Fever in a Returning Traveler… From West Africa

Francesca Lee, MD

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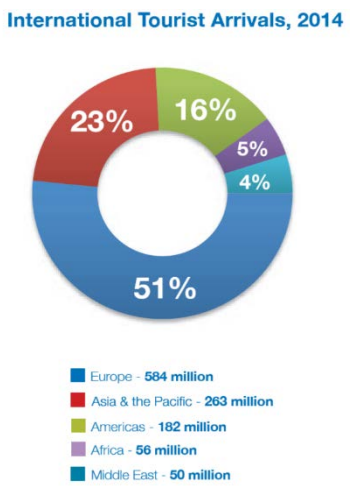
Francesca Lee, MD
Assistant Professor
Division of Infectious Diseases and Department of Pathology- Clinical Microbiology

Dr. Lee is the director of the Antimicrobial Stewardship Program at UT Southwestern, and as such, has an interest in appropriate antibiotic utilization. She is also interested in general infectious diseases, and specifically in the management of patients with nontuberculous mycobacterial infections. Additionally, Dr. Lee holds an appointment in the Department of Pathology, where she is medical director of pre-analytical services, and participates in leadership of the clinical microbiology laboratory.

At the conclusion of this lecture, the listener should be able to:

- Recognize the most common causes of febrile illness in returning travelers from West Africa
- Differentiate between a frontline, assessment, and treating hospital for Ebola virus disease
- Recognized the challenges faced by institutions when creating special pathogens response systems



International travel has increased over the past decade, hitting a record 1.2 billion arrivals in 2015 [1]. While Europe and North America remain the predominant destinations, proportionate increase in travel to areas of low economic development (sub-Saharan Africa, Southeast Asia, the Middle East) are increasing. It is estimated that between 20%-70% of travelers will have some sort of illness upon return, and somewhere between 5%-19% of these will have symptoms leading them to seek medical attention [2]. GeoSentinel is a global network of travel and tropical medicine clinics, which collects de-identified demographic, diagnostic and travel information. Currently there are 63 clinical sites in 29 countries on 6 continents, along with over 200 affiliate members.[3]

The most important initial step when evaluating a symptomatic returned traveler is to assess severity of illness. Mortality from travel-related infections is relatively low, but there are life-threatening conditions such as cerebral malaria. Also, although not easily quantified, patients may have quotidian conditions that require urgent evaluation (pulmonary embolism, diverticulitis). Other components in the assessment of a travel-related visit include travel itinerary, underlying illness or comorbidities, pre-travel vaccinations or prophylaxis, personal history of exposures, insect bites (mosquito vs tick vs fly), contaminated food or water consumption, freshwater swimming, or outdoors vs indoors residence, contact with animals, and review of notable outbreaks in the particular region of travel. Timing of symptom onset with relation to exposure can be very helpful, as several infectious agents have specific incubation periods.

The reason for travel is also very important, as clear differences exist in risk of infections between tourists and business travelers compared to visitors returning to home to visit friends or relatives (VFR). [4] GeoSentinel data shows that VFRs have an 8-fold higher risk of acquiring malaria compared with tourists, and significantly higher rates of typhoid, paratyphoid, and Hepatitis A. VFRs are less likely than other travelers to have a pre-travel-related healthcare encounter. Reasons for this include less awareness of risk; financial, geographic, cultural and language barriers when accessing healthcare; longer trips with higher risk travel, such as staying in family homes and adopting the local lifestyle without precautions regarding food and water consumption, bed nets, etc. Also, there may an assumption of immunity to infections from one's homeland.

When focusing on the assessment of fever in the returning traveler, one can approach the patient looking for syndromic presentations, likelihood of disease based on location of travel, and timeline of symptoms[5]. For example, fever plus jaundice after kayaking and swimming in a river in Hawaii might lead to suspicion for leptospirosis, while fever and jaundice after visiting India during monsoon season might lead to suspicion for Hepatitis E. If the patient has neurologic symptoms, evaluation is necessary for both common bacterial pathogens and viruses endemic to the areas of travel. Fever and rash is a broad category with a fair amount of pathogen overlap, although vesicular and ulcerative rashes have a narrower list of causes. Animal, arthropod and sexual contact history, along with timeline from exposure to symptom onset, can be very helpful. A number of pathogens have relatively short incubation periods and can be ruled out. Dengue, for example, has a maximum incubation period of 14 days, so a patient presenting three weeks after returning from travel with new-onset fever and myalgias is unlikely to have this as the etiology[6].

