

When You're on the Visiting Team: Travel Vaccines & Global Health

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Learning Objectives

- ▶ Following this session, participants should be able to
 - ▶ Apply recommendations and guidelines regarding vaccination for travelers
 - ▶ Understand the role of vaccination in travelers with complex co-morbid medical conditions, including contra-indications to certain vaccines
 - ▶ Discuss emerging issues in travel vaccination, including uncommonly used vaccines for special categories of travelers at higher risk for certain diseases

Travel Vaccination Recommendations

Three R's of Immunization

- ▶ Routine immunizations
 - ▶ To ensure good health at home and in travel
- ▶ Recommended immunizations
 - ▶ To protect traveler from endemic or epidemic diseases present in country of destination
- ▶ Required immunizations
 - ▶ Required by country of destination
 - ▶ Intended to protect host country's population from importation and spread of disease

Adult Routine Vaccinations

Table 1 Recommended Adult Immunization Schedule by Age Group United States, 2019

Vaccine	19-24 years	25-64 years	65-69 years	70-74 years	75-79 years	80-84 years	≥85 years
Influenza (inactivated or influenza recombinant) (IIV)	1 dose annually	1 dose annually					
Tetanus, diphtheria, pertussis (Tdap)	1 dose (Tdap, then 10 booster every 10 yrs)	1 or 2 doses depending on indication (if born in 1987 or later)					
Measles, mumps, rubella (MMR)	2 doses (if born in 1980 or later)						
Shingles (Shingrix)					2 doses		
Poliovirus (IPV)	3 or 4 doses depending on age at initial vaccination						
Poliovirus (OPV)	2 or 3 doses depending on age at initial vaccination						
Pneumococcal conjugate (PCV13)	1 or 2 doses depending on indication						1 dose
Pneumococcal polysaccharide (PPSV23)							1 dose
Hepatitis A (HepA)	2 or 3 doses depending on vaccine						
Hepatitis B (HepB)	3 or 4 doses depending on vaccine						
Adjuvanted hepatitis A, C, W, Y (HepACWY)	1 or 2 doses depending on indication, then booster every 3 yrs if risk remains						
Adjuvanted hepatitis B (HepB)	2 or 3 doses depending on vaccine and indication						
Adjuvanted hepatitis B (HepB)	1 or 2 doses depending on indication						

Adult Immunization Schedule by Vaccine and Age Group. Centers for Disease Control and Prevention. <https://www.cdc.gov/vaccines/imz/downloads/pdf/19a/adult.html>. Published February 5, 2019. Accessed 23 Sep 2019.

Adult Routine Vaccinations - Through The Lens of Travel

- ▶ Influenza
 - ▶ Recommended for all travelers during influenza season
 - ▶ The most common travel associated infection
 - ▶ Timing of travel and flu season may be relevant
- ▶ Hepatitis B
 - ▶ Body fluid/blood exposure
 - ▶ Routinely recommended for everyone
 - ▶ Vaccination not needed for all travelers, risk factor and occupation based
 - ▶ High risk sexual practices, health care workers, volunteers, medical tourism - difficult to assess risk pre-travel
 - ▶ Adjuvanted vaccine now available (HepB-AD, 2 doses) as well as Twinrix (HAV/HBV)



Freedman et al. Immunization for Travel. https://www.uptodate.com/contents/immunization-for-travel#search=hepatitis&source=search_result&selectedTitle=4~150&usage_type=default&display_rank=4#H2t3081. Published August 19, 2019. Accessed September 23, 2019.

Hepatitis B - Medical Summary. Shireland Travax. <https://www.travax.com/library/hepatitis-b/>. Published November 15, 2018. Accessed September 23, 2019.

Staff Reports. 3rd in Public Health Fight: Public health alert: measles and mumps: Mountain Home Air Force Base. Available at: <https://www.mountainhome.af.mil/News/ArticleDisplay/Article/665711/public-health-alert-measles-and-mumps/>. Published February 13, 2016. Accessed 23 Sep 2019.

