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The Role of Travel Medicine in Managing Future Pandemics: Lessons Learned from Global Infectious Disease Outbreaks

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Abstract

In an increasingly interconnected world shaped by globalization, international travel plays a significant role in facilitating the spread of infectious diseases. Travel medicine plays a vital role in preventing and controlling the spread of infectious diseases. This specialized field focuses on providing pre-travel advice, administering necessary vaccinations, promoting preventive measures during travel, and offering post-travel care. Risk assessment is essential to evaluate potential hazards associated with specific destinations. Factors such as disease prevalence, healthcare infrastructure, vaccination requirements, and environmental, as well as cultural influences are considered. Through this process, the risks can be effectively managed by formulating appropriate strategies. Preventive measures are crucial to minimize the transmission of infectious diseases during travel. These include compulsory vaccinations based on destination-specific requirements, recommended travel restrictions when necessary, and quarantine protocols for individuals exhibiting symptoms. Enhanced surveillance efforts combined with the promotion of personal hygiene practices aid further prevention. Educating travelers about safe food handling practices also serves as an effective measure against many infections. Effective pandemic management requires collaboration among countries and international organizations. Travel medicine Professionals work alongside public health authorities to provide accurate information, vaccine administration services, and increased awareness about preventive measures. This collaborative effort facilitates timely response mechanisms ensuring global protection from emerging threats like pandemics.

Keywords: Global Health, Public Health Preparedness, Epidemiology, International Travel, Vaccination Strategies, Quarantine Protocols

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Introduction

The field known as travel medicine encompasses a comprehensive range of activities, addressing the health considerations of individuals before, during, and after their travels, particularly from developed nations to areas with limited resources. [1,2] It involves the implementation of various preventive measures to safeguard against the transmission of diseases from the traveler's home country to the destination, while also promoting the well-being of the traveler during their time abroad. These preventive measures encompass actions such as vaccination against known infectious diseases that can be prevented through vaccines, consultations, assessing the risks associated with endemic diseases in the destination countries, and ensuring the availability of essential travel supplies, among other precautions. [3-5]

In an increasingly interconnected world shaped by globalization, international travel plays a significant role in facilitating the spread of infectious diseases. As individuals frequently cross borders for work or leisure purposes, the risk of transmitting pathogens across continents escalates. [6] Globalization has expanded contact among diverse populations worldwide and facilitated both trade and human movement. Consequently, this unprecedented level of interconnectivity fosters conditions conducive to rapid disease transmission across geographical boundaries. Furthermore, densely populated airports serving as major transportation hubs contribute significantly to pathogen dissemination due to regular passenger influx from various regions with different epidemiological profiles. International travelers serve as potential vectors for spreading infectious diseases globally due to their encounters with new environments carrying unique pathogens not seen within their home countries. Tourists visiting underdeveloped nations may unwittingly introduce foreign contagions upon returning home or transmit local infections abroad when traveling during periods coinciding with contagious stages.[2-5]

During times of pandemics like COVID-19 outbreaks, travelers serve as potential vectors for spreading infections globally when they move between affected areas. In these scenarios, the implementation of robust infection control protocols becomes paramount. [6,7] Travel medicine professionals play a major role in monitoring and controlling the international movement of infected individuals. They provide guidance regarding quarantine periods, self-isolation protocols, symptom tracking, and testing procedures, facilitating early identification, treatment, interruption, maintaining surveillance system which helps to gain better control over pandemic.[2]

In addition, during an ongoing pandemic scenario like COVID-19 today, where there are still uncertainties regarding global vaccine coverage levels or effectiveness against new variants; adherences to protective measures become crucial for both outbound and inbound travelers' safety. Encouraging consistent hand hygiene practices alongside proper use of face masks ensures that people traveling do not amplify existing infections nor introduce novel ones across borders inadvertently due to inadequate precautions. [8-10]

Travelers must be aware of the potential infectious disease risks associated with specific regions. Global outbreaks have shown that managing pandemics demands comprehensive approaches involving various interventions from the field of travel medicine. By understanding past lessons learned from such events, efforts can be directed towards reducing adverse impacts in future occurrences. This is the aim of this review article.

Concept and scope of Travel Medicine

Travel medicine is an emerging field dedicated explicitly towards safeguarding travelers' health before departure or upon return from overseas destinations associated with higher infection risks than at home. It plays a vital role in preventing and controlling infectious diseases during global crises. Through effective dissemination of information regarding risk factors for specific regions and necessary preventive measures like vaccination campaigns or health screenings at airports, it assists individuals making informed decisions, while traveling abroad. [2,8,9]

Furthermore, travel medicine encompasses various aspects, including pre-travel advice to individuals planning trips abroad, immunizations, and preventive measures during travel, as well as post-travel care (Figure1). In the context of pandemics, this involves educating travelers about potential risks associated with their destination regarding infectious diseases such as Coronavirus Disease 2019 (COVID-19), Monkeypox (Mpox), Ebola, Yellow fever or other emerging pathogens. By considering factors like vaccination requirements, local disease outbreaks, and hygiene practices specific to each region visited by tourists or business travelers alike can take informed decisions before embarking on their journey. While routine vaccinations protect against common illnesses at home countries; additional vaccines may be required depending on a traveler's planned destinations and activities involved (e.g., hiking in remote areas or engaging with wildlife). These immunizations help mitigate individual risk, while also preventing further transmission between regions when dealing with pandemic-prone diseases. [10-14]

Figure 1: Scope of travel medicine (***Image Credit**: Enitan, S. S.*)

Major Global Infectious Disease Outbreaks and Their Impact on Travel

Over the past two decades, there have been several significant global outbreaks of infectious diseases that have had a profound impact on global travel and mobility.[4,5] For instance, the global spread of H1N1 Influenza in 2009 led to increased airport screenings and raised public awareness of health risks associated with travel. The Ebola outbreaks from 2014 to 2016 resulted in the implementation of travel restrictions and comprehensive health screenings, especially for individuals traveling to and from West Africa. Similarly, during the Zika virus outbreak in 2015-2016, advisories regarding pregnancy and travel were issued. The ongoing COVID-19 pandemic, which began more recently, has led to international lockdowns, quarantines, and a fundamental transformation in global travel practices.[1,6, 8] These disease outbreaks underscore the critical importance of travel medicine in managing infectious disease pandemics.[15-18] They necessitate adaptable strategies to protect public health while sustaining essential travel. Table 1 summarizes major infectious disease outbreaks in recent history, including the year they occurred, the responsible pathogens, affected regions, and their impact on travel. This table serves as a historical reference, emphasizing the need for regulating travel during pandemics.