GeoSentinel data evaluating 42,173 returned travelers seeking medical evaluation between 2007-2011 showed that Asia (32.6%) and sub-Saharan Africa (26.7%) were the travel destinations most associated with illness [7]. Latin America and the Caribbean contributed 19.2% of illness, with the remainder made up of a multitude of destinations. The majority of illness belonged to one of four syndromic categories:

- gastrointestinal symptoms (34%)
- febrile illness (23.3%)
- dermatologic conditions (19.5%)
- respiratory illness (10.9%)

The most commonly identified diarrheal pathogens include *Campylobacter, Salmonella, Shigella*, and *Giardia*. For febrile illness, malaria was identified in 29% of cases, followed by Dengue virus. Notably, no diagnosis was found in 40% of febrile cases. Dermatologic diagnoses ranged from animal bites and scratches requiring rabies postexposure prophylaxis, to scabies, marine envenomation, and cutaneous larva migrans. Finally, influenza (which exists year-round in the tropics) and pulmonary tuberculosis competed for the lead cause of respiratory illnesses. Notably, while only 15.5% of ill travelers were VFR, they comprised 62% of the P. falciparum malaria diagnoses, as well as a disproportionate number of enteric fever and *Strongyloides* infections. Travel to the developed world may also lead to illness; European destinations accounted for 20% of measles and 15% of acute HIV cases, as well as *Legionella*, Hepatitis A, trichinellosis, leishmaniasis, rickettsioses, and Lyme borreliosis. The US provided 23 travel-related cases of Lyme borreliosis, 3 coccidioides infections, and 1 case of babesiosis.

Notably absent from this list are viral hemorrhagic fevers (VHF). The risk was estimated at <1 per 1 million travel episodes to African countries where infection is present, with febrile patients 1000 times more likely to have malaria than any VHF upon return the their native countries [8]. When a large analysis was performed specifically looking at acute, potentially life-threatening tropical diseases in travelers from 1996-2011, no VHF was identified [9]. And then, in 2014, the world met Ebola virus.

Brief Overview of Ebola

The *Ebolavirus* genera is comprised of 5 viruses: Ebola (formerly Zaire), Sudan, Tai Forest, Bundibugyo, Reston [10]. Along with *Marburgvirus*, they belong to the family Filoviridae, which are enveloped, negative, single-stranded RNA viruses. Named after the Ebola river, the virus was first identified in 1976 in outbreaks in southern Sudan and northern Zaire (now the Democratic Republic of Congo). No definite reservoir has been identified, although both bats and rodents are suspected. Humans and apes are considered end hosts. The incubation period ranges from 2-21 days, followed by an abrupt onset of nonspecific, non-pathognomonic symptoms (malaise, fever, chills, myalgias). Bleeding diatheses range from petechiae to visceral hemorrhagic effusions; this occurs in less than half of patients. Laboratory findings include early leukopenia followed by neutrophilia, thrombocytopenia, transaminitis, abnormal coagulation values. Death usually occurs between day 6 and 16; those who have non-fatal cases seem to improve between days 6-11, when antibody response is detected [11]. Despite over 20 outbreaks since 1976, there is no specified treatment for Ebola virus disease (EVD) and management depends on isolation and containment of infected patients and their contacts. Mortality rates have ranged between 37-74% [12].