Routine Vaccines

- ▶ Measles, Mumps, Rubella
 - ▶ Global epidemics of measles associated with vaccine hesitancy
 - ▶ Concern in adults who may not have received 2 doses of vaccine, should be considered for all born after 1957
 - ▶ Live attenuated vaccines, thus contra-indicated in immunocompromised patients
 - ▶ Could also consider serologic testing in high risk patients - cost may be higher than re-vaccination, however
- ▶ Tetanus, diphtheria, pertussis
 - ▶ Ongoing pertussis outbreaks internationally, immunity wanes over time
 - ▶ No ACIP recommendation for Tdap booster beyond 1 adult dose
 - ▶ However, could consider Tdap even if recent Td booster for pertussis protection

Measles, Mumps, Rubella. Shoreland Travax. <https://www.travax.com/library/measles-mumps-rubella>. Published March 14, 2019. Accessed September 23, 2019.

Tetanus, Diphtheria, Pertussis (7 Years and Older). Shoreland Travax. <https://www.travax.com/library/tetanus-diphtheria-pertussis>. Published February 11, 2019. Accessed September 23, 2019.

Routine Vaccines

- ▶ Pneumococcal
 - ▶ Should be given as indicated, not specifically recommended for travels beyond risk factor and age recommendations
- ▶ Varicella/Herpes zoster
 - ▶ Varicella vaccine not generally needed for travel, can consider if no history of disease and not immunocompromised
 - ▶ Shingles can be problematic if occurring during travel, though no additional risk
 - ▶ Use of recombinant vaccine (Shingrix) can be considered, occasionally requested in travel consultations
 - ▶ Side effects of vaccine also to be considered, injection site and systemic symptoms

Pneumococcal - Medical Summary. Shoreland Travax. <https://www.travax.com/library/pneumococcal>. Published July 10, 2019. Accessed September 23, 2019.

Herpes Zoster - Medical Summary. Shoreland Travax. <https://www.travax.com/library/herpes-zoster>. Published April 9, 2019. Accessed September 23, 2019.

Travel Vaccines

<ul style="list-style-type: none"> ▶ Recommended <ul style="list-style-type: none"> ▶ Influenza ▶ Hepatitis A ▶ Hepatitis B ▶ Typhoid ▶ Rabies ▶ Japanese encephalitis ▶ Tick-borne encephalitis ▶ Cholera 	<ul style="list-style-type: none"> ▶ Required <ul style="list-style-type: none"> ▶ Yellow fever ▶ Meningococcal ▶ Adult polio booster
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Recommended Vaccines

- ▶ Vary based on travel itinerary and plans
- ▶ Important to obtain full patient medical history to determine risk factors as well as possible contra-indications to vaccination

Hepatitis A

- ▶ Hepatitis A
 - ▶ Fecal/oral transmission resulting in acute hepatitis, rarely liver failure
 - ▶ Lower risk in many countries now due to improved sanitation, but also local outbreaks due related to IVDU and homelessness
 - ▶ Vaccination recommended for travel to countries with intermediate to high endemicity - most developing nations globally
 - ▶ Counselling regarding food and water safety important
 - ▶ Vaccine safe in pregnancy, immunocompromised patients
 - ▶ One dose prior to travel, repeat dose in 6-12 months for long-term protection

Freedman et al. Immunizations for Travel. UpToDate. https://www.uptodate.com/contents/immunizations-for-travel?search=hepatitis%20A&source=search_result&selectedTitle=4-150&usage_type=default&display_rank=4&it=73081. Published August 2019. Accessed September 23, 2019.

Hepatitis A Areas at Risk

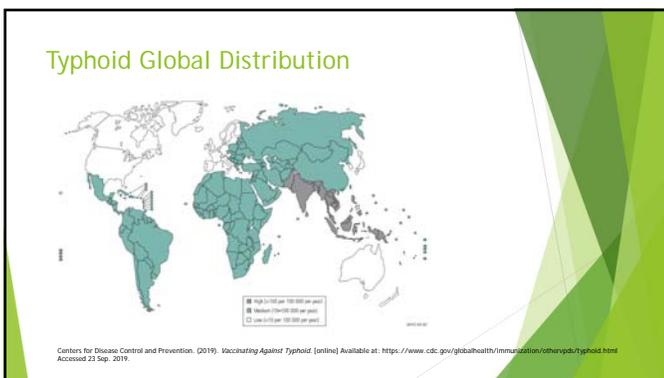


Hepatitis A countries or areas at risk. World Health Organization. http://gamapserv.who.int/mapslibrary/files/Maps/Global_Hepta_THRiskMap.png?v=1. Published 2012. Accessed September 23, 2019.

