (HIV). Hendra, Nipah virus (NiV) fall into such category since they have caused frequent epidemics in current years. These viruses can resurface after a gap, then spread quickly and kill millions of people (Zumla et al., 2019; Singh et al., 2019). These epidemics inferred high morbidity and death, primarily in developing countries in Asia, Africa, and South America (Jones et al., 2008; Aiyar and Pinga1i, 2020).

The lethal and easily transmirttab1e NiV, high mortality rate in humans, its zoonotic mode of transmission the

likelihood of human-to-human transmission, and unavailability of potent vaccine, has been renowned by the World Health Organization (WHO) as a global health problem (Anderson et al., 2019; World Health Organization [WHO]). Consecutively, the NiV is classified as category C by Centers for Disease Control and Prevention (CDC) and the National Institute of Allergy and infectious Diseases (NIAID) that cou1d be used as bio war and agro terrorism agent (Ochani et al., 2019; Lam et al., 2003), Pakistan is already a poor country. In view of the burden that has been caused by COVID-19 pandemic, Pakistan is already stressed with healthcare systems (Awan et al., 2022; Mehmood ct al., 2022). The health systems of Pakistan faced various obstacles during the COVID-19·19 pandemic and shortage of health facilities such as adequate man power, laboratory equipment, hospital beds, and ventilators makes the situation worse (Butt et al, 2021). The scarce budget of health care and poor medical facilities would collapse further if NiV starts to spread in Pakistan. This article will cover a comprehensive analysis of the biology, epidemiology, spread, identification, potential therapeutic of NiV.

NIPAH VIRUS (NIV)

NiV first emerged in Malaysia and Singapore in 1998 and 1999 (CDC, 1999). NiV belongs to the Paramyxoviridae family's, and Henipavirus genus. This family is a house of many other pathogenic viruses, such as the measles virus or mumps virus, Also, Henipavirus genus contain the highly pathogenic Hendra virus (HeV) (Shoemaker and Choi, 2020). NiV and HeV share the 80% nucleotide homology (Shat1n.a e:t al. 2019; Thakur and Bailey 2019). However structurally, NiV bear a resemblance to other paramyxoviruses: it is a pleomorphic, spherical, or thread-like enveloped virus ranging in size of 40-1900 nm, having a monolayer of surface protrusions of around 17 nm, Under an electron microscope, the virus displays a distinctive pattern that resembles a herringbone (Ang et al., 2018; Sharma et al., 2019). The genome contains negative sense single-stranded RNA with size ranging from 18,246 to 18,252, subjected to the different strain type (Devnath and Al Masud, 2021; Chakraborty et al., 2019).

GENOME OF NIPAH VIRUS

The NiV genome mainly encode 6 genes having function in rnaintaining the structural integrity of virus: nuclcocapsid (N), matrix protein (M), phospboprotein (P), attachment glycoprotein (G), fusion protein (F) and the large protein or RNA polymerase protein (L) in the order 3'-N-P-M-F-G-L-5'. The P gene further encodes non-structural proteins C, V, and W, which render the virus pathogenic prope1ties (Wang et al., 2001; Martinez-Gil et al., 2017). G and F proteins have role in the first stage of the viral life cycle as they facilitate binding and fusion to the host cell. Transcription is catalyzed by L and P proteins, mRNA of virus is template for the main structural proteins (Hauser et al., 2021). The. N protein have important role in viral replication and transcription. The M protein helps in assembling the virion and exit from the cell (Sun et al., 2018). The particular receptor for NiV is ephrin (B2/B3) and it is found in almost all tissues, hence growing the possibility of infection (Xu et al., 2012; Taylor et al., 2017). Ephrin-B2 have an important role during embryogenesis in the migration of neuron precursors (Zimmer et al., 2003). Hence, it is highly conserved among different classes of anin1als. The receptor is conserved in bats and pigs with ratio of 95 96% (Bossart. et al., 2008). The spreading of NiV occurs in the host by blood as ephrin (82/B3) on leucocytes helps NiV bind to it (Mathieu et a1., 2011). There is high expression of ephrin (82/83) receptors in the central nervous system, therefore. NiV possess the highest potential to cause neurologic disease (Navaratnarajah el al., 2020).