Table. **Cases of Ebola Hemorrhagic Fever in Africa, 1976 to 2014***

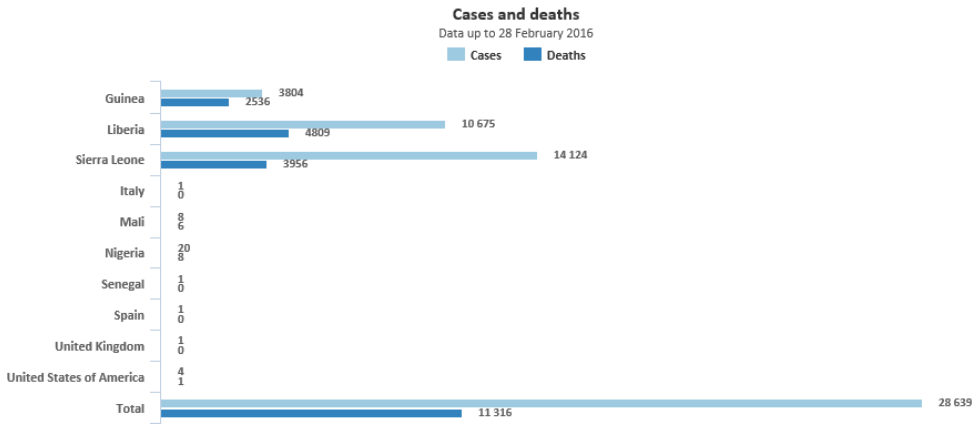
Year	Country	Town	Cases, *n*	Deaths, *n*	Species
1976	Democratic Republic of the Congo	Yambuku	318	280	EBOV
1976	South Sudan	Nzara	284	151	SUDV
1977	Democratic Republic of the Congo	Tandala	1	1	EBOV
1979	South Sudan	Nzara	34	22	SUDV
1994	Gabon	Mekouka	52	31	EBOV
1994	Ivory Coast	Tai Forest	1	0	TAFV
1995	Democratic Republic of the Congo	Kikwit	315	250	EBOV
1996	Gabon	Mayibout	37	21	EBOV
1996	Gabon	Booué	60	45	EBOV
1996	South Africa	Johannesburg	2	1	EBOV
2000	Uganda	Gulu	425	224	EBOV
2001	Gabon	Libreville	65	53	EBOV
2001	Republic of the Congo	Not specified	57	43	EBOV
2002	Republic of the Congo	Mbomo	143	128	EBOV
2003	Republic of the Congo	Mbomo	35	29	EBOV
2004	South Sudan	Yambio	17	7	EBOV
2007	Democratic Republic of the Congo	Luebo	264	187	EBOV
2007	Uganda	Bundibugyo	149	37	BDBV
2008	Democratic Republic of the Congo	Luebo	32	15	EBOV
2011	Uganda	Luwero District	1	1	SUDV
2012	Uganda	Kibaale District	11†	4†	SUDV
2012	Democratic Republic of the Congo	Isiro Health Zone	36†	13†	BDBV
2012	Uganda	Luwero District	6†	3†	SUDV
2014	Guinea, Sierra Leone, Liberia, Nigeria	Multiple	1009†	574†	EBOV

BDBV = Bundibugyo virus; EBOV = Ebola virus; SUDV = Sudan virus; TAFV = Tai Forest virus.
* Adapted from www.cdc.gov/vhf/ebola/resources/distribution-map.html.
† Laboratory-confirmed cases only.

The most recent Ebola outbreak erupted in December 2013 in Guinea, although the virus was not officially identified until March 22, 2014. By that time, 49 cases and 29 deaths were officially recognized. The region's borders are porous, and infection had already crossed into Liberia and Sierra Leone; again, there was delayed recognition. One contributing problem was that this was the first time EVD was seen in West Africa. EVD is a known pathogen in equatorial Africa, a regions which has medical infrastructure both to diagnose and isolate patients, and experience with containment. The three West African countries primarily affected are among the world's poorest, with very little ability to provide basic health care, much less Ebola. On July 20, 2014, Ebola entered Lagos, Nigeria via an airline passenger. Nigeria, with a more robust health care and epidemiologic infrastructure, was on high alert, and was able to contain their outbreak to 19 cases, with 7 deaths. Senegal and Mali also experienced imported cases, contained with active surveillance systems. [13].

Guinea was declared free of EVD transmission as of Dec 29, 2015. Liberia was cleared on January 14, 2016. As of March 2, 2016, the WHO reported that the last identified case of EVD was on January 20th, in Sierra Leone. Assuming no other cases are reported, transmission will be declared contained on March 17th. All three countries either have started, or will start an enhanced 90-day surveillance program to improve the ability of HCWs and the public to report concerning febrile illness or death [14].