Key Principles of Travel Medicine in Pandemic Management

Travel medicine plays a pivotal role in pandemic management by giving priority to preventive and preparatory actions aimed at diminishing the transmission of contagious illnesses. Its core principles are essential for safeguarding the health of both individual travelers and the wider community. The pre-travel health assessment (PTHA) entails an examination of travelers to recognize potential risks, considering factors such as their destination, health status, and vaccination prerequisites. Administration of vaccinations guarantees that travelers maintain up-to-date protection against diseases, including those related to pandemics. This, in turn, serves as a vital protective barrier. Additionally, health education and promotional (HEP) efforts aim to educate travelers on preventative measures, hygiene protocols, and emerging health risks, thereby enabling them to make informed choices. [2,4]

Table 1: Major Global Infectious Disease Outbreaks and Their Impact on Travel

Outbreak	Year	Pathogen	Affected Regions	Impact on Travel
SARS	2002-2003	SARS-CoV	Asia, North America	Travel restrictions, reduced tourism
H1N1 Influenza	2009	H1N1 Influenza A	Worldwide	Airport screening, public awareness
Ebola	2014-2016	Ebola Virus	West Africa, globally	Travel bans, heightened health checks
Zika Virus	2015-2016	Zika Virus	Americas, globally	Pregnancy-related travel advisories
COVID-19	2019-2020	SARS-CoV-2	Worldwide	International lockdowns, quarantines

Furthermore, should travelers fall ill or encounter infectious agents, guidelines on quarantine and isolation provide instructions for self-isolation, which effectively mitigates the transmission of diseases. Travel restrictions and border control measures (TRBCM) involve the implementation of advisories and health checks at borders during pandemics to minimize cross-border transmission. Telemedicine and remote medical consultations (TRMC) provide remote healthcare options for travelers in need, relieving the burden on local healthcare systems.

Surveillance and monitoring (S&M) systems track the health status of travelers and report outbreaks, enabling early intervention. International collaboration and communication (ICC) facilitate coordinated efforts and information sharing. When applied together, these principles constitute an integrated approach to pandemic management within the framework of travel medicine. [5,10] Table 2 outlines the key principles of travel medicine in pandemic management, emphasizing the critical components for managing and mitigating the transmission of infectious diseases through travel.

Table 2: Key Principles of Travel Medicine in Pandemic Management

Principle	Description
Pre-Travel Health Assessment (PTHA)	Evaluating travelers for potential risks and providing appropriate advice.
Vaccination and Immunization	Ensuring travelers are up-to-date on vaccinations, including specific pandemic vaccines.
Health Education and Promotion (HEP)	Providing travelers with information on preventive measures and health practices.
Quarantine and Isolation Guidelines (QIG)	Advising on the quarantine and isolation protocols for infected or exposed travelers.
Travel Restrictions and Border Control Measures	Implementing restrictions and health checks at borders during pandemics.
Telemedicine and Remote Medical Consultations (TRMC)	Offering remote healthcare options for travelers in need.
Surveillance and Monitoring (S&M)	Tracking the health status of travelers and reporting outbreaks.
International Collaboration and Communication (ICC)	Working with global health organizations to coordinate efforts and share information.

Comparison of Travel Medicine and Pandemic Management Strategies

Travel medicine and pandemic management have similar objectives, but vary in their focus and extent. Travel medicine primarily concerns itself with the well-being of individual travelers, offering personalized advice to prevent health issues related to travel. Conversely, pandemic management strategies address wider public health concerns during large-scale disease outbreaks, concentrating on containment and mitigation. Travel medicine places emphasis on Pre-Travel Health Assessment for evaluating the risks of travelers, while pandemic management involves extensive monitoring, testing, and symptom screening for entire populations.[19,20] Vaccination and Immunization (V&I), a shared concept, take distinct forms: travel medicine concentrates on routine vaccinations for travelers, whereas pandemic management deals with the development and distribution of specific vaccines for pandemics. [21,22] Health Education and Promotion (HEP) are common in both fields, but travel medicine is directed towards educating individual travelers, while pandemic management educates the public about general preventive measures. Quarantine and Isolation Guidelines (QIG) are provided by travel medicine to offer advice to individual travelers, while pandemic management enforces isolation and quarantine measures at a societal level. Travel Restrictions and Border Control Measures, a strategy utilized by both, differ in scale, with travel medicine issuing recommendations, and pandemic management implementing travel bans and stringent border controls. [20] Telemedicine and Remote Medical Consultations cater to individual travelers in travel medicine, whereas pandemic management extends remote consultations to a broader patient population.[23] Surveillance and Monitoring principles are applicable to both but differ in scale, with travel medicine monitoring the health of travelers and pandemic management tracking the spread of diseases. International Collaboration is a shared objective, but the scope varies; travel medicine focuses on collaboration with health organizations, while pandemic management involves intergovernmental cooperation.[13,24] The interplay between travel medicine and pandemic management demonstrates the nuanced and complementary approaches required to protect public health during global crises. Table 3 provides a comparison of how travel medicine strategies align with and differ from broader pandemic management approaches.

Table 3: Comparison of Travel Medicine and Pandemic Management Strategies

Strategy	Travel Medicine Approach	Pandemic Management Approach
Pre-Travel Health Assessment	Assess travelers' health and risk factors.	Monitor, test, and screen travelers for symptoms.
Vaccination and Immunization	Administer routine and recommended vaccines.	Develop and distribute vaccines for the pandemic.
Health Education and Promotion (HEP)	Educate travelers on travel-related health.	Educate the public on pandemic prevention.
Quarantine and Isolation Guidelines (QIG)	Advise travelers on self-isolation if ill.	Implement isolation and quarantine measures.
Travel Restrictions and Border Control	Implement travel advisories and health checks.	Enforce travel bans and border control measures.
Telemedicine and Remote Consultations	Offer telehealth services for travelers.	Provide remote medical consultations for patients.
Surveillance and Monitoring	Track health of travelers during trips.	Monitor pandemic spread and disease patterns.
International Collaboration	Work with global health organizations.	Collaborate with other countries and WHO.