GLOBAL EPIDEMIOLOGY AND PREVALENCE OF NEPHA VIRUS

The lethal and easily transmittable Nipah virus (NiV) was initially discovered in Malaysia during 1998. Subsequent to this, there have been intermittent occurrence of the disease in various nations, such as Bangladesh, India, and the Philippines.

Malaysia

NiV Surfaced for the first time in Malaysia during 1998 and primarily impacted individuals working in pig fanning and slaughterhouse. occupations within the nation (Centers for Disease Control and Prevention [CDC] (1999). The emergence of the virus led to a total of 265 individuals contracting the disease, which unfortunately resulted in the death of 105 people (Looi and Chua, 2007; Aditi and Shariff, 2019; Ambat et al., 2019). Subsequent to that, no additional instances of NiV have been recorded in Malaysia.

Bangladesh and India

Bangladesh and India are two sovereign nations that share a border and have historical, cultural, and economic ties. Most of the cases of NiV outbreaks have taken place in Bangladesh and India, where the virus. Is prevailing in specific species of bats. NiV made its first appearance in Bangladesh back in 2001, where it spread across 13 districts, contributing to the demise of 45 individuals (Ambat et al., 2019; Anderson et al., 2019). Subsequently, the nation has experienced numerous incidents of outbreaks, with the latest occurring during the period of 2019-2020. Several outbreaks of NiV have also been observed in India, with the initial occurrence being recorded in the state of West Bengal in 2001. Afterward, various other states have experienced intermittent episodes of the outbreak, including Kerala, which saw a deadly outbreak leading to the demise of 17 individuals in 2018 (Ambat et al., 2019; Plowright et al., 201 9).

Philippines

Last year, there was an instance of NiV outbreak in the southern part of the Philippines, which impacted a

particular family. The virus outbreak led to 16 fatalities and 17 cases underlining the risk of a widespread epidemic in uncharted territories (Ching et al., 2015· Aditi and Shariff, 2019; Ambat ct al., 2019). NiV has been detected in various other nations such as Cambodia, Thailand, and Vietnam, but thus far there have been no reported incidents of its outbreak in these regions. The detection of NiV in a bat in Japan in 2021 has caused worry about the vin1s's ability to propagate in previously unaffected regions.

Pakistan

Pakistan shares different cultural values as well as 2912-kilometer eastern border with India and lots of people travel between two countries. Furthermore. two-sided trade ties between two countries also upsurge the risk of disease transmission across borders (Ma11hi et al., 2018). In September 2021, there were reports of NiV in Khyber Pakhtunkhwa, Pakistan (please add ref from news).

MODE OF TRANSMISSION

NiV has be n confirmed in species Ptcropus hypomelanus Pteropus lylei, and Pteropus vampyrus in Malaysia (Shanna et al., 2019). In India, NiV is present in fruit bats also of the genus Pteropus, e.g., Pteropus giganteus (Plowright et al., 2019; Thakur and Bailey, 2019). Bats were the most possible source of human infection during NiV epidemic since high sequence similarity of NiV genes exist between infected hats and Indian patients. Possible route of transmission could be by consuming or in11aling belongings contaminated by bats (Yadav et al., 2019). Raw date palm liquid co1Lld also be a factor for NiV transmission in Bangladesh (Aditi and Shariff, 2019).

Bats are the principal reservoir for NiV vims, but pigs were found to be the source of human infection in Malaysian epidemic (Looi and Chua, 2007). Pigs become infected when they consumed bats contaminated fruits (Thakur and Bailey, 2019). Pigs- show symptoms of airway inflammation and encephalitis. Neurological indications of NiVinclude muscle trembling, and weakness of the hind legs (Singh et al., 2019). Pig mortality from NiV infection is comparatively low (Mohd Nor et al., 2000). NiV transmission to humans has occurred through close contact with infected pigsrin Malaysia. The virus isolated from pigs bad similar gene sequences to those of humans (Abu Bakar et al., 2004). In Singapore, cases of NiV infection caused by pigs either by direc.t contact with their feces and or by slaughterhouse. workers (Paton et al, 1999; Chan et al. 2002; Aditi and. Shariff, 2019). However, in Bangladesh and India, the contribution of pigs with virus spread has not been witnessed (Centers for Disease Control and Prevention [CDC], 1999; Thakur and Bailey, 2019). NiV also infect dogs and cats through contact with infected pigs but that is not transmitted to humans. Also. The epidemic of Malaysia ended when massive destruction of pigs was performed proving the fact that other animals have negligible role in spread of virus to humans (Parashar et al., 2000; Chua, 2003; Mills et al, 2009).