Typhoid

- ▶ Systemic bacterial illness, fecal-oral transmission
- ▶ South Asia highest risk, also Africa, less in Latin America, increases in MDR strains
- ▶ Food safety and hygienic eating habits key
- ▶ Vaccines not completely effective - 60-70% efficacy
- ▶ Available vaccines
 - ▶ Live oral vaccine
 - ▶ Caution in immunocompromised patients
 - ▶ Oral capsules on days 1, 3, 5, 7
 - ▶ Polysaccharide injectable vaccine
 - ▶ Subunit vaccine, safe in immunocompromised patients

Typhoid Fever - Medical Summary, Shoreland Travax. <https://www.travax.com/library/typhoid-fever>. Published December 15, 2018. Accessed September 23, 2019.



Typhoid - Oral versus IV?

Oral vaccine	Injectable vaccine
Live attenuated	Inactivated
Approved for age >6	Approved for age >2
Requires refrigeration	Single dose
4 enteric coated tablets - empty stomach	Shorter duration of immunity
Inactivated by antibiotics - generally within 3 days	No issue with antibiotic use
GI side effects may occur	Injection site side effects

Typhoid Fever - Medical Summary, Shoreland Travax. <https://www.travax.com/library/typhoid-fever>. Published December 15, 2018. Accessed September 23, 2019.

Rabies

- ▶ Virus transmitted by dogs, bats, other animals, resulting in encephalopathy and death
- ▶ Endemic to Asia, Africa, Central and South America
- ▶ Pre-exposure vaccination based on risk
 - ▶ Intra-dermal more immunogenic than IM
 - ▶ Exposure to animals
 - ▶ Limited immediate medical care
 - ▶ Days 0, 7, 21, 28 prior to travel
 - ▶ Shorter WHO regimen also now available - days 0 and 7 +/- third dose
 - ▶ If exposure in unvaccinated, RIG and post-exposure vaccines needed,
 - ▶ If previously vaccinated only post-exposure vaccines needed



Hydrophobie ou Mesure de Chien Enragé. Iconographic Collection. Wellcome Collection Gallery, 2018.

Case

- ▶ 56 year old male travels to Thailand, wakes up in the morning and finds a bat in his room, fairly confident he was not bitten
 - ▶ No pre-exposure prophylaxis taken
 - ▶ What else do we want to know or do?
- ▶ What should we do?
 - ▶ RIG
 - ▶ Post-exposure vaccination
 - ▶ RIG and post-exposure vaccination

Japanese Encephalitis

- ▶ Arbovirus endemic in Asia and Western Pacific
 - ▶ Useful for travels visiting during periods of transmission
 - ▶ Low risk overall for travelers, but severe infection
 - ▶ Risk factor based shared decision making
- ▶ Inactivated vaccine (IXIARO) available in USA
 - ▶ Days 0, 7-28
- ▶ Live attenuated vaccine, contraindicated in immunocompromised
- ▶ Duration of protection? 3rd dose >1 year after primary series

Japanese Encephalitis - Medical Summary. Shoreland Travax. <https://www.travax.com/library/japanese-encephalitis>. Published December 31, 2018. Accessed September 23, 2019.

Japanese Encephalitis Distribution



Case

- ▶ 18 year old male Dartmouth College student planning to backpack across Europe this summer, will be going hiking and camping on several occasions.
- ▶ He comes in to travel clinic having read about tick-borne encephalitis online, asks about a vaccine to protect himself against this, as he has had Lyme disease and Babesia previously while at college in New Hampshire
- ▶ Can he be vaccinated?

Tick-borne Encephalitis

- ▶ Viral CNS infection transmitted by ticks
- ▶ Occurs in Spring/Summer in Northern, Western, and Central Europe, former Soviet Republics
- ▶ Travelers to forested areas up to 1500 feet elevation, expats with prolonged stays, extensive outdoor activities
- ▶ No vaccine available in the USA
- ▶ Can be considered on arrival to Europe for those who will be in high risk areas
 - ▶ Adequate immunity takes 4 weeks post-vaccination, however

Tick Borne Encephalitis - Medical Summary. Shoreland Travax. <https://www.travax.com/library/tick-borne-encephalitis>. Published January 15, 2019. Accessed September 23, 2019.