Risk Assessment for Travelers

Risk assessment in travel medicine involves identifying potential hazards that travelers may encounter during their journeys, including diseases, accidents, climate conditions, political instability, or inadequate healthcare facilities. [25,26] By evaluating these factors beforehand, individuals can take appropriate preventive measures. One of the primary concerns when traveling is exposure to infectious diseases prevalent in certain regions worldwide. For example, malaria is common in tropical areas, while Hepatitis A remains a risk across various countries. To minimize disease transmission risks: vaccinations should be up-to-date according to destination-specific recommendations, basic hygiene practices such as handwashing and using sanitizers must be followed diligently, safe food handling practices are essential; and consuming properly cooked meals from reputable establishments is advised. Incorporating an effective risk assessment strategy into travel planning is vital to safeguard the well-being of individuals traveling internationally. By considering potential disease risks, safety concerns, and understanding climate conditions in advance, travelers can take appropriate measures to ensure a safe and enjoyable journey. [27]

Travelers should conduct thorough risk assessments to evaluate the overall safety conditions prevalent in their desired destinations. One crucial aspect of risk assessment focuses on understanding and addressing potential health issues associated with particular regions before embarking on a journey. Infectious diseases prevalent within certain geographical locations can pose serious threats and compromise traveler's well-being significantly. By assessing vaccination requirements, disease prevalence statistics, and availability of medical facilities at intended destinations beforehand enables travelers not only to prepare preemptively but also empowers them with essential information regarding possible healthcare challenges they may encounter abroad. [28,29]

Another critical component that must be evaluated during pre-travel planning is considering natural disasters such as earthquakes, hurricanes, floods or forest fires that are more likely based on region-specific characteristics like climate patterns or proximity to geological fault lines. Certain disease outbreaks like cholera have been associated with natural disasters like flooding. Conducting comprehensive research regarding environmental hazards raises awareness among travelers who then have adequate time for preparation by packing necessary supplies like emergency kits ensuring their survival until help arrives after any unforeseen incidents occur. [30]

Risk Identification

Before embarking on any journey, it is imperative for travelers to research and understand the health profiles specific to their intended destination(s). [31] Countries may vary significantly in terms of disease prevalence due to climate conditions, socio-economic disparities, healthcare infrastructure, or cultural practices affecting hygiene standards. Monitoring disease outbreaks can provide valuable insights regarding potential risks associated with a particular region at a given time frame. Regularly checking official sources such as national health agencies or global organizations like the Centers for Disease Control and Prevention (CDC) helps identify areas currently experiencing escalating infectious diseases threat levels. Many countries have mandatory vaccine requirements upon entry; therefore, travelers must familiarize themselves with these regulations beforehand by consulting embassy websites or travel clinics specializing in international health advisories. Moreover, seeking recommendations from healthcare professionals becomes crucial when visiting regions where vaccines are not compulsory but strongly recommended due to local risk factors like mosquito-borne illnesses such as malaria or dengue fever. [25, 32]

Furthermore, it is crucial to identify environmental and cultural factors impact significantly on infectious diseases risks. Firstly, climate conditions play a significant role in determining regional infection risks globally. For example: 1) Tropical climates contribute substantially toward vector-borne infections since they facilitate insect breeding and 2) Areas prone to poor sanitation systems might lead to waterborne diseases such as cholera or hepatitis A transmission rates increase significantly during natural disasters or post-conflict situations due to compromised healthcare systems and limited access to clean water. Understanding such environmental factors can assist travelers in making informed decisions regarding personal protective measures like using mosquito repellents, practicing safe food and water consumption, or avoiding areas known for high infection rates. Secondly, unique cultural practices specific to certain regions can affect the spread of infectious diseases. For instance, crowded markets with live animal trade may heighten the risk of zoonotic disease transmission, while inadequate hygienic practices during food preparation could increase chances of contracting foodborne illnesses. Travelers should be aware of these cultural nuances prevailing in their destination(s) as they impact individual vulnerability. Adapting appropriate prevention strategies enables tourists to minimize exposure risks significantly. [26, 33, 34]

Risk Analysis

Once risks have been identified through diligent research methods pre-travel phase, prioritizing these based on their probability level allows travelers prioritize their concerns.[35] Likewise, the severity that each hazard poses plausibly determines which precautions one should take. For instance, in areas where an epidemic is prevalent might require social distancing, wearing of face masks etc. Conducting cost-benefit analysis can help ensure prudent allocation resources required addressing probable contingencies. Furthermore, knowing individual's vulnerability traits, such as underlying medical conditions will allow timely mitigative steps-as example vaccinations, beforehand seeking insurance etc - are implemented wisely. These assessments provide comprehensive understanding of the overall risk profile, to enhance preparedness and minimize undesired outcomes during travel expeditions. [27-29]

Before embarking on any journey, one should carefully assess various factors that contribute to increased infection risks. These include local healthcare infrastructure, disease prevalence rates, vaccination requirements, personal health status and immunity levels, as well as travel activities planned during the trip. The quality and accessibility of healthcare services play a vital role in determining how effectively infectious diseases are managed within a region. Travelers must research beforehand about medical facilities available at their destination(s), including hospitals equipped with resources essential for dealing with emergencies or outbreaks. [30,36]

Analyzing epidemiological data helps evaluate the likelihood of encountering infections within specific regions while traveling. Tracking reports from reliable sources such as national or international health organizations enables tourists to make informed decisions regarding preventive measures like vaccinations or medications tailored specifically for anticipated illnesses endemic in those areas. Certain countries may require proof of immunization against particular diseases (e.g., yellow fever) prior entering their borders. Complying with vaccine mandates not only safeguards individuals but also prevents transmission chains among populations worldwide by reducing importation risks related to cross-border movement patterns. [33-36]