The overall mortality rate for this EVD outbreak is about 40%, ranging from a low of 0% in Europe, to a high of 67% in Guinea. The vast disparity in survival has prompted a closer look at overall healthcare

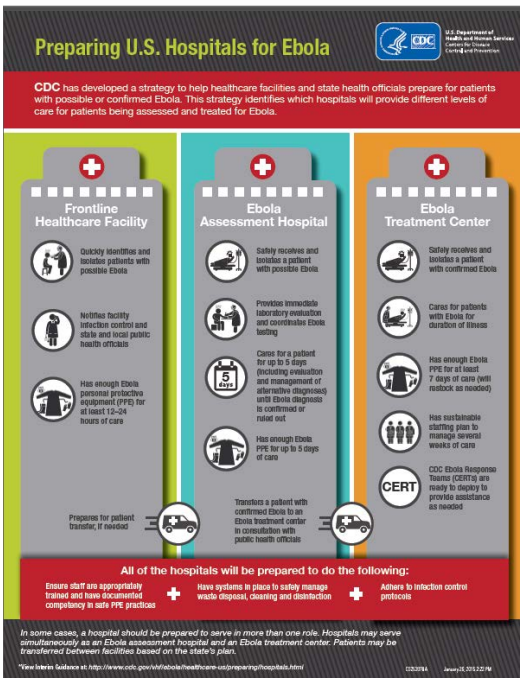


disparities, and recognition that with more aggressive, supportive care, perhaps far more patients would have survived. A recent NEJM publication summarized the European and US experiences managing patients with EVD [12]. There were 27 total patients, of whom five died, with a mortality rate of 18.5%. However, the authors hypothesize that there could have been up to 6 more deaths, as 2 patients required noninvasive mechanical ventilation, 2 received invasive mechanical ventilation, and 2 required both invasive mechanical ventilation and continuous renal replacement therapy. This would have changed the mortality rate to 41%, close to the average experience in Africa. In other words, with adequate resources, perhaps 6, 161 additional African patients might have survived.

EVD in Texas

On September 20, 2014, Mr. Thomas Duncan arrived in Dallas from Liberia. Five days later he presented to a local emergency room, but through a combination of incomplete disclosure of exposures and miscommunication, he is discharged home. Three days later he returned and was admitted, with the diagnosis of EVD confirmed on September 30th. Despite intensive, aggressive care, he died on October 8th, 2014. Two nurses who cared for him were subsequently diagnosed with EVD; the first on October 11, the second on October 15. Both survived. The Dallas County Department of Health and Human Services (DCHHS), with assistance from the Centers for Disease Control (CDC), determined that the index Dallas patient had 20 community contacts, plus 159 healthcare contacts, all requiring monitoring. Twenty-four healthcare personnel contacts were deemed either "high risk" or "some risk", based on known unprotected exposures during the initial ED visit or EMS transport. 62 contacts lived outside of Dallas County, necessitating the involvement of three local counties plus the state health department (Dr. Chung, personal communication).

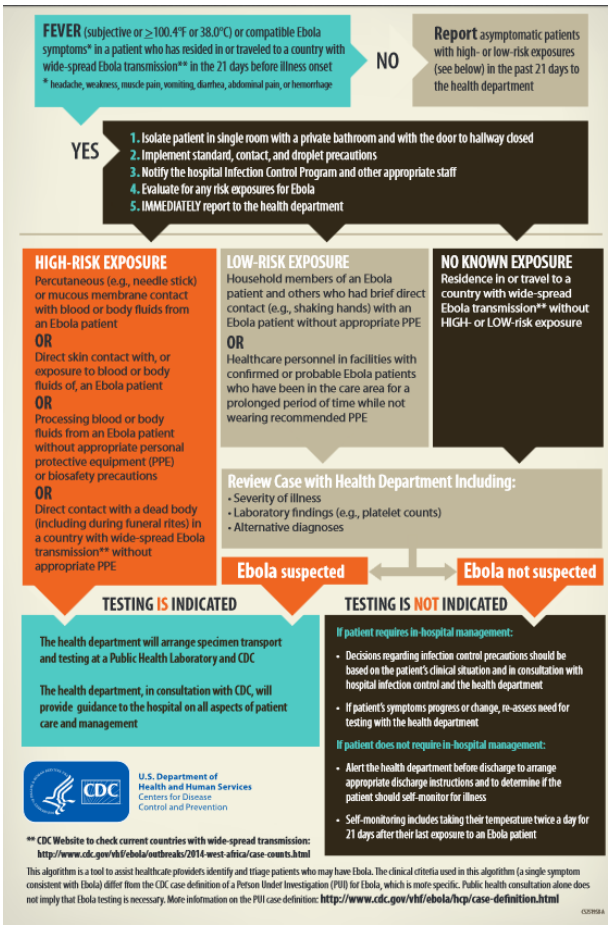
Once the two nurses were diagnosed with Ebola, there was significant concern that more contacts would progress to active disease. North Texas hospitals, which had been focusing on screening and identifying patients upon initial presentation, rapidly transitioned to planning for hospitalization of additional patients. UT Southwestern and Parkland worked cooperatively during this time, sharing ideas on hospital layout and patient movement, PPE selection, staff training, etc. Complicating matters for UT Southwestern was that these events occurred at the end of 2015, the same time that the institution planned to move to a new building. This required EVD protocols to be designed for both the existing St. Paul Hospital, and the soon-to-open Clements University Hospital. Simultaneously, CDC guidelines for evaluation and management of patients with possible EVD were evolving, leading to differentiation between frontline, assessment, and treatment hospitals [15].



