The Forest for the Trees: Why mosquitoes pose the greatest global health threat to humans than any other species in the animal kingdom

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According to Rachel Nuwer (www.Smithonian.com), millions of people around the world suffer from galeophobia (the fear of sharks), ophidiophobia (the fear of snakes), arachnophobia (the fear of spiders), and cynophobia (the fear of dogs). Most of the global populace, however, is unaware of the biggest threat in the animal kingdom to their well-being: the mosquito. No other species, including our own, is responsible for the loss of as many human lives each year as mosquitoes. The diseases mosquitoes carry and transmit kill over 725,000 people each year.

In an average year, humans are responsible for killing approximately 475,000 people, snakes kill 50,000, dogs (via rabies) kill 55,000, crocodiles kill 2,000, lions kill 100, and sharks are responsible for less than a dozen human deaths. None of these species compare to the 725,000 lives taken by mosquitoes each year. Mosquitoes kill people by transmitting infections such as malaria, dengue fever, yellow fever, and multiple strains of arboviral encephalitis, including West Nile Virus.

Malaria is one of the deadliest diseases transmitted by mosquitoes. Each year, malaria infects 200-300 million people and kills more than 600,000 people around the world. Approximately forty percent of the world's population is susceptible to malaria, mostly those living in tropical and sub-tropical areas. The United States reports, on average, 1,500 cases of malaria each year. However, the vast majority of US cases occur in people who have traveled to Sub-Saharan Africa and South Asia.

Dengue fever and yellow fever are other major threats to people living in tropical climates. It has been reported that more than one-third of the world's population lives in an area at risk from dengue fever. Dengue virus is responsible for infecting more than 50-100 million people a year. Yellow fever has become a rare illness for travelers in recent years due to the availability of the vaccine. Unfortunately, even with the vaccine, yellow fever causes approximately 30,000 deaths and 200,000 infections each year.

The largest domestic threat from mosquitoes is West Nile Virus (WNV). From 1999 to 2013, 39,557 cases of WNV have been reported to the Centers for Disease Control and Prevention (CDC). Of those cases, 17,463 resulted in meningitis, encephalitis, or acute flaccid paralysis, and 1,668 cases resulted in death. Of these cases, 610 occurred to Indiana residents. The CDC estimates that at least 1.5 million infections occur each year, with 82% of those occurring in asymptomatic individuals.

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The new domestic threat in the field of mosquito-borne illness is the chikungunya virus. Chikungunya occurs in Africa, Asia and the Indian subcontinent. In recent decades, mosquito vectors of chikungunya have spread to Europe and the Americas. In 2007, disease transmission was reported for the first time in a localized outbreak in north-eastern Italy. In late 2013, the virus was found for the first time in the Americas and on the Caribbean islands. As of September 9, 2014, 934 cases have been reported in the US, according to the CDC. Although the vast majority of these cases were identified in travelers to the Caribbean, several locally-acquired cases have been identified in Florida.

With the exception of malaria, there are no treatments for most of these diseases. Limiting exposure to mosquitoes in order to reduce one's risk of being bitten is often the best prevention. When outdoors, using repellants that contain DEET, picaridin, IR3535, or lemon eucalyptus oil provides longer-lasting protection. Many mosquitoes are most active from dusk till dawn, so be sure to use repellent during these time periods. Wearing long sleeves and pants to limit skin exposure are additional ways to protect oneself in the presence of mosquitoes. The safest preventive measure is to stay indoors during these hours.

There are several things that can be done in one's environment to reduce exposure to mosquitoes. In order to eliminate breeding sites, empty standing water from flower pots, buckets, and barrels, and change the water in your pet dishes and bird baths weekly. Drill holes in tire swings so water can drain out to eliminate breeding pools. Make sure there are appropriate screens on windows and doors to keep mosquitoes from entering living quarters. Many communities also have vector control programs.

What seems to be a pesky insect is in fact one of the greatest disease threats. Although a vast majority of mosquito-borne illnesses are found in tropical climates, mosquitoes live in climates all over the world. Mosquitoes pose a threat to every country. Instead of practicing anopheliphobia (fear of mosquitoes), know the risk factors associated with mosquitoes and take precautions to decrease contact with them.