Preventive Measures for Travelers

Preventive measures play a vital role in travel medicine, safeguarding travelers from potential health risks associated with their destination. [31]

a) Vaccination

One of the most effective preventive measures that travelers can undertake is obtaining up-to-date vaccinations before embarking on their trip. Vaccinations are crucial for protecting against various diseases prevalent in specific regions or countries. For instance, individuals traveling to tropical areas should consider vaccines like yellow fever, dengue fever, or malaria prophylaxis if recommended by healthcare professionals. Additionally, routine immunizations should be reviewed and updated as required before international travel. These include vaccinations such as measles-mumps-rubella (MMR), tetanus-diphtheria-pertussis (Tdap), hepatitis A and B, influenza vaccine, among others.[19,37]

By acquiring up-to-date vaccines tailored to specific regions or countries, individuals can effectively protect themselves against various diseases prevalent in those areas. Obtaining appropriate pre-travel vaccinations prior to embarking on a journey is imperative for several reasons. Firstly, it helps prevent infectious diseases from spreading across borders by reducing transmission rates among healthcare systems worldwide. Secondly, immunization directly benefits individual health by shielding travelers from potentially life-threatening conditions while abroad. By receiving vaccines targeted at disease prevention linked with specific destinations or activities (such as yellow fever or hepatitis A), individuals significantly mitigate risks associated with exposure during their travels. In this way, vaccines act as an essential barrier between tourists and regionally endemic illnesses.

Unfortunately, some barriers hinder widespread adoption of pre-travel immunizations. Key factors contributing to limited uptake include inadequate awareness about destination-specific immunization requirements, hesitancy towards vaccine safety, and logistical obstacles like time constraints and costs. To overcome these challenges, government bodies should enhance public education campaigns regarding the importance of travel vaccinations. Local healthcare providers should proactively recommend vaccines during pre-travel consultations. In addition, reducing financial burdens by providing affordable or subsidized vaccination services could further encourage travelers to prioritize their health before embarking on journeys. [19,20]

b) Travel restrictions

Travel restrictions play a crucial role in managing pandemics by limiting the cross-border transmission of infectious diseases. One key advantage of implementing travel restrictions during a pandemic is that it allows authorities to detect cases early and implement necessary control measures promptly. By screening individuals at

airports, seaports, or land crossings for symptoms or exposure history related to infectious diseases, potential carriers can be identified before they enter a country's territory. Another benefit offered by travel restrictions lies in their ability to break the chain of disease transmission across regions or countries swiftly and effectively. In particular, tightening border controls helps reduce instances where infected individuals freely move without being aware they are spreading contagions. Moreover restrict travels assist prevent overburdening healthcare systems, resulting from localized outbreaks transforming into widespread epidemics rapidly. Thus, the implementation of such measures aids public health authorities better manage resources while mitigating risks associated with uncontrolled infections' propagation. Adopting travel restrictions can also serve as a sign of social responsibility as individual participation in collective efforts combat spreads. Identifying and self-isolating or quarantining potential carriers before they step foot in the destination country demonstrates safety measures while prioritizing societal health. Also, to ensure public trust during pandemic management, it becomes crucial to transparently communicate grounded safety reasons behind such measures.[19,20,38]

c) Quarantine

Quarantine serves as an essential tool for disease containment by separating potentially infected individuals from unaffected populations during the incubation period. By doing so, it significantly reduces transmission rates while allowing for timely identification and monitoring of possible cases. Moreover, quarantine provides healthcare professionals with valuable opportunities to administer necessary treatments or vaccinations promptly if available. Furthermore, this approach helps prevent overwhelming medical facilities during times when resources may be limited due to sudden surges in patients seeking care. Throughout history, numerous instances have demonstrated how quarantine measures effectively controlled contagious outbreaks. For instance, strict isolation protocols helped stem the progression of severe acute respiratory syndrome (SARS) and Ebola virus disease within affected regions. Similarly today, amidst Coronavirus Disease 2019 (COVID-19) pandemic airlines are taking precautions like mandatory testing before traveling.[19,20] Some countries even require travelers arriving from high-risk areas to undergo periods of self-isolation upon arrival. Collectively these examples highlight that swift implementation and adherence to appropriate quarantining strategies can curtail viral spread considerably. Beyond preventing immediate contagion threats, some secondary benefits arise. These include heightened awareness among communities regarding personal hygiene practices; reinforced importance placed on preventive vaccines, and improved international cooperation aimed at sharing information. Expertise gained through combating epidemics thus aids future preparedness efforts. On top of that, research studies show us people interest towards selecting tourist destinations where they are satisfied that strict quarantine measures were implemented successfully.[39]

d) Enhanced Surveillance Efforts

Enhanced surveillance efforts play a critical role in preventing and controlling disease outbreaks. By closely monitoring the distribution, transmission patterns, and severity of diseases, health authorities can swiftly respond with effective measures to protect public health. Monitoring potential cases of emerging infections is paramount for early detection and response efforts during a pandemic outbreak. Travel medicine specialists collaborate closely with public health authorities to establish efficient surveillance systems that address both inbound and outbound passengers' health status at airports and other significant entry points into countries experiencing an outbreak similar to Ebola virus disease or COVID-19 pandemic. [19,20]

Furthermore, enhanced surveillance acts as an early warning system that enables healthcare professionals to detect emerging infectious diseases promptly. Through rigorous data collection on symptoms and diagnoses across different regions, countries can identify patterns indicative of potential outbreak threats before they escalate into global crises such as COVID-19. [40]

Timely detection through robust surveillance is crucial for initiating swift response mechanisms like quarantine measures or travel restrictions when dealing with contagious pathogens. Rapid identification expedites containment interventions at borders or within communities where cases have been identified while minimizing further virus spread. Sophisticated technological advancements now facilitate real-time monitoring systems integrating reports from hospitals, clinics, laboratories worldwide regarding specific illnesses' incidence rates. Digital platforms like electronic medical records (EMRs), telemedicine services enable seamless information exchange among healthcare providers enabling proactive decision-making during outbreaks without delay caused by traditional paper-based documentation approaches.

