Ontario Critical Care Clinical Practice Rounds (OC3PR)

June 25, 2025

High-Consequence Pathogen Care and Outbreak Readiness (With a Focus on Viral Hemorrhagic Fever)

Chaired by Dr. Dave Neilipovitz

Presented by Dr. Rob Fowler

Meeting Etiquette

- Attendees can submit questions to Q&A in the Zoom icon in the menu
- Please note, reproduction in part or in full of any of this presentation requires express permission from CCSO.

Hosted by CCSO | SMPCO

I wish to acknowledge this land on which Sunnybrook Hospital and the University of Toronto operate.

For thousands of years, it has been the traditional land of the Huron-Wendat, the Seneca, and the Mississaugas of the Credit.

Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

Objectives

1. Review viral hemorrhagic fevers, clinical presentations, and outcomes

2. Review current supportive and specific treatments

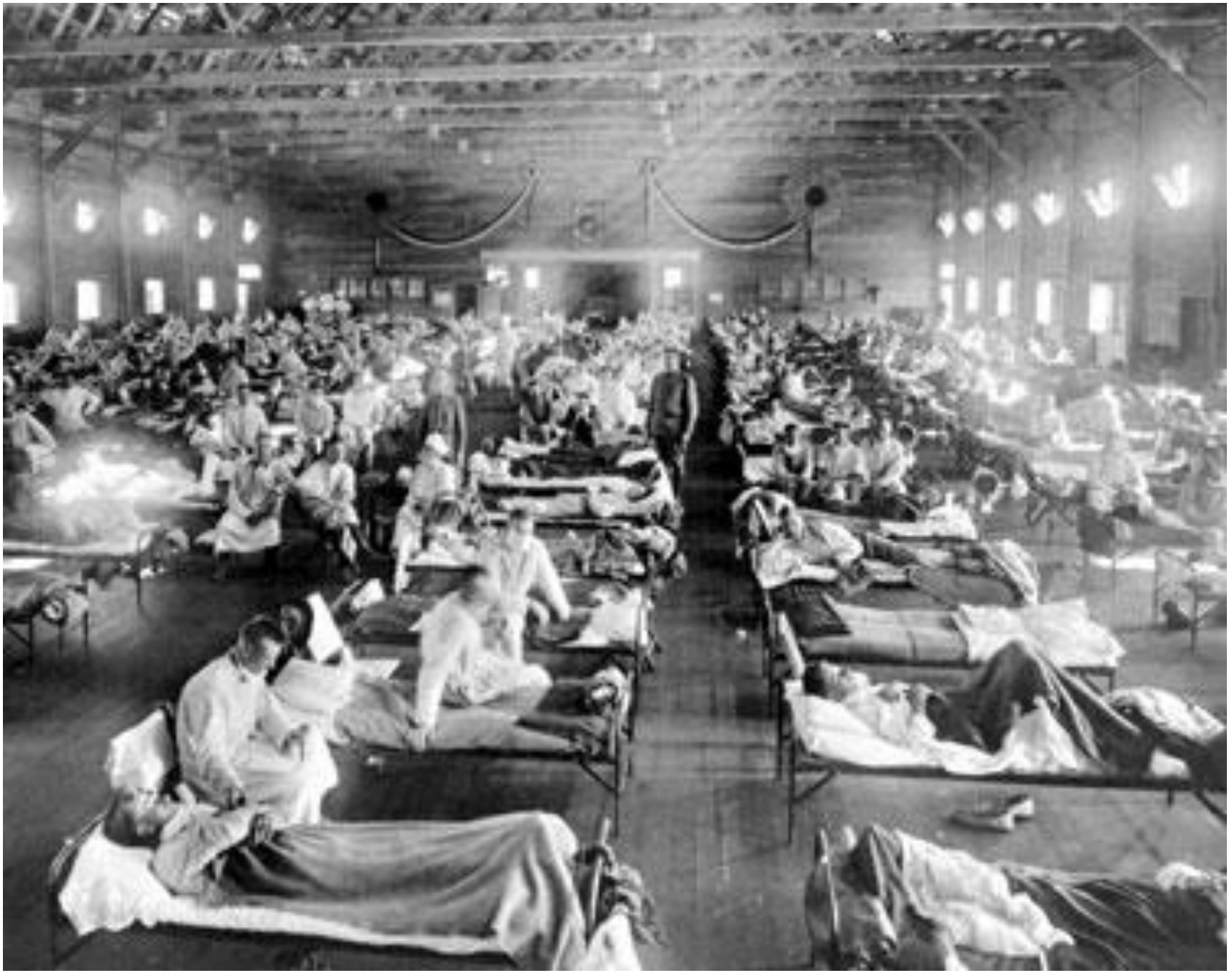
3. Review treatment unit considerations and outbreak readiness in Canadian and global contexts for viral hemorrhagic fever

Disclosures

- **No consulting past or present with industry**, never a speakers bureau member, no gifts from pharma or industry, no investments in pharmaceutical organization, medical devices or communications companies, etc.

- **Co-principal investigator - CIHR grants** for the WHO global SOLIDARITY trial; CIHR Network of COVID Trials Networks; co-investigator on other CIHR grants.

- **Frequent WHO consultant** (unpaid).



