Preparing and Caring for Patients with Ebola Virus Disease

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Disclosures: None
Learning Objectives

After completion of the session, participants should be able to:

1) Describe the pathophysiology of Ebola virus disease (EVD)
2) Recognize challenges presented by EVD and implications for healthcare workers
3) Prevent the spread of EVD in the hospital environment
Ebola Matters to the U.S.

California’s six busiest airports had more than 165 million total air passengers in 2014.
What happened in Dallas?
Would your hospital have performed better?

After EIGHT PUIs, all false alarms…

Mid-Sept: Patient had significant contact with Ebola in Liberia

Didn’t report Ebola contact on forms before flying to DFW

3 days of headache, fever, rhinorrhea, and abdominal pain.
Goes to ED at THPH Dallas

Intake screen notes travel in Africa. Physician unaware.

SIRS score 3 (out of 4). Imaging unremarkable.

Diagnosis: sinusitis, given a Treatment: Z-Pack, sent home

Dallas 2014

Day 5: Paramedics bring patient to THPH Dallas by ambulance.

Isolation in ED for 30 hours, then isolation in MICU

Day 7: Profuse vomiting and diarrhea, tested for Ebola

Staff following CDC guidelines for PPE: Contact & Droplet Precautions

Day 8: Test positive for Ebola

CDC site visitors approve of operations at THPH Dallas
Dallas 2014 (cont.)

- **Day 11**: Mechanical ventilation and continuous hemodialysis started
- **Day 15**: Despite full life support, the patient dies
- **Day 19**: MICU nurse #1 tests positive for Ebola
  - Makes full recovery
- **Day 22**: MICU nurse #2 tests positive for Ebola
  - Makes full recovery

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**Findings of Independent Panel**

September 4, 2015  www.texashealth.org

- Experts from Mayo, University of Michigan, JCAHO, Emory and American College of Physicians
- Initial ED Visit
  - EVD Preparedness Training had not been completed
  - Poor communication between nurses, physicians, EMR alerts (Systemic Inflammatory Response Syndrome Score, Travel)
- Initial PPE recommended by CDC was inadequate (exposed skin)
- Poor collaboration between THPH, CDC, HHS, State/Local Public Health Resources

*Dallas Morning News*
Review: What is Ebola?

Ebola: Virology

- Filovirus
  - “Filum” is Latin for “thread, string”
  - Single-stranded RNA

- Six subtypes
  - Zaire (Current Outbreak)
  - Sudan
  - Bundibugyo
  - Cote d’ Ivoire/Tai Forest
  - Reston
  - Lloviu
Ebola: History

- Discovered in 1976 near Ebola river in the Democratic Republic of Congo
- Sporadic outbreaks in Africa
- 2014 Ebola outbreak is, by far, the largest in history

### Contagious versus Infectious

- A highly **contagious** disease is very easily transmitted from person to person
- A highly **infectious** disease requires very few pathogenic particles (virions, bacteria) to make an exposed person ill

Ebola is not highly contagious, but it IS highly **infectious**
Ebola is Not Terribly Contagious

- Isolate the infected patient before symptoms
- $R_0$ goes to zero
- Area becomes Ebola free

... But Ebola IS Very Infectious

Infectious Dose (number of virions)

- Influenza: 1000
- HIV: 100
- Ebola: 1
Bats are the main reservoir of Ebola virus. Bats pass Ebola virus to other animals. Humans contract Ebola virus from animals (bats and larger animals), then human-to-human transmission occurs.

Ecology of Ebola Virus

Nebraska Biocontainment Unit
NBU at UNMC

- UNMC
  - 621-bed academic tertiary care center in Omaha, NE
  - Level 1 Trauma Center
  - National Center of Excellence in Hematologic Malignancy, BMT and Solid Organ Transplantation
- Nebraska Public Health Laboratory (level 3) on campus
- Omaha airport and Offut Air Force Base both within 10 miles

Origins of Nebraska Biocontainment Unit

- Opened in 2005 with modest Federal funding
  - Response to SARS outbreak
  - Threat of bioterrorism
- Evolved into joint venture between UNMC and Nebraska Department of Public Health
- One of 4 Biocontainment Units in the U.S.
Leadership of the Nebraska Biocontainment Unit
Air Handling in NBU