e) International Collaboration

Collaboration plays a pivotal role in effectively managing pandemics like COVID-19 by fostering coordinated responses on a global scale. By working together across

borders without discrimination or boundaries drawn by geography or politics, countries can harmonize their approaches to prevention strategies, early detection systems, mitigation measures, treatment protocols as well as vaccine development.[19,20] This ensures that best practices are identified swiftly through collective experience sharing while leveraging diverse perspectives from various scientific communities worldwide. Efficient collaborations enhance resource efficiency via pooling essential medical supplies distribution networks internationally throughout vulnerable areas hit hardest by pandemics synergistically mitigating supply shortages. Furthermore, scientific research initiatives can be collectively funded to accelerate the development of innovative treatments and vaccines. Collaborative networks also promote standardization of practices across borders, reducing ambiguity or confusion regarding preventive measures. Common strategies are shared to optimize healthcare systems' response capacities while minimizing duplication and redundancy in information sharing channels during times of crisis. [40]

f) Food safety practices

Traveling to destinations with different hygiene standards poses potential health risks, particularly in terms of consuming contaminated food or water. One cannot underestimate the significance of adhering to proper dietary precautions when visiting countries with differing hygiene standards. Consuming contaminated food or water may result in severe gastrointestinal illnesses like diarrhea or typhoid fever when visiting certain destinations around the globe where hygiene standards differ significantly from one's home country. To alleviate these risks, travelers should: 1) Opt for cooked foods served piping hot instead of raw produce, 2) Avoid consuming raw fruits/vegetables unless they have been thoroughly washed, 3) Consume fruits that can be peeled rather than those requiring direct contact, 4) Eat well-cooked meals at reputable establishments, 5) Avoid eating street vended foods, 6) Be vigilant about hand hygiene both before eating and after using restroom facilities, and 7) Drink bottled water instead of tap water amongst other measures. [41]

g) Safeguarding against unsafe medical supplies abroad

Equally important is addressing concerns regarding medical supplies purchased overseas. While many medications are available without prescription internationally, caution must be exercised when procuring these items abroad as quality control standards may differ from those at home.[19,20] Counterfeit medicines present a significant risk globally; hence it's advisable only purchasing medications from licensed pharmacies recognized by respective governments within visited nations. Moreover, avoid self-medicating without consulting a healthcare professional since ingredients could vary greatly across borders leading potentially dangerous reactions or inefficacy. To minimize these risks, travelers should: 1) Carry a sufficient supply of prescription medications in their original packaging, 2) Consult local healthcare professionals if medical assistance is needed, and 3) Verify the authenticity and safety of any over-the-counter drugs before purchase by checking for proper labeling and expiration dates. [42]

h) Protection against mosquito bites:

In many countries located within tropical regions mosquitoes are carriers for various infections including malaria, dengue fever, and Zika virus. Travelers are expected to follow these guidelines: 1) Use mosquito repellents containing DEET on exposed skin surfaces, 2) Wear long sleeves/pants whenever possible especially during dusk and dawn, and 3) Sleep in air-conditioned accommodations or those with bed nets. [43]

i) Personal Hygiene:

Maintaining good personal hygiene while traveling can significantly reduce the risk of infections: 1) Wash hands frequently using soap and clean water, especially before eating or touching your face/mouth, and 2) Carry hand sanitizers for instance, when washing facilities aren't available. [39,41]

j) Travel Insurance:

Obtaining comprehensive travel insurance covering medical emergencies is strongly advised as unexpected illnesses or accidents can occur at any time. Ensure that the policy covers all potential health risks associated with specific destinations. These preventive measures are fundamental in ensuring safe travels by reducing the likelihood of illness abroad. It's important to remember that individual requirements may vary depending on factors such as destination choice, duration of stay, and personal health history. It is always recommended seeking advice from healthcare professionals specializing in travel medicine to obtain personalized recommendations based on these factors. [40-42]

Role of travel medicine professionals in Managing Future Pandemics

Travel medicine professionals play an indispensable role in the comprehensive management of future pandemics. Their interdisciplinary expertise and global outlook position them as essential contributors to a well-coordinated and effective pandemic management strategy. These include, but limited to the following:

1) **Preventive Measures:** Professionals in travel medicine play a crucial role in enacting preventative measures to control the dissemination of infectious diseases across borders. This entails formulating strategies for health assessments prior to travel, administering vaccinations, and providing education to diminish the risk of disease transmission.
2) **Surveillance and Early Detection:** Monitoring the worldwide health landscape is an essential responsibility. Experts in travel medicine actively contribute to surveilling potential outbreaks, aiding in the timely identification of emerging infectious threats. Swift recognition is imperative for a rapid response and containment.
3) **Risk Assessment and Communication:** The assessment of the risk of disease transmission during travel represents a fundamental skill set. Practitioners in this field evaluate risks specific to destinations and communicate these effectively to travelers, offering guidance on appropriate precautions and behaviors to minimize exposure.
4) **International Collaboration:** Collaboration with international health organizations and governments is crucial. Professionals in travel medicine engage actively in partnerships to exchange information, share best practices, and coordinate responses to potential global pandemics.
5) **Public Health Education:** A central role for these professionals involves educating the public, including travelers and healthcare providers. Disseminating accurate information about infectious diseases, preventive measures, and appropriate responses enhances public awareness and preparedness.
6) **Quarantine and Isolation Strategies:** In the event of a pandemic, experts in travel medicine contribute to the formulation and implementation of effective quarantine and isolation strategies. Their expertise is vital in minimizing the spread of infectious agents.
7) **Post-Pandemic Recovery:** Beyond the acute phase of a pandemic, these professionals are pivotal in planning and executing recovery strategies. This includes assessing the impact on travel, reinstating safe travel practices, and contributing to the reconstruction of healthcare infrastructure. [37-41]

Lessons Learned from Global Infectious Disease Outbreaks

Several lessons have been learnt from global infectious disease outbreaks[44-50], these include:

1. Swift Detection is Crucial: The significance of promptly identifying and reporting novel infectious diseases cannot be emphasized enough. Early detection enables the immediate implementation of containment measures and reduces the rate of transmission.
2. Clear and Open Information Sharing: Transparent and open communication of outbreak data and discoveries fosters public confidence and international collaboration, which is vital for an effective response.
3. Global Readiness: The world needs to be better prepared for pandemics. This entails maintaining stockpiles of medical resources and vaccines, as well as establishing a coordinated global response system.
4. Role of Travel in Disease Spread: Infectious diseases can spread rapidly through travel. It is imperative to enforce travel restrictions and health checks during outbreaks.
5. Accelerated Vaccine Development: The importance of expediting vaccine development and distribution mechanisms became evident during the COVID-19 pandemic. Securing funding and streamlining this process is essential.
6. Resilient Healthcare Systems: Outbreaks can strain healthcare systems. Preparing for increased capacity, enhancing medical infrastructure, and training healthcare personnel are critical.
7. Community Engagement: Communities play a central role in controlling the spread of diseases. Building trust, encouraging active participation, and maintaining clear communication with communities are fundamental.
8. The Holistic Health Approach: Recognizing the interconnectedness of human, animal, and environmental health is vital for predicting and addressing zoonotic diseases effectively.
9. Versatility and Adaptability: Responses need to be adaptable and flexible because what works for one disease may not be suitable for another. Valuable lessons should guide the development of evolving strategies.
10. Socioeconomic Consequences: The extensive economic and societal impacts of pandemics must not be underestimated or overlooked. Robust safety nets, economic resilience, and social support systems are of utmost importance.

Conclusion

Travel medicine plays an essential role in managing pandemics by focusing on prevention through pre-travel advice and immunization programs. It also emphasizes protective measures during travel to minimize the transmission risks associated with contagious diseases globally. Furthermore, post-travel care and surveillance are crucial components that enable prompt identification and management of potential cases within communities. Risk assessment plays a vital role in ensuring the safety and well-being of travelers. Informing individuals about potential risks empowers them to make informed decisions while planning their travel itineraries. Coupled with adequate preparation and genuine caution, it can significantly reduce the likelihood of adverse events occurring during travel journeys. Overall, travelling should be accompanied by an understanding of appropriate precautions necessary for maintaining optimal health throughout the journey. Preventive measures including vaccinations prior departure, following food safety guidelines, maintaining good personal hygiene, and obtaining adequate travel insurance play vital roles in safeguarding travelers' health. By adhering to these practices, travelers will ensure not only a memorable trip, but also one free from preventable infectious diseases.

List of abbreviations

CDC: Centers for Disease Control and Prevention; COVID-19: Coronavirus Disease 2019; EMRs: Electronic Medical Records; HEP: Health Education and Promotion; ICC: International Collaboration and Communication; MMR: Measles-Mumps-Rubella; Mpox: Monkeypox; PTHA: Pre-Travel Health Assessment; QIG: Quarantine and Isolation Guidelines; S&M: Surveillance and Monitoring; SARS: Severe Acute Respiratory Syndrome; SPF: Sun Protection Factor; Tdap: Tetanus-Diphtheria-Pertussis; TRBCM: Travel Restrictions and Border Control Measures; TRMC: Telemedicine and Remote Medical Consultations; V&I: Vaccination and Immunization; WHO: World Health Organization.

Review Highlights

What Is Already Known?

The globalized nature of the world significantly contributes to the spread of infectious diseases through international travel.

Travel medicine, as a specialized discipline, is pivotal in preventing and controlling the spread of infectious diseases during travel.

Essential for effective management, risk assessment takes into account factors like disease prevalence, healthcare infrastructure, and cultural influences.

Review Highlights

What This Review Add?

The study furnishes a thorough overview of how travel medicine plays a crucial role in handling global infectious disease outbreaks, amalgamating insights gleaned from prior incidents.

It underscores the significance of risk assessment in formulating strategies for proficient disease management during travel.

The article underscores the collaborative endeavors needed among nations and international organizations for effective pandemic management, spotlighting the contributions of travel medicine professionals in this global initiative.

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References

1. Hu, F., Wen, J., Zheng, D. and Wang, W. "Travel medicine in hospitality: an interdisciplinary perspective", *International Journal of Contemporary Hospitality Management*, 2023; 35(9): 3134-3153. Doi: https://doi.org/10.1108/IJCHM-05-2022-0574
2. Du, M., Yuan, J., Jing, W., Liu, M., & Liu, J. The Effect of International Travel Arrivals on the New HIV Infections in 15–49 Years Aged Group Among 109 Countries or Territories From 2000 to 2018. *Frontiers in Public Health*, 2022; *10*, 833551. Doi: https://doi.org/10.3389/fpubh.2022.833551

3. Schwartz, K. L., & Morris, S. K. Travel and the spread of drug-resistant bacteria. *Current infectious disease reports*, 2018; *20*, 1-10. Doi: https://doi.org/10.1007/s11908-018-0634-9

4. Chen, L. H., Leder, K., Barbre, K. A., et.al. Business travel-associated illness: a GeoSentinel analysis. *Journal of travel medicine*, 2018; *25*(1), tax097. Doi: https://doi.org/10.1093/jtm/tay030

5. Khatib, A. N., Carvalho, A. M., Primavesi, R., To, K., & Poirier, V. Navigating the risks of flying during COVID-19: a review for safe air travel. *Journal of travel medicine*, 2020; *27*(8), taaa212. Doi: https://doi.org/10.1093/jtm/taaa212

6. Enitan, S. S., Junaid, S. A., Avwioro, G. O. et. al. The Role of International Flights in COVID-19 Pandemic: Global, Africa and Nigeria's Narratives. *International Journal of Health, Safety and Environment*, 2020; 6(09): 696- 710. Doi: https://www.academiascholarlyjournal.org/ijhse/publications/abstract/ijhse_dec20abs3.htm

7. Wilder-Smith, A. COVID-19 in comparison with other emerging viral diseases: risk of geographic spread via travel. *Tropical Diseases, Travel Medicine and Vaccines*, 2021; *7*, 1-11. Doi: https://doi.org/10.1186/s40794-020-00129-9