Human Transmission

Transmission of NiV occurs through close contact with bodily fluids of infected individuals, such as respiratory secretions, blood, and urine, which can also be passed on from person to person (Hsu et al., 2004; Nikolay -et al., 2020). Upon contracting the infection, a broad array of symptoms may manifest, spanning from mild to severe, with terminal encephalitis and respiratory ailments among the potential end stage pathologies leading to fatality.

MORTALITY RATE AND IMPACT ON PUBLIC HEALTH

It should be emphasized that the mortality rates associated with NiV outbreaks may differ due to various factors: such as the potency of the virus, access to adequate medical care for patients, and the efficacy of disease management protocols. Between 1998 and 1999, Malaysia experienced a significant increase of 39.6% (Paton et al., 1999). Between 2003 and 2007, Bangladesh experienced a 69% change or increase (Giurley et al. 2007). 111 2001, 68% of India's population exhibited the specified characteristic of viral infections. 1n 2007, India achieved a complete success rate of 100%. During the period of 2008 to 2012, Bangladesh achieved a rate of85-l%. In 2018, 81% of individuals in India were represented (World Health Organization [WHO]).

The NiV virus is an extremely infectious disease that presents a major risk to the well-being of the general population. The vin1s has the potential to lead to serious respiratory and neurological ailments in people, caus1ng death at rates varying between 40% and 90% (World Health Organization [WHO). To evade NiV contami1mtion one should take various precautirn:1s such as refraining from coming into contact with bats and their waste, maintaining good sanitary habits, and abstaining from eating uncooked or partly cooked fruits and veggies. It is crucial to keep a close watch on potential outbreaks of NiV in regions where it is prevalent, and to swiftly quarantine those who have contracted the virus while taking strong measures to prevent its spread.

At present, there exists no certain cure for the NiV disease and providing necessary Support is the primary approach for handling it Respiratory assistance, proper handling of fluids, and addressing potential issues such as seizures and inflammation of the brain are all part of the treatment plan. We will discuss different techniques for combating NiV.

ADVANCED RNA TECHNIQUES AGAINST NIPAH VIRUS

The employment of small interfering RNA (siRNA) technology presents a hopeful method for treating various viral illnesses, such as Nipah virus (NiV).

siRNAs are minute RNA molecules that exist in a paired and structured form. They have the ability to silence particular viral genes by disrupting their RNA through targeted binding. This technology offers a multitude of benefits in comparison to traditional antiviral treatments, such as precision targeting, minima1 harm to healthy cells, and the capacity to tackle multiple genes at once (Agrawal et al., 2003).

Numerous research has shown the effectiveness of siRNA technology when it con1es to combating NiV in labora.101-y and live animal settings. In a particular investigation, experts developed siRNAs which aimed at the N and P genes of NiV, and the outcome evidenced a substantial hindrance of viral replication in infected cells when subjected to these siRNAs (Oany et al., 2015). Researchers have conducted another study that involved using a siRNA-based method to specifically target the NiV Polymerase (L) gene. The findings of this investigation revealed that this approach resulted in a significant decrease in viral replication and enhanced the survival rate of NiV-infected mice (Mungall et al., 2008).