References:

1. "Mosquito-Borne Diseases." *American Mosquito Control Association*. N.p., n.d. Web.12 May 2014
2. Nuwer, Rachel. "Mosquitoes Kill More Humans than Human Murderers Do." *Homepage / Smithsonian.* N.p., 30 Apr. 2014. Web. 12 May 2014.
3. World Health Organization (WHO)
4. Centers for Disease Control and Prevention (CDC)

US Measles Set to Shatter Record for Post-Elimination Era

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In 2000, measles elimination was declared in the US, meaning that endemic transmission was no longer occurring. Incidence of measles in the US now occurs primarily through importation via international travel. Travelers who contract the infection abroad return to the US introduce the virus to susceptible pockets of individuals, sparking secondary cases and clusters. The source of the imported virus could be any country where measles continues to circulate, and measles remains endemic in five of the six World Health Organization (WHO) regions of the world. Travel to and from the Philippines in recent months have been cited as contributing largely to this year's outbreaks in Ohio and California.

Measles is one of the most highly communicable infectious diseases, with secondary attack rates greater than 90% among susceptible persons. Measles may be transmitted from four days before to four days after onset of rash through respiratory or airborne routes. The prodrome for measles characteristically begins with fever, which may peak as high as 105°F. Other clinical manifestations during this period include cough, coryza or conjunctivitis. Following prodrome, a distinctive, red maculopapular rash appears at the hairline and progresses downward and outward from the head to the extremities. The rash is evident for 5-6 days, and then fades in the same progression as it appeared. The incubation period from exposure to rash onset averages 14 days. Complications such as otitis media and diarrhea occur in young children, but more rare and serious complications include pneumonia and encephalitis, which can result in death. Worldwide, a marked decrease in the incidence of measles has occurred over the past few decades, yet measles on a global scale persists as a leading cause of death of vaccine-preventable deaths in young children.

Before licensure of the first measles vaccine in 1963, an estimated 3-4 million cases occurred each year in the US, resulting in approximately 500 deaths from measles complications. The equivalent of a birth cohort acquired the infection every year, and virtually all individuals acquired measles during childhood. Following introduction of the vaccine, incidence of measles decreased 98%. In 1989-1991, a resurgence of measles occurred predominantly in unvaccinated preschool-aged children. Campaigns to vaccinate at the appropriate age, along with implementation of a 2-dose MMR vaccine recommendation, brought about reductions in reported measles cases. The main reason for a 2-dose schedule was primary vaccine failure among about 5% of recipients of one dose whose immune response was lacking. All states now require two doses of measles vaccine for school-aged children. However, an increasing number of children are home-schooled and not subject to school entry requirements or have parents who choose not to immunize them for religious, philosophical or personal reasons.

Measles virus vaccine is currently available in the US as a combination vaccine with measles mumps and rubella (MMR) antigens or MMR plus varicella vaccine (MMRV). MMR vaccine was first licensed in 1971. Although measles vaccine generally isn't given to children before the first birthday according to the routine recommended schedule, infants traveling abroad can be inoculated with one dose as young as six months. If this strategy is employed, the early dose does not count as valid since it was given to provide temporary protection. The child will need two doses (which are separated by at least four weeks) after attaining 12 months of age. For in-depth guidance on the use of MMR vaccine for routine vaccination and as post-exposure prophylaxis, refer to Prevention of Measles, Rubella, Congenital Rubella Syndrome and Mumps, 2013: Summary Recommendations of the Advisory Committee on Immunization Practices (ACIP), published in the MMWR on June 14, 2013.

Measles cases occur across the age spectrum among unvaccinated individuals, and failure to vaccinate is the root cause of today's measles outbreaks. Among the 2014 cases to date, 81% were unvaccinated and another 12% had an unknown vaccination status. Of the unvaccinated group, 87% were personal belief exemptors.

In the United States, the number of people who choose not to be immunized for personal belief reasons is surfacing as a public health problem. According to Dr. Anne Schuchat, Director of the National Center for Immunization and Respiratory Diseases at the CDC, an estimated ≥4% of enrolled kindergarten students in 11 states had been exempted from receiving one or more vaccines. A study conducted in 2008 in San Diego County, California showed numerous schools and a few school districts with ≥20% of kindergarteners with personal belief exemptions. This can result in a sufficient number of susceptible individuals to propagate rapid virus transmission when an importation of such a highly infectious disease arrives in that population.

The largest US outbreak in 2014 centered in an Amish community in Ohio, where many of the residents were unvaccinated. It began when a group of Amish travelers without measles vaccination went on a mission trip to the Philippines, which is the source responsible for the great number of imported measles cases in the US this year. At least one of them, while still contagious upon return to Ohio, exposed others who had no immunity to the virus. The earliest onset of symptoms for the imported cases was on March 24, 2014, but it has spread through several generations since then. As of September 15, 2014, a total of 377 cases were reported in nine Ohio counties, with the majority of cases from Amish or Mennonite communities.