8. Sharun, K., Tiwari, R., Natesan, S. et al. International travel during the COVID-19 pandemic: implications and risks associated with 'travel bubbles'. *Journal of travel medicine*, 2020; *27*(8), taaa184. Doi: https://doi.org/10.1093/jtm/taaa184

9. Rodríguez-Morales, A. J., MacGregor, K., Kanagarajah, S., Patel, D., & Schlagenhauf, P. Going global–Travel and the 2019 novel coronavirus. *Travel medicine and infectious disease*, 2020; *33*, 101578. Doi: https://doi.org/10.1016/j.tmaid.2020.101578

10. Pavli, A. & Maltezou, H. C. Travel vaccines throughout history. *Travel medicine and infectious disease*, 2022; *46*, 102278. Doi: https://doi.org/10.1016/j.tmaid.2022.102278

11. Sulaiman, L. H. Travel medicine: travelling to space and the reality on the ground, 2022; *IeJSME*, *16*, 1-2. Doi: https://doi.org/10.56026/imu.16.1.1

12. Vignier, N., & Bouchaud, O. Travel, migration and emerging infectious diseases, 2018; *EJIFCC*, *29*(3), 175. Doi: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6247124/

13. Torresi, J. & Leder, K. Defining infections in international travellers through the GeoSentinel surveillance network. Nature Reviews Microbiology, 2009; 7, 895–901. Doi: https://doi.org/10.1038/nrmicro2238

14. Bloom, D. E. & Cadarette, D. Infectious Disease Threats in the Twenty-First Century: Strengthening the Global Response. Frontiers in Immunology.2019; 10:549. Doi: https://doi.org/10.3389/fimmu.2019.00549

15. Isenring, E., Fehr, J., Gültekin, N., & Schlagenhauf, P. Infectious disease profiles of Syrian and Eritrean migrants presenting in Europe: a systematic review. *Travel medicine and infectious disease*, 2018; *25*, 65-76. Doi: https://doi.org/10.1016/j.tmaid.2018.04.014.

16. Shenge, J. A. Occurrence and Environmental Dimensions of Specific Pandemics and Epidemics. Chapter 1 (16 pages) *In:* Nazneen, S., King Abia A. L., Madhav, S. (eds.). Emerging Pandemics (First Edition). CRC Press, Boca Raton. eBook ISBN: 9781003288732. 2023, Doi: https://doi.org/10.1201/9781003288732-1.

17. Mantosh, K.S., Hemant, K., Chih-Hao, Y., Ting-Lin Y., Papita, D. Pandemics, Environment, and Globalisation: Understanding the Interlinkage in the Context of COVID-19. Chapter 5 (18 pages) *In*: Nazneen, S., King Abia A. L., Madhav, S. (eds.) Emerging Pandemics (First Edition). CRC Press, Boca Raton. eBook ISBN: 9781003288732. 2023, Doi: https://doi.org/10.1201/9781003288732-5.

18. Klevor R, Kissani N. One Health: Lessons from 2 Years' Experience of the COVID-19 Pandemic. *In*: Headache Disorders in Pandemic Conditions 2023, (pp. 11-20). Cham: Springer International Publishing. Doi: https://doi.org/10.1007/978-3-031-26309-5_2

19. Enitan, S. S., Ibeh, I. N., Oluremi, A. S., Olayanju, A. O. & Itodo, G. E. The 2019 Novel Coronavirus Outbreak: Current Crises, Controversies and Global Strategies to Prevent a Pandemic. *International Journal of Pathogen Research*, 2020; 4(1): 1-16. Doi: https://doi.org/10.9734/ijpr/2020/v4i130099

20. Ibeh, I. N., Enitan, S. S., Akele, R. Y., Isitua, C. C. & Omorodion, F. Global Impacts and Nigeria Responsiveness to the COVID-19 Pandemic. *International Journal of Healthcare and Medical Sciences*, 2020; 6(4): 27-45. Doi: https://doi.org/10.32861/ijhms.64.27.45

21. Zinatizadeh MR, Zarandi PK, Zinatizadeh M, Yousefi MH, Amani J, Rezaei N. Efficacy of mRNA, adenoviral vector, and perfusion protein COVID-19 vaccines. Biomedicine & Pharmacotherapy. 2022; 1;146:112527. Doi: https://doi.org/10.1016/j.biopha.2021.112527

22. Attia YA, El-Saadony MT, Swelum AA et al. COVID-19: pathogenesis, advances in treatment and vaccine development and environmental impact—an updated review. Environmental Science and Pollution Research. 2021; 28:22241-64. Doi: https://doi.org/10.1007/s11356-021-13018-1

23. Aggarwal, N., Ahmed, M., Basu, S. et al. Advancing Artificial Intelligence in Health Settings Outside the Hospital and Clinic. *NAM Perspectives*. Discussion Paper, National Academy of Medicine, Washington, DC. 2020. Doi: https://doi.org/10.31478/202011f.

24. de Lima M. M., Rodrigues, G. A & de Lima, M. R. Evaluation of emerging infectious disease and the importance of SINAN for epidemiological surveillance of Venezuelans immigrants in Brazil. Brazilian Journal of Infectious Disease. 2019; 23(5): 307–312. Doi: https://doi.org/10.1016/j.bjid.2019.07.006.

25. Leder K, Steffen R, Cramer JP, Greenaway C. Risk assessment in Travel medicine: how to obtain, interpret, and use risk data for informing pre- travel advice. Journal of Travel Medicine. 2015; 22(1):13-20. Doi: https://doi.org/10.1111/jtm.12170

26. Leggat PA. Risk assessment in travel medicine. Travel medicine and infectious disease. 2006 4(3-4):127-34. Doi: https://doi.org/10.1016/j.tmaid.2005.06.005.

27. Angell SY, Behrens RH. Risk assessment and disease prevention in travelers visiting friends and relatives. Infectious Disease Clinics. 2005; 19(1):49-65. Doi: https://doi.org/10.1016/j.idc.2004.11.001.

28. Noble LM, Willcox A, Behrens RH. Travel clinic consultation and risk assessment. Infectious Disease Clinics. 2012; 26(3): 575-593. Doi: https://doi.org/10.1016/j.idc.2012.05.007.