- Negative air pressure
  - Entire Unit
- Air handling system separate from hospital
  - Digital monitoring
  - >15 air exchanges per hour
  - Exhausted air is HEPA filtered
- Air locked entrance

NBU Team: 2005–present

- 100% Volunteer Staff
  - Extensive interview process
  - Call system 24/7/365
  - Pager notification for NBU activations

- Training & Skill Maintenance
  - Initial training
  - Monthly staff meetings
  - Quarterly drills
    - All equipment
    - All types/levels of PPE
NBU Team

- Nurses and Therapists
  - Wide variety of backgrounds
  - “Day jobs”
    - Floors, ICUs, ED, OR, IR
  - Respiratory Therapists
  - Care Techs

- Physician Team
  - Infectious Disease specialists
  - Critical Care specialists
  - Other Specialties as needed
    - Nephrology
    - GI

Teamwork during PPE Donning
Clinical Care for Ebola Virus Disease

Three Patients with Ebola

- Sept 5, 2014: Received an American physician medically evacuated from Liberia
  - Admitted on day #8 of illness
  - Discharged after 21 days in NBU

- Oct 6, 2014: Received an American journalist medically evacuated from Liberia
  - Admitted on day #6 of illness
  - Discharged after 17 days in NBU

- Nov 15, 2014: Received an American surgeon medically evacuated from Sierra Leone
  - Admitted on day #14 of illness
  - Multi-organ failure prior to admission
  - Died on hospital day #3
Multi-Organ System Failure

Day 1 Management

- One physician enters room
- History and physical
- Documentation by colleague at video-conference station
- Initial labs ordered and drawn
Establish Central Venous Access

- FIRST, check for coagulopathy and thrombocytopenia
  - Frequent lab draws
  - Large fluid administration
  - Electrolyte repletion
  - Experimental therapies
  - CVP monitoring
NBU Policy: True Isolation

Confirmed Ebola = ZERO movement outside of NBU room for any reason

Risk *versus* Benefit

For present patient and for society in general
Laboratory Abnormalities

- Leukopenia
- Thrombocytopenia
- Transaminitis
- Coagulopathy
- Electrolyte disturbances
  - Hypokalemia
  - Hypomagnesemia
  - Hypocalcemia

Cardiovascular Effects

- All patients: **Hypovolemia**
  - Resource-Limited Areas: Oral Rehydration
  - Resource-Rich Areas: IV Rehydration
  - Healthy people with adequate rehydration maintain normal HR, BP, Perfusion

Secondary infection/ WORSENY SEPSIS

Low Vascular Tone + Myocardial Dysfunction + Ongoing Hypovolemia

Hemodynamic collapse
Respiratory Effects

- Early in disease, without massive fluid resuscitation, previously healthy patients remain normal
- ALL patients present with elevated minute ventilation
- Combination of leaky capillaries (Sepsis) and fluid resuscitation results in extra-vascular lung water
  - A-a gradient → Oxygen requirement → Can progress to hypoxemic respiratory failure

CXR from a patient with Ebola; at the onset of Multi-Organ Failure
Gastrointestinal

- Control nausea and vomiting
  - Anti-emetics administered
- Reduce watery diarrhea
  - Anti-diarrheal agents administered
- Safely manage waste
  - Depending on patient status:
    - Bathroom versus Bedside
    - Commode versus Rectal Tube

Nutrition

- Inadequate oral intake due to nausea and vomiting
- TPN initiated
  - Continued until oral intake
- Early consultation from Registered Dietitian
- Calorie counts
- Enteral nutrition ASAP
Investigational Therapies

- No proven therapeutics
- Very limited data
- Agents used in the care of our patients:
  - TKM-Ebola
  - Brincidofovir
  - ZMapp
  - Convalescent plasma
- ALL require swift support from research leadership

Full ICU Measures are Possible

- Mechanical Ventilation (invasive only)
- Advanced vascular access/hemodynamic monitoring
- Massive fluid/blood product resuscitation
- Multiple vasopressors
- Point-of-care ultrasonography/echocardiography
- Multiple antibiotics
- CVVHD
- Frequent laboratory testing
Staffing Considerations