Although siRNA technology against NiV shows potential for clinical use, there are various obstacles to overcome. Effective delivery of siRNAs to specific cells and tissues poses a significant hurdle. SiRNAs that are not protected are quickly broken down by enzymes in the bloodstream, and they are not absorbed well by cells and are limited in their ability to enter tissues. Several delivery system have been developed by researchers, such as liposomes, nanoparticle, and viral vectors, with the aim of improving the stability of siRNAs and increasing their cellular :uptake as a solution to the challenge at hand (Hammond et al., 2005). Another obstacle arises from the possibility of off-target repercussions whereby the siRNA may unintentionally direct their effect towards the gen of the host and result in w1favorablc outcomes (Hammond et al., 2005. Researchers have tactfully crafted siRNAs featuring high specificity, while leveraging bioinformatics tools to preempt possible off-target impact and reduce any such effects.

NANOTECHNOLOGY-BASED MEDICINES TARGETING NIPAH VIRUS

The use of nanomedicines shows great potential in the treatment of various infectious diseases such as NiV infection. Through engineering, nanoparticles can precisely aim at p rticul.ar cells or tissues, which could improve the effectiveness and safety of current antiviral medications, Numerous researches have investigated the potential of nanomedicines in combating NiV contagions. As an illustration, a particular research employed gold nanoparticles that were combined with a monoclonal antibody aiming to intercept the NiV glycoprotein (G) for preventing the virus from infiltrating the host cells. The study outcomes revealed a remarkable decline in NiV infection both in vitro and in vivo with the use of these nanoparticles (Johnson et al., 2021).

A team of researchers created liposomal versions of ribavirin an antiviral medication often employed to treat NiV infection in a separate investigation. The liposomes were designed with the. purpose of improving the durability and efficacy of ribavirin while also concentrating. on treating affected cells, The outcomes displayed a noteworthy decrease in viral duplication. and increase in survival rate among NiV-infected mice upon their exposure to the liposomes (Johnson et al., 2021). Although there have been positive outcomes, the creation of nanomedicines for curing NiV has a number of obstacles to overcome. There are several difficulties to overcome in nanotechnology, such as refining the size, shape, and surface characteristics of nanoparticles, creating successful targeting techniques, and assessing the potential long-term risks and hazards.

ARTIFICIAL INTELLIGENCE IN COMBATING THE DEADLY NIPAH VIRUS

The use of advanced analytical tools powered by artificial intelligence (AI) has the potential to make a meaningful impact on combating NiV by facilitating the identification and tracking of outbreak accelerating the development of effective vaccines and therapies, and strengthening disease surveillance and response efforts. AI has a major role to play in disease monitoring and early identification. Sophisticated Al-operated formulas can efficiently scrutinize extensive data originating from various outlets including L social media, news coverage and sickness databases, with the intent of detecting and tracing epidemics instantly. Public health officials can effectively prevent the spread by using these measures to respond swiftly (Zhang 2020).

AI can also be utilized in the realm of vaccine and therapeutic advancements. By utilizing AI, it is possible to analyze genetic information from-NiV as well as similar viruses in order to detect possible target for drug development, as well as create novel vaccines and treatments. Through this method, drug development can be expedited and scientists can create treatments that are more potent (Russo et al., 2020). Moreover, the implementation of AI has potential to forecast the transmission of NiV and simulate the influence of various measures. This can assist public health officials in making well-informed choices regarding resource allocation and outbreak response The requirements for AI implementation in healthcare involve gathering substantial amounts of top-notch data, creating precise forecast model., and taking into account the ethical ramifications that come with its use (Kannan and Priya, 2020). AI has the potential to enhance the accuracy of disease detection and elevate the quality of n1edical treatment. Sophisticated AI algorithms can analyze patients' medical images and data to assist medical professionals in identifying NiV infection and creating personalized treatment strategies. By implementing this

method it is possible. to minimize mistakes in diagnosis and enhance the results for the patients (Ma et al. 2020· Chen et al. 2020).