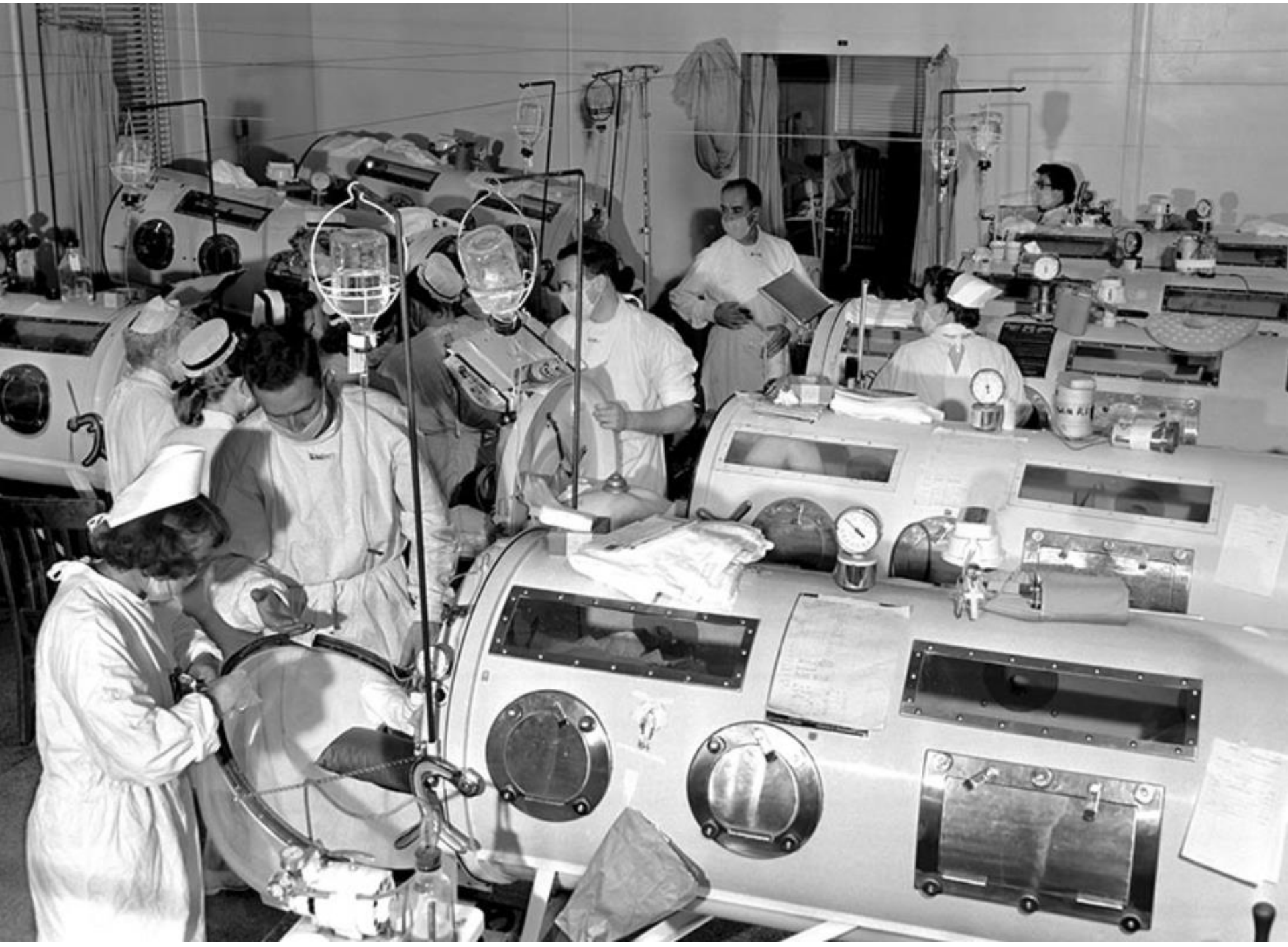
Influenza H1N1 appeared Canada in early 1918