Every acute care hospital, critical access hospital and urgent care center should consider itself a frontline hospital, with a process for identifying and triaging patients with both the appropriate exposure history as well as compatible signs and symptoms for EVD. Assessment hospitals are the next step in the chain of management,

able to care for persons under investigation (PUI) for EVD until diagnosis is either confirmed or ruled out, and until discharge or transfer to an EVD treatment center. Assessment hospitals may need to provide up to 96 hours of evaluation and care for PUIs. Patients arrive at assessment hospitals either by transfer from frontline hospitals, or by direct referral from public health authorities. As patients being actively monitored may present early in the course of illness, it may be necessary to repeat testing if initial tests are negative. Ultimately, UT Medical Branch at Galveston was selected as the adult Ebola treatment center [16] and UT Southwestern Clements University Hospital agreed to serve as the Ebola virus assessment center for north Texas.

The CDC case definition for an EVD PUI is a person with signs or symptoms including elevated body temperature or subjective fevers, severe headache, fatigue, muscle pain, vomiting, diarrhea, abdominal pain, or unexplained hemorrhage AND an epidemiologic risk factor within 21 days before onset of symptoms [17]. CDC PUI risk assessment is tiered [18]. "High risk" and "some risk" patients are relatively easy to identify. The majority of PUIs fall into the "low (but not zero) risk" category, and the decision to test for Ebola is left to the assessing clinicians and health departments.



<u>In any country</u>

- Brief direct contact (such as shaking hands) with a person in the early stages of Ebola, **while not wearing appropriate PPE.** Early signs can include fever, fatigue, or headache.
- Brief proximity with a person with Ebola who has symptoms (such as being in the same room, but not in close contact) **while not wearing appropriate PPE**
- Laboratory processing of blood or body fluids from a person with Ebola who has symptoms **while wearing appropriate PPE and using standard biosafety precautions**
- Traveling on an airplane with a person with Ebola who has symptoms and having had no identified *some* or *high* risk exposures

<u>In countries with widespread transmission, cases in urban settings with uncertain control measures, or former widespread transmission and current, established control measures</u>

- Having been in one of these countries and having had no known exposures

CUH Ebola Response Preparations

Our institutional story began in early October 2014, when a patient who was about to be discharged from the St. Paul emergency room told his nurse that he had been present in the Presbyterian Hospital emergency room at the same time as Mr. Duncan. There was anxiety amongst staff, but the infection prevention team worked with the health department to determine that this story was not accurate [19].

However, it confronted UT Southwestern with the need to quickly ascertain our ability to isolate and care for EVD PUI patients. At that point, it wasn't clear if everyone would be monitored by the health department or how hospitals would be notified. We conducted a videotaped drill with the help of colleagues experienced in simulation events. Watching ourselves, we realized that following the CDC's existing protocols for PPE would be concerning for inadvertent contamination. We also determined problems with logistics of patient and staff movement in the ED, particularly regarding cross-contamination. At the time we only had two powered air purifying respirators (PAPR) and very few coveralls. Twenty-five more PAPRs were ordered, along with coveralls. Complicating our efforts to get supplies was the high national demand leading to supply limitations.

The initial mandate was that all staff at UT Southwestern should be trained in PPE use. The infection prevention department was placed in charge of this, but they had little time or resources to organize a streamlined training program. This led to anxiety being reported by multiple nurses to their supervisors, including reports of nightmares and considerations of quitting. This was consistent with a national study evaluation nursing concerns regarding care for EVD patients [20]. Ultimately, it was decided that only a core group of staff volunteers would be trained, focusing on the ED nurses given their high risk of exposure. Initially, 15 nurses underwent PPE training; this has expanded to 41 volunteer ED nurses, across all shifts. All emergency room physicians have been trained, as well as staff from environmental health and safety (EH&S), facilities, and housekeeping.