29. Dollard P, Griffin I, Berro, A. et al. Risk assessment and management of COVID-19 among travelers arriving at designated US Airports, January 17–September 13, 2020. Morbidity and Mortality Weekly Report. 2020; 69(45):1681. doi: https://doi.org/10.15585/mmwr.mm6945a4.

30. Leggat PA, Franklin R. Risk perception and travelers. Journal of Travel Medicine. 2013; 20(1):1-2. Doi: https://doi.org/10.1111/j.1708-8305.2012.00663.x

31. Sridhar S, Régner I, Brouqui P, Gautret P. Methodologies for measuring travelers' risk perception of infectious diseases: A systematic review. Travel Medicine and Infectious Disease. 2016; 14(4):360-372. Doi: https://doi.org/10.1016/j.tmaid.2016.05.012.

32. Leder K, Wilson ME, Freedman DO, Torresi J. A comparative analysis of methodological approaches used for estimating risk in travel medicine. Journal of Travel Medicine. 2008 Jul 1;15(4):263-72. Doi: https://doi.org/10.1111/j.1708-8305.2008.00218.x

33. Plank PA, Gomes LF, Caldas P, Varela M, Ferreira DC. Assessing the Traveling Risks Perceived by South African Travelers during Pandemic Outbreaks: The Case of COVID-19. Sustainability. 2023; 15(12):9267. Doi: https://doi.org/10.3390/su15129267.

34. Heywood AE, Forssman BL, Seale H, MacIntyre CR, Zwar N. General practitioners' perception of risk for travelers visiting friends and relatives. Journal of travel medicine. 2015; 22(6):368-374. Doi: https://doi.org/10.1111/jtm.12229.

35. Wendt S, Beier D, Paquet D, Trawinski H, Fuchs A, Lübbert C. Medical advice for travelers. Deutsches Ärzteblatt International. 2021 May;118(21):349. Doi: https://doi.org/10.3238/arztebl.m2021.0127.

36. Wieten RW, Leenstra T, Goorhuis A, van Vugt M, Grobusch MP. Health risks of travelers with medical conditions—a retrospective analysis. Journal of travel medicine. 2012 Mar 1;19(2):104-10. Doi: https://doi.org/10.1111/j.1708-8305.2011.00594.x

37. Patel RR, Liang SY, Koolwal P, Kuhlmann FM. Travel advice for the immunocompromised traveler: prophylaxis, vaccination, and other preventive measures. Therapeutics and clinical risk management. 2015; 217-28. Doi: https://doi.org/10.2147/TCRM.S52008.

38. Van Herck K, Zuckerman J, Castelli F, Van Damme P, Walker E, Steffen R, European Travel Health Advisory Board. Travelers' knowledge, attitudes, and practices on prevention of infectious diseases: results from a pilot study. Journal of travel medicine. 2003; 10(2):75-78. Doi: https://doi.org/10.2310/7060.2003.31638.

39. Wolfe MS. Protection of travelers. Clinical infectious diseases. 1997; 25(2): 177-184. Doi: https://www.jstor.org/stable/4481101.

40. Bhattacharyya K, Dandapat S, Kiran A. S, Saysardar K, Maitra B. Exploring Public Perception Toward Travel and COVID-19 Preventive Measures: Insights From the Early Stages of Lockdown in India. Transportation Research Record. 2023; 2677(4):723-41. Doi: https://doi.org/10.1177/03611981221101032.

41. Shimoda H, Nagata T, Ishimaru T et al. Personal infection prevention behaviors and campaign to encourage travel during COVID-19: A cross-sectional study. Frontiers in Public Health. 2023; 11:1037496. Doi: https://doi.org/10.3389/fpubh.2023.1037496.

42. Nguyen HM, Phuc HN, Tam DT. Travel intention determinants during COVID-19: The role of trust in government performance. Journal of Innovation & Knowledge. 2023; 8(2): 100341. Doi: https://doi.org/10.1016/j.jik.2023.100341.

43. Mischlinger J, Rönnberg C, Álvarez-Martínez M et al. Imported malaria in countries where malaria is not endemic: a comparison of semi-immune and nonimmune travelers. *Clinical microbiology reviews*, 2020; *33*(2), 1110-1128. Doi: https://doi.org/10.1128/cmr.00104-19.

44. Dente MG, Riccardo F, Declich S et al. Strengthening preparedness against global health threats: A paradigm shift based on One Health approaches. One Health. 2022; 14: 100396. Doi: https://doi.org/10.1016/j.onehlt.2022.100396.

45. Naz K, Megan M, Rybarczyk GA et al. COVID- 19 Pandemic Prompts a Paradigm Shift in Global Emergency Medicine: Multidirectional Education and Remote Collaboration. A Global Journal of Emergency Care. 2020; 5(1). 79-90. Doi: https://doi.org/10.1002/aet2.10551.

46. Kandel N, Chungong S. Dynamic preparedness metric: a paradigm shift to measure and act on preparedness. Global Health, 2022; 10(5): E615-E616. Doi: https://doi.org/10.1016/S2214-109X(22)00097-3.

47. Global Preparedness Monitoring Board. A world at risk: annual report on global preparedness for health emergencies [Internet]. Geneva: World Health Organization (acting as the host organization for the Global Preparedness Monitoring Board), 2019. Doi: *https://apps.who.int/gpmb/assets/annual_report/GPMB_Annual_Report_English.pdf*

48. Rosa WE. The case for a paradigm shift: from global to planetary nursing. Nursing Forum, 2019; 54(2): 165-167. Doi: https://doi.org/10.1111/nuf.12310.

49. Rosa-Nunes D, Lucchi D, Andreata-Santos R, Janini LM, Braconi CT. Lessons that can be learned from the SARS-CoV-2 pandemic and their impact on the prophylaxis and treatment development for neglected tropical arboviruses. Frontiers in Drug Discovery. 2023; 3:1176768. Doi: https://doi.org/10.3389/fddsv.2023.1176768.

50. Baker RE, Mahmud AS, Miller IF et al. Infectious disease in an era of global change. Nature Reviews Microbiology, 2022; 20: 193–205. Doi: https://doi.org/10.1038/s41579-021-00639-z.