Case

- ▶ 27 year old male planning to go to Mozambique to assist in relief efforts following Cyclone Idai with the Red Cross
- ▶ Has rheumatoid arthritis on infliximab
- ▶ Should he receive cholera vaccine, and if so, which one?

Cholera

- ▶ Diarrheal illness caused by Gram negative bacterium *Vibrio cholerae*
- ▶ Low risk to travelers in general, vaccination generally not recommended
- ▶ Live attenuated oral vaccine (Vaxchora) available against serogroup O1
 - ▶ New formulation that can be kept refrigerated at 2-8 degrees C
 - ▶ 80% efficacy at 3 months post-vaccination, waning protection over 2 years post-immunization
- ▶ Not for use in immunocompromised patients
- ▶ Other killed bacterial vaccines available globally (Dukoral, Shanchol, Euvichol)
- ▶ Primary recommendation to vaccinate aid, refugee, and health care workers traveling to outbreak areas

Cholera - Medical Summary, Shoreland Travax. <https://www.travax.com/library/cholera>. Published October 1, 2018. Accessed September 23, 2019.

Cholera Vaccines

Trade Name	Shanchol	Dukoral	Euvichol	Vaxchora
Constituent	Killed whole cell	Killed whole cell	Killed whole cell	Live attenuated
Route	Oral	Oral	Oral	Oral
Doses	Two	Two	Two	One
Toxin	O1, O139	O1	O1, O139	O1



Abel M, Talbot E. Cholera and Other Vibrios. Control of Communicable Diseases Manual. Clinical Edition. 2019. (text book in press)
Le Cholera. Le Petit Journal. Bibliothèque nationale alle de France. 1912.

Required Vaccines

- ▶ Required for travel to specific countries
- ▶ Yellow fever is major issue due to availability of vaccine and legal requirements by many nation states for travelers

Yellow Fever - Medical Summary, Shoreland Travax. <https://www.travax.com/library/yellow-fever>. Published May 23, 2019. Accessed September 23, 2019.

Case

- ▶ 66W comes to prepare for a "bucket list" trip to Niger to visit her son who is an infectious disease physician at a medical mission hospital in Niamey
- ▶ PMH significant for RA on chronic methotrexate and vague history of partial DiGeorge syndrome (hypoplastic thymus)
- ▶ She has been to Caribbean before, at which time her routine vaccines were updated and she was provided hep A#1
- ▶ Yellow fever vaccine required for travel to Niger

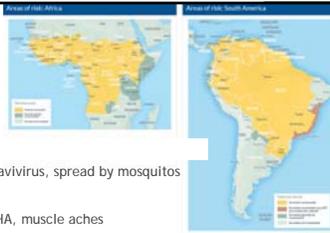
Vote

- ▶ Give yellow fever vaccine
- ▶ Do not give yellow fever vaccine - provide medical exemption letter
- ▶ Advise against trip, do not provide vaccine or medical exemption

Questions

- ▶ Does the yellow fever vaccine have to be boosted every 10 years?
- ▶ How many lifetime doses are recommended?

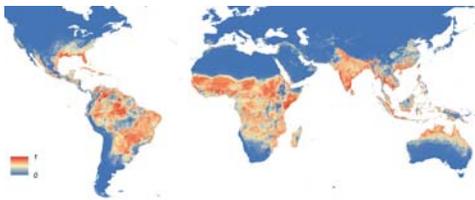
Yellow Fever



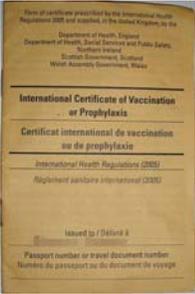
- ▶ Arbovirus of genus Flavivirus, spread by mosquitos
- ▶ Incubation 3-6 days
- ▶ Abrupt fever, chills, HA, muscle aches
 - ▶ Remission, then 15-25% hemorrhage, organ failure
 - ▶ Case fatality 10-50% in endemic populations
 - ▶ ~90% in unimmunized travelers
- ▶ One lifetime dose of vaccine now considered protective

Yellow Fever. Centers for Disease Control and Prevention. <https://www.cdc.gov/yellowfever/maps/index.html>. Published January 15, 2019. Accessed September 23, 2019.