Laboratory testing was, and remains, a challenge. The decision was made to keep patient samples in the ED and perform only point-of-care testing (POC) until a decision was made regarding the risk for EVD. This limits the number of tests that are available, but has the benefit of minimizing transport of potentially infectious specimens, as well as limiting staff exposure. Malaria testing has been an ongoing source of debate. A rapid malaria antigen test is available, but it has variable sensitivity and is not designated as a POC test, so we elected not to bring it online.

Environmental controls, including isolation as well as waste management, were key factors in this process. Everybody learned, from watching the experiences both at Presbyterian as well as at Nebraska and Emory, that there was great fear of processing waste from EVD patients. Protocols were developed in conjunction with the county and city to ensure that our waste could be safely stored and removed.

The most obvious problem, though, was where to house the patient? Existing buildings cannot be rapidly redesigned for this type of situation, so we needed an ED room with an anteroom and its own toilet, as well as a way to isolate this room from the remaining patient care areas. At St. Paul, this was ED room 1. Beginning December 6, 2014, we transitioned to CUH ED Room 22.

SP-22

Based on the selection of this room, and the desire to have a catchy name, we changed the response team's name to "SP-22" (Special Pathogens, Room 22). An on-call list was created within the emergency paging system, so we could be rapidly notified of the need for PUI assessment. A Sharepoint site was created for team members, to track documents, training, supplies, events, etc. Although the CDC recommends a tiered approach to PPE use, our staff expressed a preference for maximum protection each time they interacted with a PUI. Therefore, our current PPE protocol includes institutional scrubs and plastic shoes, a bouffant, 3 pairs of gloves (different colors), 1 Kleenguard coverall, 1 Max air helmet with face shield (and battery and belt), 1 pair of shoe covers, 1 white apron, and 1 Stryker shroud. The

EH&S team developed a process for rapid installation of Bio-barriers at entrances/exits of the ED pod involved, as well as building a shower for providers after exiting the patient's room. Infection prevention team members are responsible for ensuring safe donning and doffing with direct observation and checklists, monitoring of staff, and overall coordination. A camera has been installed in Room 22 to monitor patients and staff, dedicated walkie-talkies are used for communication, and a blue-tooth stethoscope was purchased to facilitate patient examination. There is a Special Pathogens cart and tackle box which contains supplies needed by the staff during patient care.

The DFW area saw 618 travelers returning from West Africa who required either direct monitoring (n=474) or self-observation (n=144) (Dr. Chung, personal communication). This is in addition to the October 2014 outbreak. SP-22 was activated for 11 EVD PUIs, who were assessed between March and November, 2015. Nine patients were male, 1 was under age 18. Seven patients were VFR, spending at least 3 weeks home with friends and family; none took malaria prophylaxis. Three were missionaries or charitable workers; all had taken malaria prophylaxis. One was a UN humanitarian worker, who took malaria prophylaxis until deciding that he was not at risk and stopping. One was an EVD survivor who was thought to be virologically clear, but out of an abundance of caution was sent to CUH for evaluation after developing symptoms of infection.. By history they all qualified as low, but not zero, risk. However, inconsistencies in history were identified in several patient histories. Ultimately, in conjunction with the DCHHS, we elected to test 10 of the 11 patients for EVD. All were negative.

Plasmodium falciparum was diagnosed in five patients (45%); 4 VFRs and the UN worker. One patient had a 5% parasitemia and required ICU support for two days. One VFR was diagnosed with pulmonary embolism. One humanitarian worker was diagnosed with shingles. One VFR was diagnosed with *Shigella*, and is being worked up for HIV (screening test positive but secondary testing negative). Two patients had nonspecific gastroenteritis. One had a positive serum B-hcg. One had a nonspecific viral syndrome.