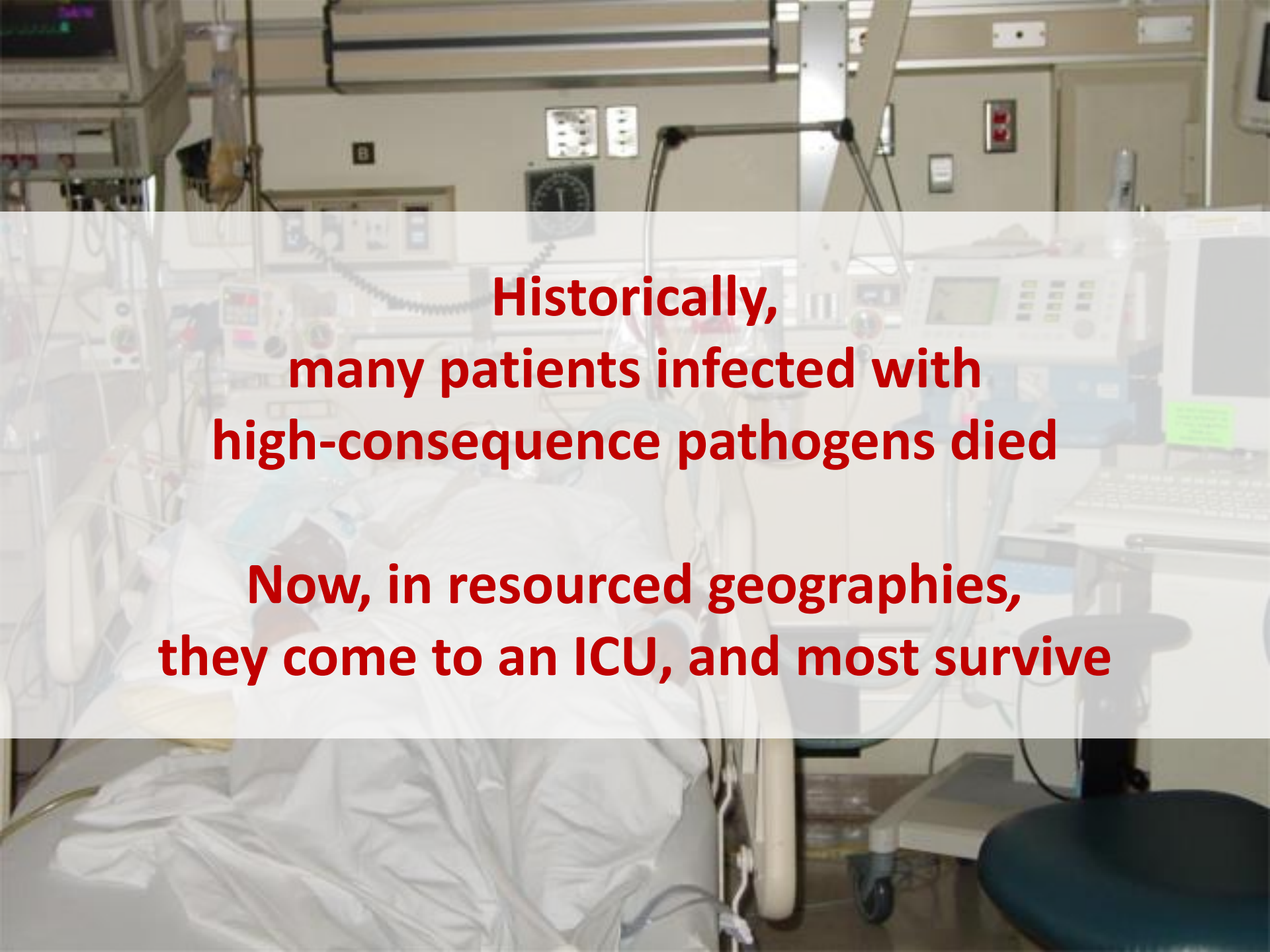
Fall of 1918, virulent strain in France, Sierra Leone and US