- If possible, IDENTIFY VOLUNTEERS ahead of time
- Build a diverse team
  - Nurses from multiple disciplines
    - ED, Floor, ICU, OR
- Train all staff in entry areas in essential steps:
  - Patient screening
  - PPE
  - Isolation Location/Procedures
  - Buddy System within isolation room

Our Standard PPE for Ebola

- Surgical gown (AAMI level 4)
- Surgical hood (covers neck)
- Surgical boots
- Face Shield
- N95 mask
- Three pairs gloves
  - Outer pair: nitrile with extended cuffs
    - 2\textsuperscript{nd} pair is “your skin” and is duct taped to gown sleeve
    - 3\textsuperscript{rd} pair is “glove”
  - Frequent change of 3\textsuperscript{rd} pair after any contact (bleach wipe 2\textsuperscript{nd} pair)
PAPR vs. N95 + Faceshield for Ebola

- **Benefits of PAPR**
  - Lower risk of accidental face touching
  - In aerosol-generating procedure (intubation), reduces risk

- **Benefits of N95 + Face Shield**
  - Easier to safely doff (major safety concern)
  - Easier to hear teammates

- **Risks of PAPR**
  - More difficult to doff (major safety concern)
  - Difficult to hear teammates

- **Risks of N95 + Face Shield**
  - Increased risk of accidental face touching
  - Increased risk risk during aerosol-generating procedure (intubation)
A True Test for PPE

During 1000 combined hours of health care workers in isolation rooms with patients with Ebola at UNMC…

More than 95% of those hours were in our standard PPE.

Zero cases of health care worker infection occurred.
Disposal of Waste

Waste Management is a MAJOR issue

• One patient with Ebola can result in > 450 kg of medical waste
  • Mostly discarded PPE
• Two options:
  • Obtain a U.S. D.O.T. permit for handling of Category A waste
  • Decontaminate onsite with an autoclave
Liquid Waste
Hospital Leadership and Media Relations
100% Attention from the Start

- Chancellor
- CEO
- President
- Vice Presidents
- Chief Nursing Officer
- Dept. Chairs & Division Chiefs
Adherence to HIPAA will be essential.

It is okay to say that the patient is "Stable."

Remember that sharing anything more than that is in violation of HIPAA.
Maintaining Mental Health in a Biocontainment Unit
Dear Rich,

I love you and this is a bunch of little ninjas fighting Ebola. We are praying for you. The ninjas are crossing as to represent us and praying for you.

Love,

[Signature]

07/17/2013
14:23
Keeping the Team Alive and Well
(It’s a Marathon, not a Sprint)

- Shared Governance: Staff involved in decision making
- Meals, Drinks, Snacks
- Provide scrubs, underwear, socks, shoes, SHOWER, place for rest
- Leadership communicates with staff every single shift
- Coaching/support when needed
- Self-scheduling for all team members

Planning for the Future
Biocontainment Unit Drill
- Recombinant vesicular stomatitis virus expressing the Ebola virus glycoprotein
- Complete protection of macaques when vaccinated 3 or 7 days prior to exposure
- Suggested excellent efficacy in prevention of disease
- VSV-EBOV vaccine given to contacts of new cases of EVD
- Immediate vaccination (n=4123) versus Delayed (21 d) vaccination (n=3528)
- Primary outcome = lab confirmed EVD >10 days after randomization

**Immediate vaccination**

**Delayed vaccination**

- ZERO cases of Ebola
- 16 cases of Ebola

**U.S. Health & Human Services Tiered Response**

- UNMC, Emory, Bellevue
- Regional
- 55
Take Home Points

- People with Ebola deserve full medical care
- U.S. Hospitals CAN and SHOULD provide care
- Health care workers in resource-rich environments can provide care to patients with Ebola with minimal risk of becoming infected
  - Requires strict adherence to pre-determined PPE protocols
  - Requires teamwork at all levels

This lecture is dedicated to Dr. Martin Salia and all of the brave healthcare workers who went to West Africa in 2014.

Their sacrifices must never be forgotten.
Questions?
Thank you

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