Table 4. Diagnostic Test Results and Final Diagnoses

Case Variable	Total n = 25
Ebola virus PCR test performed[a], n (%)	8 (32%)
Diagnosis, n (%)	
Influenza A infection[b]	6 (24%)
Influenza-like illness[c]	6 (24%)
Acute diarrhea[c]	4 (12%)
Plasmodium falciparum malaria	3 (12%)
Influenza B infection	2 (8%)
Rhinovirus infection[b]	2 (8%)
ETEC gastroenteritis[d]	1 (4%)
Blastocystis hominis gastroenteritis	1 (4%)
Diabetic ketoacidosis	1 (4%)

Our experience is different than that recently published by Emory University [21], which has a pre-existing special pathogens unit as well as a dedicated tropical medicine/travel clinic. They describe 25 travelers seen between 7/20/14 and 1/28/15 who met the case definition for a PUI. None met high risk criteria; they performed EVD PCR on 8 patients. The majority of their patients (17) traveled specifically for Ebola response work, 2 were newly emigrated to the US, and only 1 qualified as a VFR. The most common diagnosis was Influenza (4 with A, 2 with B), or influenza-like illness. Only 3 patients (12%) were diagnosed with *P. falciparum* malaria.

Lessons and observations

The most important aspect to having this system function was to ensure that the staff trusted in the process, and trusted that their safety and security were valued. Despite the recommendation from government agencies that patients be ruled out by their epidemiologic history, the Dallas experience shows that patient history is only as good as the historian. Mr. Duncan did not acknowledge that he had been exposed to an actively symptomatic person [22], and therefore qualified as "low, but not zero" risk. My personal interactions with patients included one patient who had seen a physician as well as taken an antipyretic prior to travel, to ensure that he would be allowed on the plane; one patient who

stated that she had not been sexually active during the trip but was then found to have a positive β-hcg; and one patient who, on questioning, remembered he had visited a mission school that specifically had a large population of EVD survivors, whom he thought were asymptomatic but couldn't be certain. These experiences led us, as an institution, to prefer to obtain a negative EVD PCR prior to any laboratory testing beyond the ED, and certainly prior to decisions about admission. As the months went on, and the nursing staff perceived that the process "worked", more volunteered to be trained and be part of the team. We are now developing a low-risk protocol, as there is experience nationally and internationally that "low but not zero" risk patients do not get diagnosed with EVD. A recent publication showed that, even with a trained observer monitored PPE doffing (of gowns and gloves), up to 30% of providers had some sort of contamination (measured with a fluorescent lotion) [23]. This supports the need for continuous training, regardless of the protocol being followed.

The next thing we learned is that it was ideal to have all the supplies organized and gathered in one area. There are now specific storage areas for all necessary materials ranging from provider scrubs to patient care supplies to isolation materials. This same organizational concept was applied to the creation of the Sharepoint site, which allows for updating of protocols and dissemination to team members. The one thing we could not store was food, and as PUIs seemed to arrive during dinner hours, we learned that providing the team with food beyond snackbars was good for morale (pizza was the general favorite).

Time was a major factor in this process. Each patient assessment took between 8-10 hours. First, the patients being cared for in the ED pod would need to relocated; this could impact up to 12 patients. Biosafety equipment installation took about an hour, including the temporary wall, biocontainment barriers, waste containers, decontamination pads, and shower. Direct patient care was generally 4-5 hours, followed by 2-3 hours to pack up all the supplies and clean the area.

Several lessons were learned regarding direct patient care. First, we determined that it is very difficult to hear and spell names accurately while wearing a PAPR, particularly if the patient's native language is not English. As much registration information as possible is obtained prior to patient arrival. Hearing is also a problem when examining a patient, even with the Bluetooth stethoscope. Next, it turns out that some types of ink wipe off during the process of decontaminating the patient sample tubes, so we became selective on the types of pens used. Third, we needed to increase the available counter space, as the nurses were performing more POC than they usually would in the ED. Fourth, we went through several iterations of waste collection systems, trying to find ones big enough for all the PPE, but small enough to avoid obstructing the staff. Finally, but critically, communication between the patient-care area and the command center required revision. Ultimately we dedicated a number of walkie-talkies specifically for SP-22. Benefitting from the camera installation, we had one large video debriefing, which helped identify both successes and challenges.

The patients had fears and concerns that we did our best to allay. Besides concern for themselves and their health, some were overwhelmed by being surrounded by people in "space suits". We did our best to engage them and reassure them. We also needed to determine the safest way to care for family members. This was handled on a case-by-case basis, but in one particular situation we had to find a nurse with a pediatric background to care for the young child of one of the PUIs. Privacy was another major concern for the patients. Campus police guarded the entrances to the ED pod, and the only people allowed access were those directly involved in the process. The fact that very few people outside of SP-22 even knew that this group existed speaks to the effectiveness of our efforts not to draw attention.