'*Spanish Flu*' after hit Spain in November 1918

By June 1920 approximately 50 million

(3% global population) died



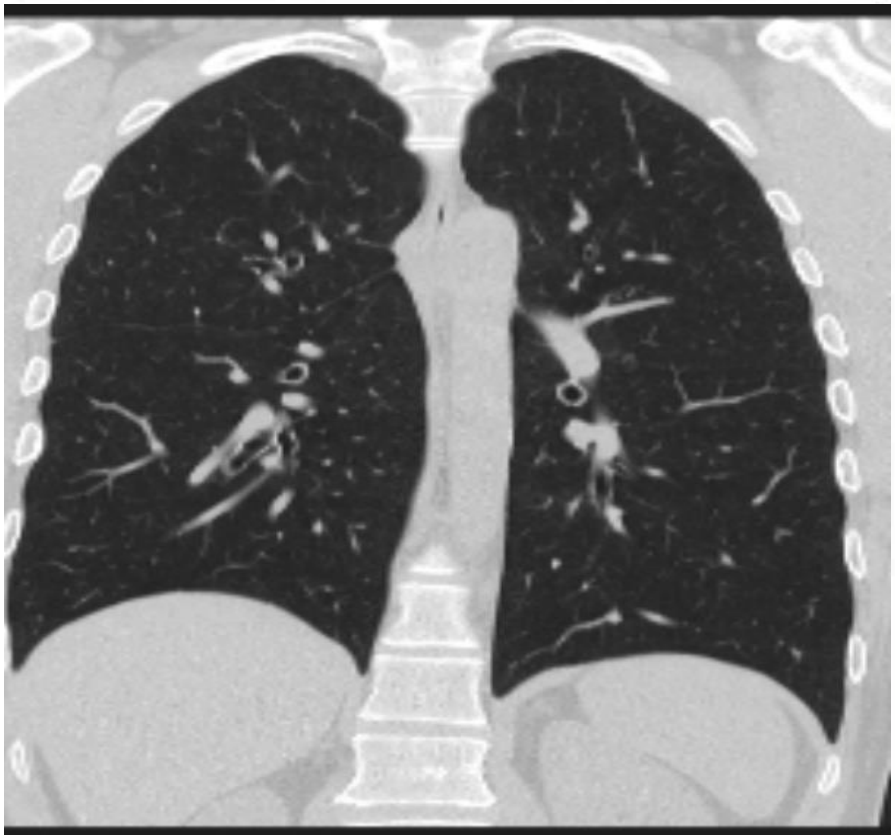


Historically,
many patients infected with
high-consequence pathogens died

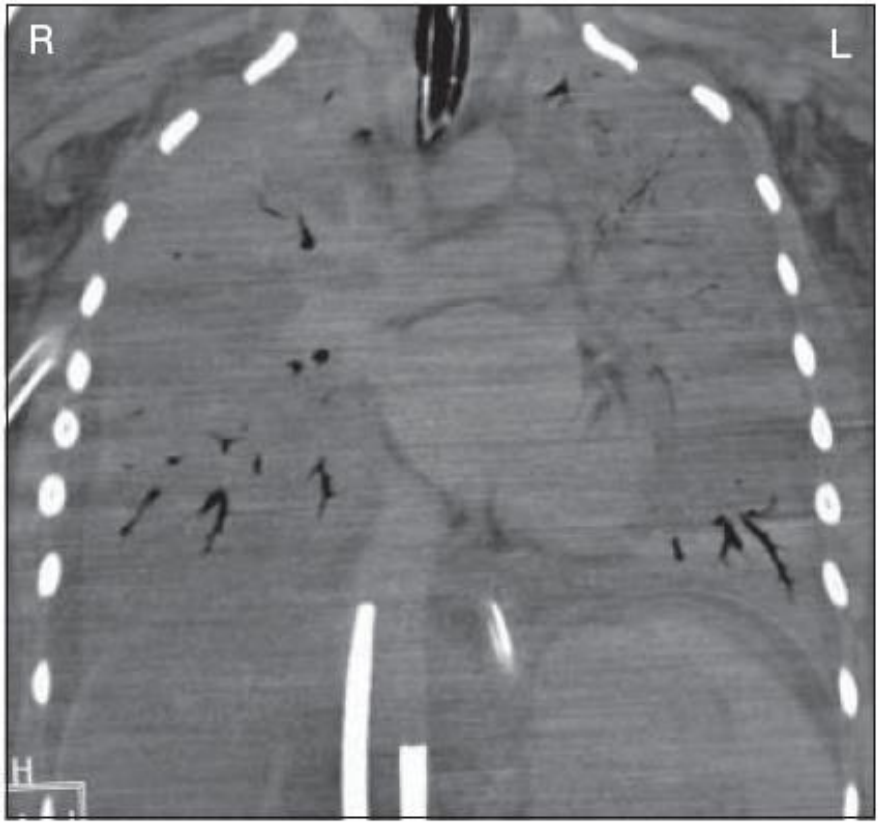
Now, in resourced geographies,
they come to an ICU, and most survive