Aedes aegypti



Kraemer MJO et al. The global distribution of the arbovirus vectors *Aedes aegypti* and *Ae. Albopictus*. eLife Sciences Publications, Ltd. <https://elifesciences.org/articles/08347>. Published June 30, 2016. Accessed September 23, 2019.



Yellow Fever: Certified Centers

- ▶ Destination countries may require
- ▶ Recommend if YF risk!
- ▶ Only certified clinicians and clinics can give YF vaccine
- ▶ Consider certifying
 - ▶ <http://www.cdc.gov/travel-training/>
- ▶ Travelers must carry International Certificate of Vaccination
- ▶ Give travelers with medical contraindications a waiver

Yellow Fever - Medical Summary Shoreland Travax. <https://www.travax.com/library/yellow-fever>. Published May 23, 2019. Accessed September 23, 2019.
 Photograph of Yellow Fever Certificate. Smartbox, 2009.

Yellow Fever Vaccine Availability

- ▶ Vaccine Availability
 - ▶ YF-VAX (Sanofi Pasteur) currently unavailable in USA due to production issues - transition to new facility
 - ▶ Expected availability in 2020
 - ▶ Stamaril (Sanofi Pasteur) similar vaccine used in Europe, currently being used in USA as an investigational new drug in 250 designated centers nationally
 - ▶ Significant access issues and strain on travel clinics as a result
 - ▶ Fractional dosing not approved by FDA or ACIP, considered an alternative by some given limitations in supply, does not meet entry criteria for countries requiring certificate

Yellow Fever - Medical Summary Shoreland Travax. <https://www.travax.com/library/yellow-fever>. Published May 23, 2019. Accessed September 23, 2019.

Vaccine Contraindications

- ▶ Infants < 6 months of age
- ▶ Women breastfeeding infants <9 months of age
- ▶ Anaphylaxis to previous dose of YF vaccine or constituent - such as egg or egg proteins
 - ▶ Skin allergy testing could be done prior to administration if egg sensitivity
 - ▶ If severe egg allergy, desensitization could be considered if vaccine essential
- ▶ Altered immunity
 - ▶ Thymus disorders - such as thymoma or myasthenia gravis
 - ▶ Transplant recipients, other conditions requiring immunosuppressant drugs, active malignancy
 - ▶ HIV/AIDS with CD4 <200

Yellow Fever - Medical Summary Shoreland Travax. <https://www.travax.com/library/yellow-fever>. Published May 23, 2019. Accessed September 23, 2019.

Adult Polio Booster

- ▶ Fecal-oral transmission, can result in CNS infection with paralysis
- ▶ Pakistan and Afghanistan remain the only nations with Polio wild-type infection (Nigeria with no infections for 3 years, awaiting WHO certification)
- ▶ Adult polio booster required for travel to Saudi Arabia for Hajj for children up to 15 years of age
- ▶ Several countries also require vaccination of travelers from endemic countries
- ▶ Long stay visitors may also be subject to exit recommendations due to outbreaks

The polio endgame

Since 1988, when the world resolved to eradicate polio, its progress has been dramatic. It is only confirmed endemic in Afghanistan, Pakistan and Nigeria (which hasn't seen a case since 2011). Last year there were only 22 new cases reported.



Polio - Medical Summary, Shoreland Travax. <https://www.travax.com/library/polio>. Published May 10, 2019. Accessed September 21, 2019.
The Polio Endgame. WHO, Polio Eradication Program. December 31, 2017.

Immunocompromised Patients

Immunocompromised Patients

- ▶ Rise in travelers with complex medical conditions
 - ▶ "Bucket list" trips
 - ▶ More patients with stable chronic diseases
 - ▶ More susceptible to vaccine preventable illnesses which may be endemic at destination
 - ▶ Should advise patients to have evacuation insurance and take extra relevant precautions
- ▶ Live attenuated vaccines generally contraindicated in these patients
 - ▶ MMR, varicella, yellow fever, oral typhoid
 - ▶ Other vaccines may result in suboptimal immunity
 - ▶ Risk-benefit discussion sometimes relevant if high risk travel planned
 - ▶ For stable HIV patients with CD4>200, live vaccines can be given

Immunocompromised Travelers - Medical Summary, Shoreland Travax. <https://www.travax.com/library/immunocompromised-travelers>. Published July 15, 2017. Accessed September 23, 2019.