In addition to the international traveler, another high risk group to the global threat of measles is health care providers, who are likely to be among the first to encounter a feverish patient with a rash upon returning from travel outside the US. Documentation of two doses of measles-containing vaccine or laboratory evidence of immunity is essential for healthcare workers.

Clinicians play a critical role in the early recognition of suspected measles cases, and they should continue to consider measles as a differential diagnosis when evaluating a patient with febrile rash illness and a history of recent travel. Americans commonly travel to areas of the world where measles has not been eliminated. Asking about travel history or exposure to someone who recently returned from overseas travel is extremely important. Serological testing for IgM antibody is used to verify infection. PCR testing and genotyping of viral specimens also confirm infection and help identify the origin of the virus.

While the declared elimination of circulating measles in the US is a major public health achievement, it is not a reason for complacency regarding measles prevention. Key challenges to sustaining measles elimination are:

- Maintenance of very high population immunity through routine vaccination
- Identifying high risk groups for vaccination, such as international travelers and healthcare workers
- Collaborating with international agencies on global reduction and elimination goals
- Educating parents and clinicians to recognize the symptoms
- Initiating prompt and aggressive public health response when cases are identified

Sources:

1. Clinician Outreach and Communication Activity (COCA) Webinar titled “Why Measles Matters” presented on May 22, 2014 by Gregory S. Wallace, MD, MS, MPH, of CDC’s Epidemiology Branch, Division of Viral Diseases
2. Clinician Outreach and Communication Activity (COCA) Webinar titled “Record High US Measles Cases: Patient Vaccination, Clinical Assessment and Management” presented on July 1, 2014 by Jane Seward, MBBS, MPH, Deputy Director of CDC’s Division of Viral Diseases
MMWR August 2, 2013/62(30); 597-616 MMWR June 6, 2014/63(22); 496-499

Influenza B Outbreaks in Hospital Employees

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Background: On April 23, 2014 a local health department (LHD) was notified by a neighboring hospital that a significant number of employees were experiencing respiratory illnesses and were unable to work. A large number of the symptomatic employees (59%) were vaccinated against influenza with the seasonal trivalent vaccine. The hospital did not have a mandatory flu vaccine policy but offered and encouraged vaccine usage. It was estimated that 62% of employees were vaccinated for the 2013-2014 influenza season. The LHD was not aware of any unusual respiratory illnesses circulating in the community and contacted the Indiana State Department of Health (ISDH) to arrange for laboratory samples to be submitted for analysis. On April 24, 2014, three nasopharyngeal specimens were submitted to the ISDH Laboratory for PCR testing, and influenza B was identified. Two of those samples were forwarded to the CDC for further analysis. Results received on May 27, 2014 indicated the virus was influenza B/Brisbane/60/2008-like. This strain is not currently in the trivalent 2013-2014 vaccine.

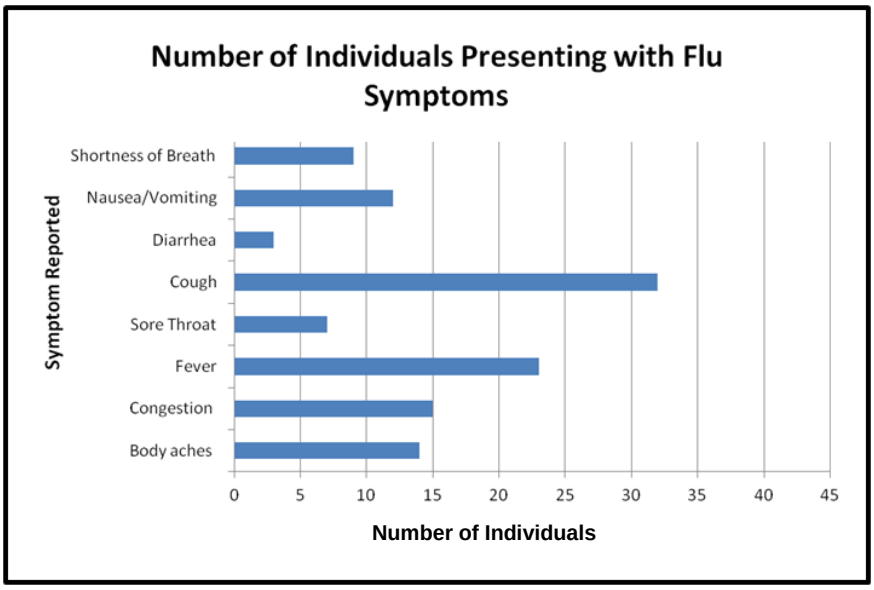
Note: The trivalent vaccine is formulated to protect against three flu viruses (two type A strains and one type B). The quadrivalent vaccine protects against four flu strains (two type A and two type B). Vaccine efficacy can vary based on characteristics of the individual and similarity of the circulating virus to that of the vaccine virus.