Severe Acute Respiratory Infections

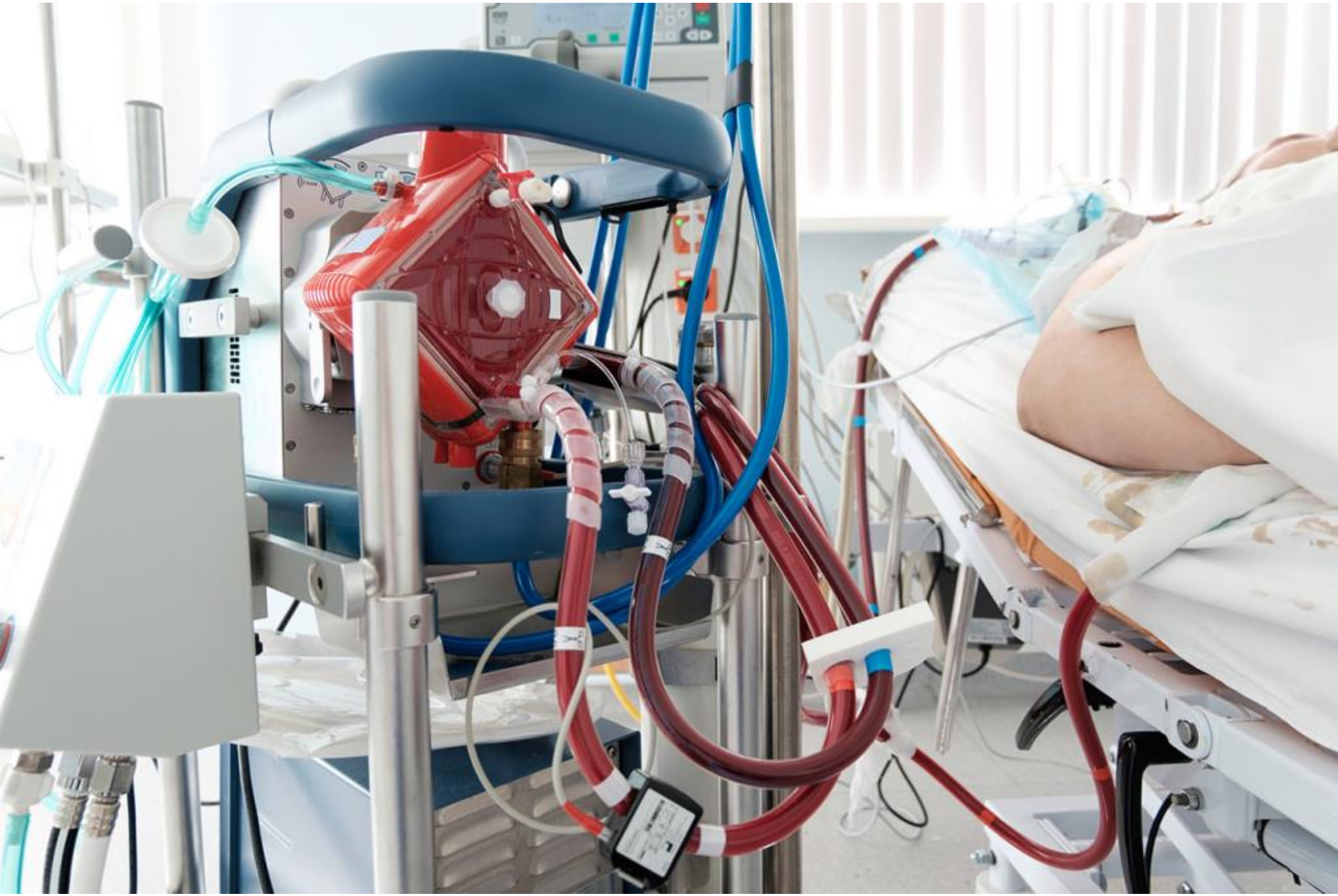
NORMAL CT SCAN



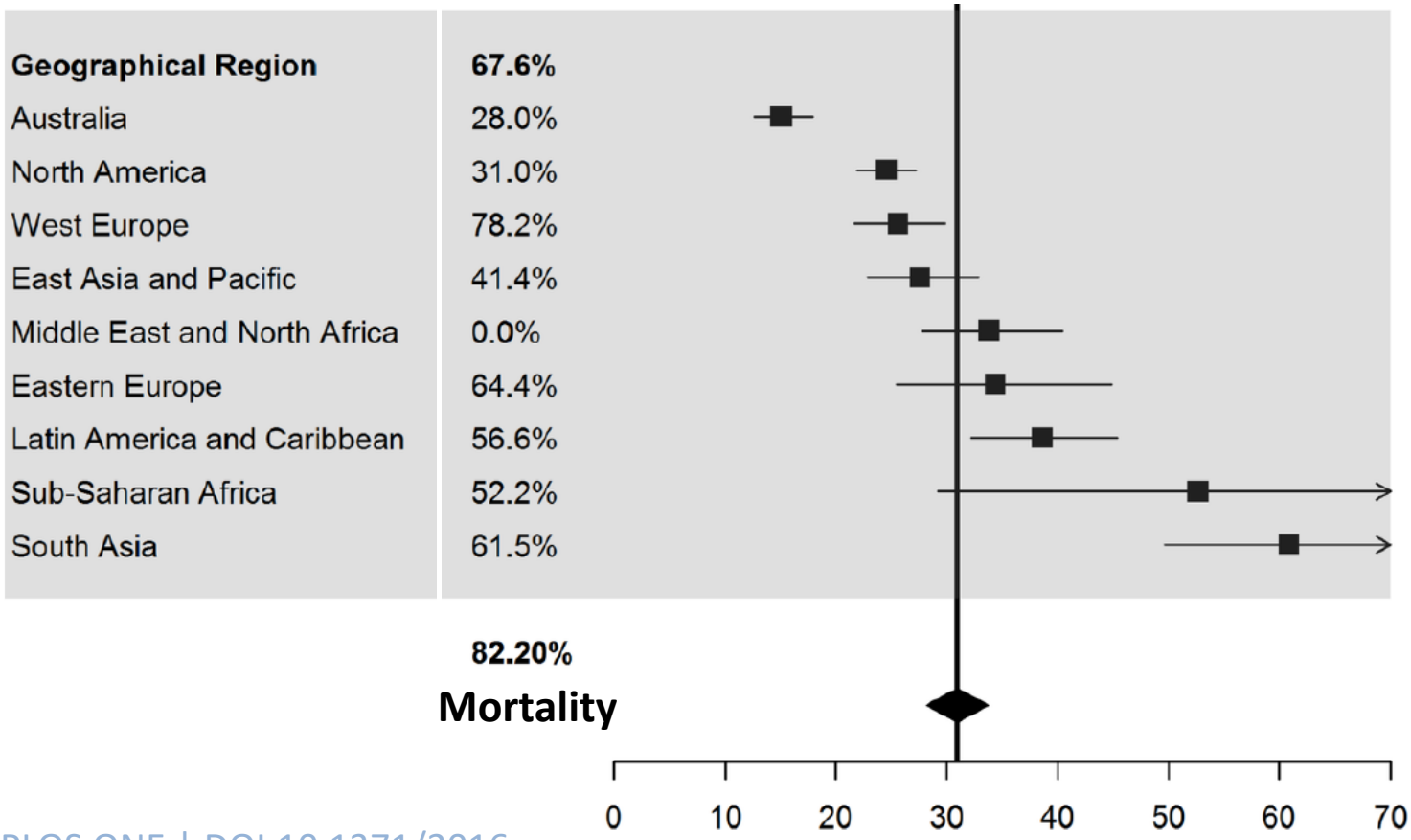