Special Sub-Populations

- ▶ Active malignancy
 - ▶ May be on immunosuppressive therapy
 - ▶ Influenza, pneumococcal vaccines recommended, as well as other inactivated vaccines
 - ▶ Consider serologies for diseases such as measles
 - ▶ Delay travel when possible
- ▶ Hematopoietic stem cell transplant recipients
 - ▶ Require re-vaccination with all childhood vaccines 6-24 months after transplant, with exception of live vaccines which are contraindication until after 24 months
 - ▶ Travel should be avoided during 24 month period post-transplant

Immunocompromised Travelers - Medical Summary. Shorland Travax. <https://www.travax.com/library/immunocompromised-travelers>. Published July 15, 2017. Accessed September 23, 2019

More Sub-Populations

- ▶ Solid organ transplant recipients
 - ▶ Delay travel until >2 years after transplant when possible
- ▶ Immunodeficiencies or use of immunosuppressive drugs
 - ▶ Avoid live vaccines
 - ▶ Consider IVIG to provide passive immunity prior to travel
 - ▶ Inactivated vaccines recommended
 - ▶ For immunodeficiencies, asplenic patients - pneumococcal, meningococcal, and Hib vaccines to be considered

Immunocompromised Travelers - Medical Summary. Shorland Travax. <https://www.travax.com/library/immunocompromised-travelers>. Published July 15, 2017. Accessed September 23, 2019

Chronic Medical Conditions

- ▶ Chronic renal failure
 - ▶ Difficult response, high risk of exposure especially in dialysis patients to induce vaccine
 - ▶ HBV, influenza, pneumococcal vaccines important
- ▶ Chronic liver disease
 - ▶ Caution with travel to areas with endemic hepatitis viruses
 - ▶ Hepatitis A and B vaccination key
 - ▶ Pneumococcal vaccination
- ▶ Diabetes mellitus
 - ▶ General immune impairment, pre-travel vaccines as for general population, catch up of recommended routine vaccines

Immunocompromised Travelers - Medical Summary. Shorland Travax. <https://www.travax.com/library/immunocompromised-travelers>. Published July 15, 2017. Accessed September 23, 2019

Emerging Vaccines

The future of travel health?



Dengue/Zika Vaccine Efforts

- ▶ Dengue
 - ▶ No currently available vaccine for travelers
 - ▶ Dengvaxia - evidence showing higher risk of severe Dengue infection following vaccination in those not previously infected, should only be used in Dengue seropositive patients (IgG ELISA)
 - ▶ Two other promising vaccine candidates in Phase 3 clinical trials
- ▶ Zika
 - ▶ Recommendation to men planning to conceive with partners to wait 3 months after last possible Zika exposure such as travel to affected area, 2 months for women who were symptomatic or exposed
 - ▶ Several vaccines under development currently
 - ▶ Challenges in developing neutralizing vaccine safe in pregnancy

Dengue - Medical Summary, Shoreland Travax. <https://www.travax.com/library/dengue>. Published August 1, 2018. Accessed September 23, 2019.
National Institute of Allergy and Infectious Diseases. Zika Virus Vaccines. Available at: <https://www.niaid.nih.gov/diseases-conditions/zika-vaccines>. Published August 16, 2018. Accessed September 23, 2019.



Case

- ▶ 43 year old female nurse who is planning to work in the Democratic Republic of Congo as part of Ebola response efforts by the WHO
- ▶ She asks whether there is anything she can do to prevent Ebola infection?



Ebola Vaccine Development

- ▶ Vaccine candidates currently in clinical trials
- ▶ Most promising with extensive use in 2018-19 is rVSV-ZEBOV
- ▶ Live replicating recombinant vaccine based on vesicular stomatitis vaccine, with Ebola virus genome incorporated into it
- ▶ Surface glycoproteins immunogenic

Chappell KJ, Waterson D. Fighting Ebola: A Window for Vaccine Re-evaluation? PLOS Pathogens 13(1): e1006027.