Epidemiologic Investigation: Between April 9 and April 28, 2014, approximately 39 workers were absent due to respiratory issues, with five of those also experiencing gastrointestinal symptoms. This impacted nine different departments at the hospital. The majority of those ill worked in Surgery, ICU and the Catheterization Lab (Table 1). Duration of illness was reported as lasting from one day to three weeks, with the average being seven days. The chief symptoms reported were cough, fever, congestion, body aches, headaches, difficulty breathing, sore throat, and gastrointestinal problems (Figure 1). One individual was hospitalized, and fifteen reported seeing a physician. Of the 39 individuals reporting symptoms, 23 (59%) were reported as having been vaccinated against influenza with the trivalent vaccine. An additional seven (18%) were reported as having an unknown vaccine status, and nine (23 %) did not receive the vaccine.

Table 1: HOSPITAL DEPARTMENTS

Department	Number of Ill Employees	Vaccination Status		
		Yes	No	Unknown
Intensive Care Unit	6	4	0	2
Surgery	15	8	7	0
Catheterization Lab	6	2	0	4
Sterile Processing Dept.	3	2	1	0
Pre-op Care Unit	3	3	0	0
Quality Control	2	2	0	0
Cardiac/Rehab	1	0	0	1
Dietary	1	1	0	0
Medical/Surgical	2	1	1	0
Total	39	23	9	7

Figure 1: SYMPTOMS



Lab Results: Three employee samples were submitted to the ISDH Laboratories on April 24, and results for two of the nasopharyngeal samples tested by PCR indicated influenza B. Due to the fact that several of the employees were experiencing severe symptoms and had been vaccinated against influenza, the samples were forwarded to the CDC for further analysis. The results indicated the type B influenza was Brisbane/60/2008-like.

Conclusion: The timing of influenza is unpredictable and can vary from season to season. Seasonal influenza can begin in October and last until June (typically peaking in January or February). Cases of Influenza B have been noted to circulate late in a typical flu season. The CDC graphically indicates this occurrence for 2014 at http://www/cdc.gov/flu/weekly/index.htm#whomap. Other hospitals in the region also reported cases of influenza B still occurring in late spring of 2014.

Influenza B is often considered as being mild compared to type A, but symptoms can still interrupt daily routines and even result in hospitalizations. The trivalent vaccine did not contain the B/Brisbane virus and provided no protection. However, the quadrivalent vaccine lineage contained the B/Victoria/2/87 lineage component, which was not an exact match for the B/Brisbane virus, but similar enough that it would have provided some protection (although not 100%). The 2014-2015 vaccine includes two type A strains, H1N1, H3N2 and two type B strains, B/Massachusetts/2/2012 and B/Brisbane/60/2008.

In conclusion, it appears many employees may have had this influenza B strain, given that many of the symptoms in other employees were similar. Many influenza strains exist, and vaccine may not necessarily provide complete protection each season depending on the strains included in the vaccine. The quadrivalent vaccine was produced in limited supplies during 2013-2014 and is expected to be more readily available in 2014-2015. As a result of this outbreak investigation, the hospital decided to order the quadrivalent vaccine for the 2014-2015 season in an effort to provide more protection for staff. General reasons for being vaccinated against influenza can be found on the CDC website https://www.cdc.gov/flu/pdf/freeresources/general/flu-vaccine-benefits.pdf

Training Room

INDIANA STATE DEPARTMENT OF HEALTH
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Immunization Health Educators offer this FREE, one-day educational course that includes:

- Principles of Vaccination
- Childhood and Adolescent Vaccine—Preventable Diseases
- Adult Immunizations—Pandemic Influenza
- General Recommendations on Immunization
    - Timing and Spacing
    - Indiana Immunization Requirements
    - Administration Recommendations
    - Contraindications and Precautions to Vaccination
- Safe and Effective Vaccine Administration
- Vaccine Storage and Handling
- Vaccine Misconceptions
- Reliable Resources

This course is designed for all immunization providers and staff. Training manual, materials and certificate of attendance are provided to all attendees. Please see the Training Calendar for presentations throughout Indiana. Registration is required. To attend, schedule/host a course in your area or for more information, please visit http://www.in.gov/isdh/17193.htm.