A potentially successful technique involves utilizing artificial intelligence for the development of epitope-specific vaccine. The immune system identifies particular regions of a pathogen's protein called epitopes. By utilizing Al-driven algorithms, it is possible to anticipate the epitopes that could gei1ernte a robust immune reaction and formulate vaccines that pa1iicularly focus on those area, By utilizing this method, the process of creating a vacd11e can be accelerated significantly and the probability of achieving a favorable outcome can be improved (Singh and Mehta, 2016; Lundegaard et al., 2011· Nanni et al., 2011· Jabbari et al. 2019). AI can be utilized to improve vaccine formulations, which is a potential field for its application in vaccine development. The utilization of Al technology has potential in scrutinizing adjuvants and delivery system-s as vaccine components, refining their composition and dosage for superior vaccine safety and efficacy (Bannan et al. 2014). Al has the potential to hasten the clinical trials and regulatory approval procedures. Sophisticated AI-powered algorithms have the capability to anticipate the safety and efficacy of fresh vaccine contenders by utilizing preclinical data thereby facilitating research specialists in discerning the most promising candidates for clinical trials. Moreover, with the assistance of Al, the regulatory approval procedure can be made more efficient as it can recognize likely safety issues and enhance the designs of studies (Nanni et al., 2011; Jabbari et al. 2019). While there is potential for AI to aid in the development of an effective vaccine for NiV, there are also several obstacles that must be overcome. Some essential factors for effective use of AI in healthcare are superior genomic and clinical information, creation of precise forecasting models and raking ethical co1tsid rations into account.

NiV presents a grave and potentially lethal viral infection that presents a significant risk to public h a)tb across various regions of the globe (Anderson et al., 2019). Although there is no unique re1rtedy or inoculation at the moment, timely detection, aid and preventive approaches can effectively mitigate the consequences of outbreak. It is essential to conduct further studies on the biology, transmission and prevention of NiV to create efficient tactics for managing th.is newly-emerging illness.

The NiV's genetic structure includes s1x gene, that are responsible for producing nine crucial proteins involved in the virus ability to replicate, transcribe, assemble, and penetrate host cells (Wang et al, 2001· Martinez-Gil et al., 2017). Additional investigation into NiV's genetic makeup and it associations with host cells could lead to the creation of powerful therapies and preventive measures to combat this newly emerging infection. Although there is no particular treatment or vaccine existing, the risk of infection can be reduced through prevention techniques such as refraining from contact with bats and their waste, maintaining proper personal hygiene, and abstaining from consuming uncooked or partly cooked fruits and vegetables. It is of utmost importance to conduct further investigation on the worldwide spreading of NiV and to create successful methods for prevention and control in order to reduce the effects if future outbreaks.

The use of siRNA technology appears to have a lot of potential for treating NiV and looks very promising as a therapeutic solution. Additional research is imperative in order to enhance the design, administration and safety protocols of siRNA for use in clinical contexts. Ongoing studies show that the usage of siRNA technology has the potential to be a viable remedy for addressing and averting NiV infections. The use of nanomedicines displays immense promise in the management of NiV illness. Nanomedicines hold great promise in providing a viable solution for the prevention and treatment of NiV infections as research and development in this field continues.

AI is regarded as having immense potential in battling NiV via its advanced analytical tools for detecting and tracking outbreaks, creating effective cures and vaccines, and enhancing disease surveillance and response measures. By further exploration and advancement in AI technology, it is possible for health authorities to pro1nptly and efficiently tackle the dissemination of this lethal disease. Sophisticated analytical tools offered by AI can potentially bring about a revolution in the way hew vaccines for NiV are developed, as they can facilitate the identification of vaccine targets streamlining of vaccine formulations, and hastening of clinical trials and regulatory approval procedures. Ongoing studies and advancement in technology could lead to Al-based vaccines serving as a viable resolution for managing and preventing NiV epidemics.

As there is a lack of approved human treatments and vaccines, it is crucial to develop vaccines and therapeutics because of the extreme pathogenicity and pandemic potential of the Nipah virus and its use in bioterrorism. Many antiviral therapies have been investigated for treatment or post-exposure prophylaxis against Nipah virus infection. (Johnson, Vu, & Freiberg, 2021).