Our patients fit the profile described in the previous studies on international travel. Those who were VFRs had minimal healthcare contact, and all of the malaria burden. We did not see influenza (in contrast to Emory), but we did see typical health concerns such as PE, shingles, and pregnancy. Based on this, and the lack of any further low risk patients being diagnosed with EVD, we will implement rapid malaria antigen testing as part of the ED protocol. Also, there are at least four EVD survivors in the north Texas area, and at some point they will each need medical care. Our patient had been followed by CDC and had been free of viremia for months, but everyone, including the patient's Ebola treatment Center (ETC) physicians, felt most comfortable having the patient assessed and retested.

We learned how much we appreciate the Dallas County Department of Health and Human Services. They were intimately involved with each event, helping to communicate between patients, ambulances, outside institutions. Staff personally came to the ED to pick up samples for testing, and called/emailed immediately when results were available.

Finally, we realized how great the team at UT Southwestern truly is. Multiple departments came together to make this process work, and did so in a short amount of time, with constant need to update and adjust practices. Needing to plan the entire process for two different hospitals added to the stress, but also to the camaraderie.

Next Steps

At the institutional level, it would be ideal to have a dedicated medical director for the Special Pathogens project, who would be responsible for coordination of protocols, training and drills, as well as keeping up with the literature and having IRB and IND processes in place. UT Southwestern has been awaiting the arrival of an Infectious Diseases Division Chief to formalize this type of position. There should also be systems for redundancy in other areas of the hospital. As evidenced by the 8-10 hour staff commitment during a PUI assessment, many team members had to delay completing other aspects of their jobs. This is not unique to UT Southwestern; a survey of hospital epidemiologists found that, during a single week in fall 2014, 80% of hospital epidemiology time was devoted to EVD preparation, with 70% of other hospital infection prevention activities not being completed [24] The impact on the day-to-day activities of each component of the SP-22 team should be reviewed, and proactive plans laid to prevent these problems.

The differentiation between an assessment center and a treatment center may not be as vast as it appears. Learning from the Presbyterian experience, many of the active interventions actually took place during those first few days [22]. If an EVD PUI did require prolonged care at our institution, we would quickly become a treatment center, rather than waiting for the patient to be transferred.

Recognizing this, our diagnostic laboratory capacity would benefit from expansion. We are currently unable to house a true satellite laboratory in the ED, for logistical, staffing and regulatory reasons, but this would be something to reassess. Should Clements University Hospital continue to be the assessment center for this, and other infectious diseases, we will need to carefully evaluate the space, staffing, and supplies needed for this role.

None of these changes come without cost. To date, UTSouthwestern has spent almost $400,000 in equipment, supplies and training, and patient care; very little of this has been reimbursed. If state and federal agencies want municipalities to be prepared for special pathogens, then support should be provided with both guidance and funding. Expecting institutions to fund disaster management planning through grant applications no longer seems adequate. By the same token, funding agencies do have a justified expectation for return on investment, which could be part of the process of truly being designated an assessment center.

At the state level, there is a recently formed Task Force on Infectious Diseases. Ideally this group will help guide and standardize readiness for Texas hospitals for a multitude of infections. I hope that the Task Force will make recommendations regarding physical space needs, employee training, testing capacity, and establishment of evaluation and treatment protocols that can be studied for effectiveness. Hopefully it will also contemplate the unknown, future potential outbreak (zombie apocalypse excluded).

At the national and international level, there needs to be much more support for public health infrastructure, including diagnostic capabilities, epidemiologic and investigative abilities, and alert and response capacity. Criticism of the response to the 2014 EVD outbreak is beyond the scope of this Grand Rounds, although much has been said. Hopefully, every government and non-government organization is humbly searching for what it could have done better, and planning for the next, inevitable, event.

Bringing It All Together

GeoSentinel analyzed data on travelers arriving from Sierra Leone, Liberia, or Guinea between 1 September 2009 and 31 August 2014 [25]. Out of 805 sick travelers, malaria was the most common diagnosis, followed by acute diarrhea. There were no cases of VHF identified. The general approach to the traveler with fever remains stable, even in the post-Ebola world. However, 1.2 billion international arrivals yearly will only increase the likelihood of another transmissible infection.

Federal, state and local governments are responsible to preparing for these eventualities, but have many competing responsibilities. It may fall on individual hospitals to prepare to take care of complicated, potentially highly infectious patients, while protecting their staff and the community at large. UT Southwestern has embarked on the quest to meet this need.

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