ISDH Data Reports

The following data reports and the *Indiana Epidemiology Newsletter* are available on the ISDH webpage:
http://www.IN.gov/isdh/

HIV/STD/Viral Hepatitis Semi-Annual Report (June 2007 – December 2013)	Indiana Mortality Report (1999-2012)
Indiana Cancer Reports: Incidence; Mortality; Facts & Figures	Indiana Linked Infant Birth/Death Report (1999, 2002, 1990-2003)
Indiana Health Behavior Risk Factors Report (1999–2012)	Indiana Natality Report (1998–2012)
Indiana Health Behavior Risk Factors (BRFSS) Newsletter (2003–2014)	Indiana Induced Termination of Pregnancy Report (1998–2013)
Indiana Hospital Consumer Guide (1996)	Indiana Marriage Report (1995, 1997-2004)
Public Hospital Discharge Data (1999–2013)	Indiana Infectious Disease Report (1997 - 2012)
Assessment of Statewide Health Needs (2007)	Indiana Maternal & Child Health Outcomes & Performance Measures (1989-1998 through 2002–2011)

HIV Disease Summary

Information as of June 30, 2014 based on 2010 population of 6,483,802

HIV - without AIDS:

110	New HIV cases from April 1, 2014 thru June 30, 2014	12-month incidence	1.70 cases/100,000
5,278	Total HIV-positive, alive and without AIDS on June 30, 2014	Point prevalence	81.40 cases/100,000

AIDS cases:

65	New AIDS cases from April 1, 2014 thru June 30, 2014	12-month incidence	1.00 cases/100,000
6,069	Total AIDS cases, alive on June 30, 2014	Point prevalence	93.60 cases/100,000

12,439 Total AIDS cases, cumulative (alive and dead) on June 30, 2014

Reported cases of selected notifiable diseases		
Disease	**Cases Reported in April - June**	
	2013	**2014**
Animal Bites	2,134	1,595
Brucellosis	0	0
Campylobacteriosis	146	69
Chlamydia	6,653	5,219
Cryptococcus neoformans	8	9
Cryptosporidiosis	14	11
Dengue Fever	0	0
E. coli, shiga toxin-producing	28	20
Ehrlichiosis	18	0
Giardiasis	55	22
Gonorrhea	1,687	1,292
Haemophilus influenzae, invasive	41	19
Hemolytic Uremic Syndrome (HUS)	0	1
Hepatitis A	10	8
Hepatitis B (acute)	26	19
Hepatitis B, infant born to HBsAg-positive mother	1	0
Hepatitis C (acute)	53	1
Hepatitis D	0	0
Hepatitis E	1	0
Histoplasmosis	20	10
Influenza-Associated Death	4	1
Influenza, other or unspecified	12	0
Legionellosis	28	17
Listeriosis	3	0
Lyme Disease	39	0
Malaria	4	0
Measles (rubeola)	0	0
Meningitis, other	5	2
Meningococcal, invasive	4	1
Mumps	0	6
Pertussis (Whooping Cough)	83	87
Rabies, Animal	3	0
Rocky Mountain Spotted Fever	0	0
Rubella	0	0
Salmonellosis	199	151

Reported cases of selected notifiable diseases (cont.)		
Disease	**Cases Reported in April – June**	
	2013	**2014**
Shigellosis	34	240
Severe *Staphylococcous aureus* Infection in Previously Healthy Person	9	1
Streptococcus disease, invasive, Group B, Newborn	11	7
Streptococcus Group A, invasive	45	42
Streptococcus Group B, Invasive (All ages)	90	62
Streptococcus pneumoniae (invasive, all ages)	169	123
Streptococcus pneumoniae (invasive, drug resistant)	0	0
Streptococcus pneumoniae (invasive, <5 years of age)	10	9
Syphilis (Primary and Secondary)	70	29
Toxic Shock Syndrome, streptococcal (STSS)	3	3
Tuberculosis	23	26
Tularemia	2	1
Typhoid Fever	0	1
Typhus/Rickettsial disease	0	0
Varicella (Chickenpox, confirmed and probable)	29	14
Varicella (Hospitalization or Death)	3	3
Vibriosis (non-cholera Vibro species infections)	0	0
West Nile Virus neuroinvasive disease	0	0
Yersiniosis	1	1
For information on reporting of communicable diseases in Indiana, call the *ERC Surveillance and Investigation Division* at 317.233.7125.		

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http://www.in.gov/isdh/25154.htm

Indiana State Department of Health
Epidemiology Resource Center

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CDC Mobile Apps

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