ANTI-VIRAL THERAPY

Ribavirin, a guanosine analogue with broad-spectrum antiviral properties, has shown effectiveness in inhibiting RNA replication of both NiV and HeV in vitro, making it the first antiviral treatment for NiV infection. Although an initial human study during the Malaysian outbreak in 1998-1999 showed a 36% reduction in mortality, a subsequent study did not yield significant results. Dosage guidelines for Ribavirin are unclear, but WHO suggests a loading dose of 30mg/kg for children and 2000mg/kg for adults, followed by a 10-day course of therapy. Ribavirin

is not bound to plasma proteins, has oral bioavailability of 32.6% to 52%, and crosses the blood-brain barrier with a 0.7 CSF/Plasma ratio. However, long-term use of Ribavirin may cause adverse effects such as neutropenia, anemia, and lymphocytopenia. (Hauser, Gushiken, Narayanan, Kottilil, & Chua, 2021) The Infectious Disease Society of America has recommended the use of Ribavirin for NiV cases due to its positive in vivo and in vitro performance with considerable safety. (Banerjee et al., 2019) Although Ribavirin and Chloroquine have demonstrated independent efficacy in vitro, they did not reduce mortality in hamster models when used in combination. Acyclovir has not been tested against NiV in vitro or in vivo trials.(Hauser et al., 2021) Favipiravir, a viral RNA-dependent RNA polymerase inhibitor, has shown potential in treating NiV infection in Syrian hamster models when administered immediately after infection daily for 14 days. Remdesivir, a nucleotide analogue, has shown a 100% survival rate in IV administration daily after 24 hours of infection for 12 days. (Johnson et al., 2021) However, the main drawbacks of these synthetic drugs are the absence of targeted action and the potential harm they may cause to the host cells. Given the gravity of the infection and the urgent need for a novel treatment that is effective against multiple targets while remaining non-toxic, the utilization of tuneable nanotechnology-based strategies appears to be a highly promising alternative. Various forms of nanotechnology have been employed in the treatment and diagnosis of other viral infections, thereby paving the way for future applications in the detection and inhibition of NiV. (Kerry et al., 2019)

MONOCLONAL ANTIBODIES

The m102.4 monoclonal antibody has emerged as a highly promising therapeutic treatment for Nipah virus (NiV) infection. Through affinity maturation, this antibody effectively neutralizes the attachment glycoprotein G of both NiV and Hendra virus (HeV), preventing their interaction with host cellular entry receptors. In a ferret model of disease, a single intravenous infusion of m102.4 administered 10 hours after intranasal infection with NiV provided complete protection. Notably, no adverse effects related to the treatment were observed in this small-scale trial, although further research is needed to fully evaluate its efficacy and safety. Another investigation explored the potential of h5B31, a humanized neutralizing monoclonal antibody targeting glycoprotein F. However, in vivo characterization of this antibody remains limited, necessitating additional studies. (Banerjee et al., 2019; Johnson et al., 2021)

VACCINES

At present, there are no authorized vaccines for human NiV infection. However, several experimental vaccines, such as DNA vaccines, virus-like particles (VLPs), live and recombinant virus vectors, and other advanced vaccines, have been tested for their ability to confer protection against the virus. (Singh et al., 2019; Thakur & Bailey, 2019) Among these, Nipah VLPs made up of three NiV proteins obtained from mammalian cells have demonstrated remarkable efficacy as vaccines in BALB/C mice. They have proven to be highly potent immunogens and have achieved complete protection against viral load, indicating their potential for advancing to clinical trials.(Walpita et al., 2017)

NON-PHARMACOLOGICAL APPROACHES

In the quest to minimize human contact with bat-contaminated date palm sap, several non-pharmacological techniques have been explored. These include the transformation of raw date palm sap into molasses through boiling, as well as efforts to impede bat access to date palm trees. (Hauser et al., 2021)

PREVENTION

In the prevention and control of human NiV infection, vaccines are not the only important strategy. Livestock prevention is effective in areas where they are intermediate hosts. To prevent infection, it is important to keep fruits and bat roosting trees away from livestock and properly wash fruits and vegetables to remove traces of bat excreta. The safety of healthcare workers is also a major concern, and utilizing standard precautions, hand hygiene, and Personnel Protective Equipment (PPE) is crucial for comprehensive infection prevention and control. Isolating patients, using masks and gloves, and using PPE during procedures that generate aerosols or patient contamination are also essential. (Banerjee et al., 2019; Singh et al., 2019).

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