SEVERE INFLUENZA H1N1 CT SCAN



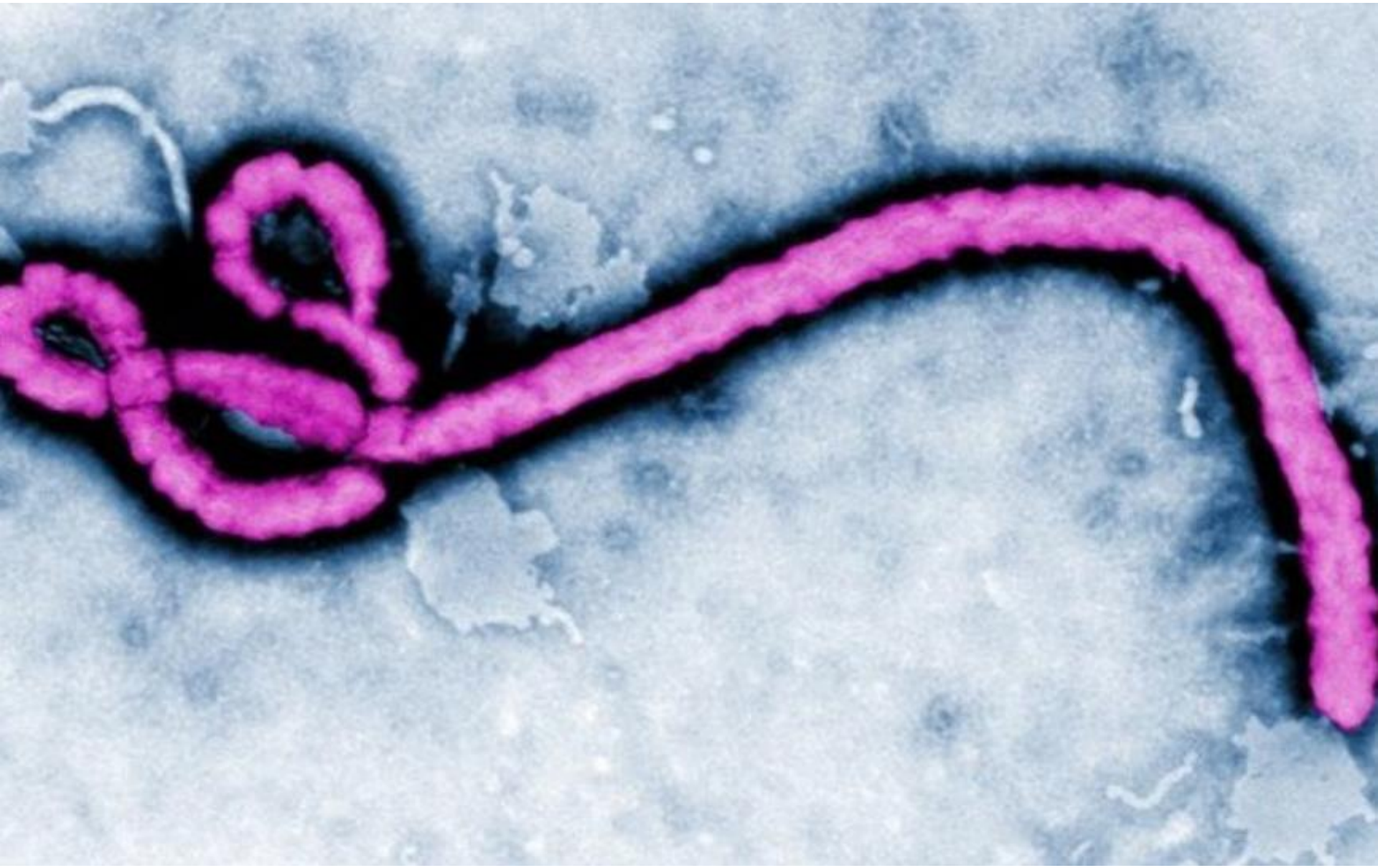
JAMA. 2009;302(17):(doi:10.1001/jama.2009.1535)