MERS Coronavirus Vaccine Development

- ▶ Middle East Respiratory Syndrome, significant concern globally
- ▶ Challenges similar to SARS vaccine development
 - ▶ Difficult to develop vaccines effective against Coronaviruses
 - ▶ Appropriate animal models
 - ▶ Several in development, focus on targeting spike glycoprotein on viral surface
 - ▶ Some promising results in a study on rhesus monkeys with high seroconversion rates using vaccine targeted to MERS spike glycoprotein

Arabi YH, et al. Special Report: Middle East Respiratory Syndrome. N Engl J Med 2017; 376:6-584-94.
 K Mullaikani et al. A synthetic consensus anti-spike protein DNA vaccine induces protective immunity against MERS-CoV in nonhuman primates. Science Translational Medicine 19 Aug 2015. Vol. 7, Issue 301, pp. 301ra132
 Belouzard S, Millet J, Lichtra B, and Whittaker G. (2012). Mechanisms of Coronavirus Cell Entry Mediated by the Viral Spike Protein. Viruses, 4(6), pp. 1011-1033.

The "Holy Grail" A Universal Influenza Vaccine

Wednesday, April 3, 2019

NIH begins first-in-human trial of a universal influenza vaccine candidate

Investigational vaccine designed to provide broad, durable protection from flu.

- ▶ Major focus of vaccine research on viral proteins less likely to mutate
- ▶ Challenge given ability of influenza virus to mutate - antigenic drifts and shifts
- ▶ Vaccine currently in phase 1 clinical trials
- ▶ Uses ferritin with part of influenza hemagglutinin protein on its surface (part less likely to mutate)

National Institutes of Health (NIH). (2019). NIH begins first-in-human trial of a universal influenza vaccine candidate. [online] Available at: <https://www.nih.gov/news-events/news-releases/nih-begins-first-human-trial-universal-influenza-vaccine-candidate>. Accessed September 23, 2019.

Clinicaltrials.gov. (2019). Dose, Safety, Tolerability and Immunogenicity of an Influenza H1N1 Stabilized Stem Ferritin Vaccine, VRC/LIN/099-001VP in Healthy Adults. [online] Available at: <https://clinicaltrials.gov/ct2/show/NCT03814150>. Accessed September 23, 2019.

Avian Influenza

- ▶ Concern regarding H5N1 and H7N9, prior outbreaks related to poultry
- ▶ No current significant human-to-human transmission
 - ▶ Remains a significant concern however, given antigenic shifts in virus
 - ▶ Significant transmissions from birds to humans
 - ▶ Several year outbreak, in early 2000s, in Asia and Middle East
 - ▶ H5N1 vaccine available, being stockpiled



Centers for Disease Control and Prevention. (2019). Highly Pathogenic Avian Influenza A(H5N1) Virus. [online] Available at: <https://www.cdc.gov/flu/avianflu/h5n1-virus.htm>. Accessed 23 Sep 2019.

H5N1 Avian Influenza - IMA manuscript - March 3, 2017

Summary

- ▶ Essential to review routine vaccinations with travelers and ensure they are up to date
- ▶ Influenza is the most common travel associated infection
- ▶ Re-emerging vaccine preventable illnesses such as measles
- ▶ Important to consider traveler medical history and risk factors to individualize recommended vaccines
- ▶ Consideration of whether to administer or exempt travelers from required vaccines - issues with yellow fever vaccine availability
- ▶ Emerging vaccines against global threats, may be relevant for travelers in the future
- ▶ An exciting time to be a travel medicine clinician indeed!

Resources for Travel Medicine Clinicians

- ▶ CDC Yellow Book
- ▶ Shoreland Travax
- ▶ IDSA Guidelines for the Practice of Travel Medicine

Learning Objectives

- ▶ Participants should be able to
 - ▶ Apply recommendations and guidelines regarding vaccination for travelers
 - ▶ Understand the role of vaccination in travelers with complex co-morbid medical conditions, including contra-indications to certain vaccines
 - ▶ Discuss emerging issues in travel vaccination, including uncommonly used vaccines for special categories of travelers at higher risk for certain diseases

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- ▶ Dartmouth-Hitchcock Infectious Disease and International Health



Bon Voyage: Pixabay, June 15, 2016.