2009-2010 H1N1-related Critical Illness: Clinical Outcomes by Global Region



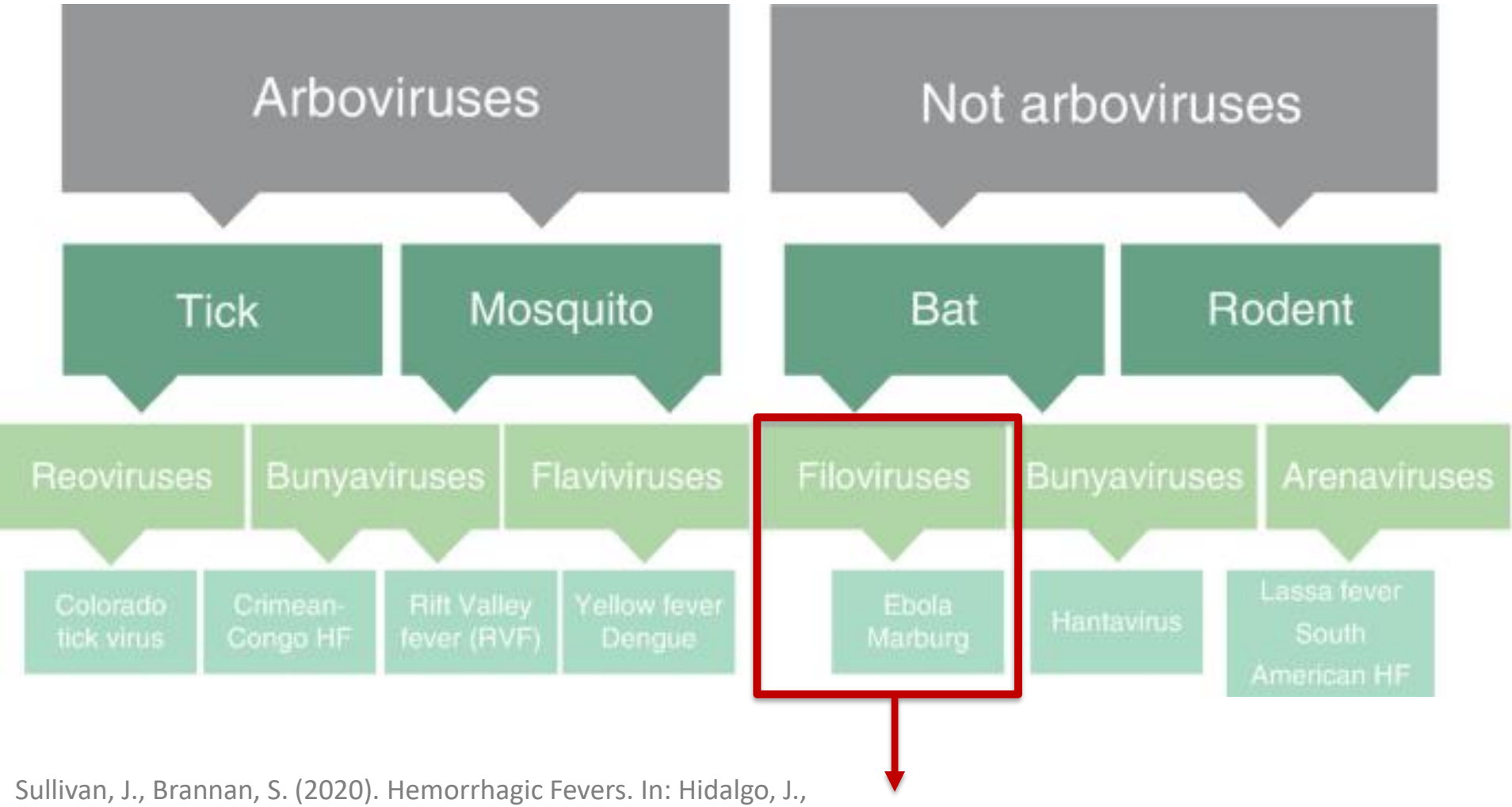
Duggal A et al PLOS ONE | DOI:10.1371/2016



World Health Organization

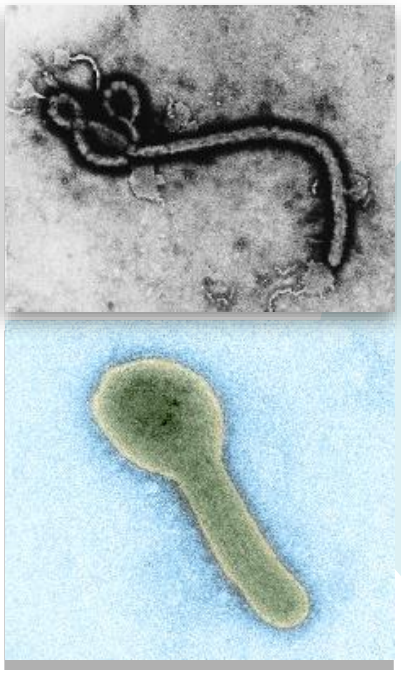

LIBERIA

Viral ‘Hemorrhagic’ Fevers



Sullivan, J., Brannan, S. (2020). Hemorrhagic Fevers. In: Hidalgo, J., Woc-Colburn, L. (eds) Highly Infectious Diseases in Critical Care. Springer, Cham. https://doi.org/10.1007/978-3-030-33803-9_7

Filovirus Disease



Filovirus family

Ebolaviruses

Zaire (EBOV)

Bundibugyo (BDBV)

Sudan (SUDV)

Reston (RESTV)*

Taï Forest (TAFV)

Bombali (BOMV)*

Marburgviruses

Marburg (MARV)

Cuevavirus *

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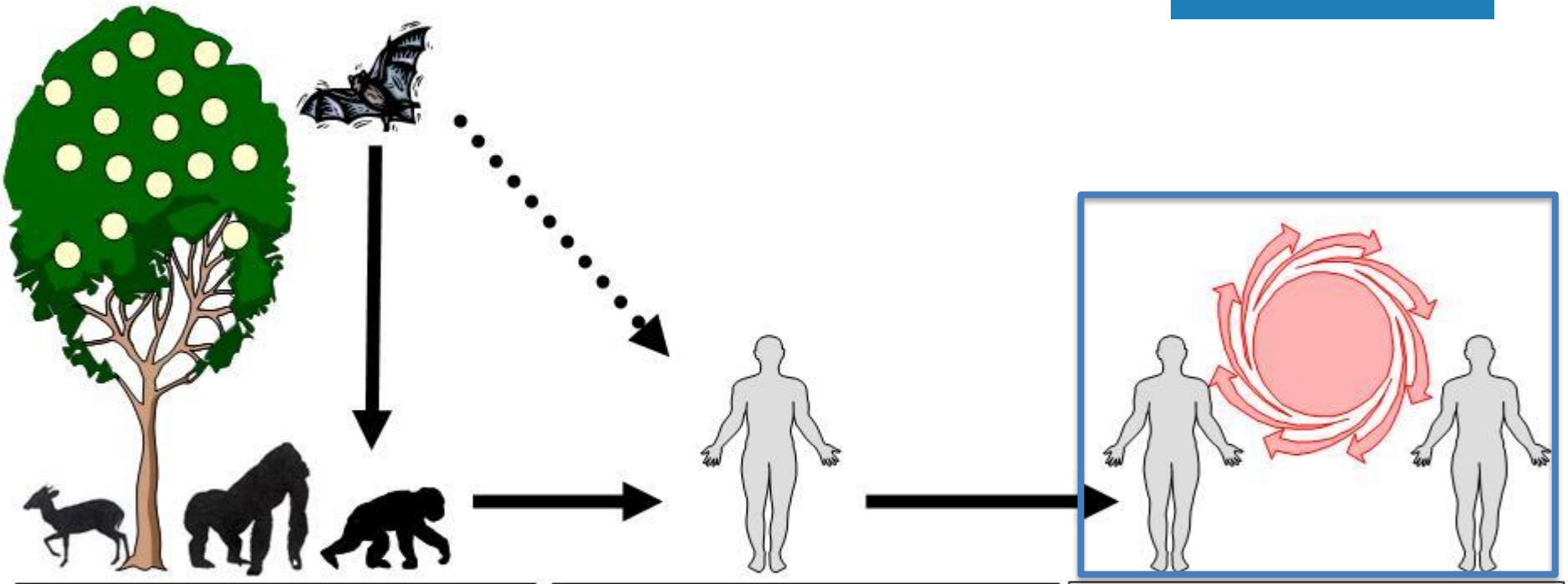
HEALTH EMERGENCIES programme

Ebola & Marburg

World Health Organization

1. Virus reservoir : Fruit bats

The virus maintains itself in fruit bats. The bats spread the virus during migration.



2. Epizootic in primates

Infected fruit bats enter in direct or indirect contact with other animals and pass on the infection, sometimes causing large-scale epidemics in gorillas, chimpanzees and other monkeys or mammals (e.g. forest antelopes).

3. Primary human infection

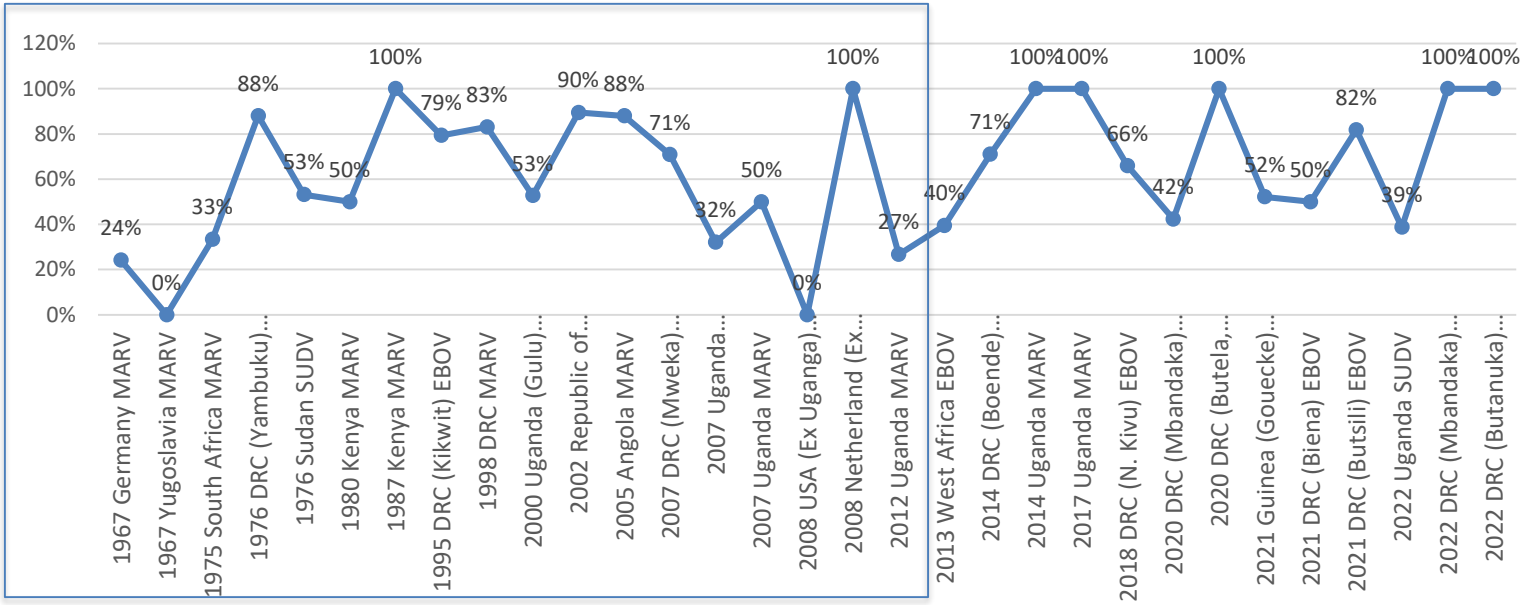
Humans are infected either through direct contact with infected bats (rare event), or through handling infected dead or sick animals found in the forest (more frequent)

4. Secondary transmission

Secondary human-to-human transmission occurs through direct contact with the blood, secretions, organs or other body fluids of infected persons. High transmission risk when providing direct patient care or handling dead bodies (funerals).

Historical Case Fatality Rates

Case fatality rates (CFR) vary across outbreaks



Median Mortality 70%*

**case-weighted across all Ebola & Marburg Outbreaks prior to 2013*

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Usual Geography of Ebola Outbreaks

Ebola Virus Disease in West Africa

Conakry, Guinea, March 2014


DR TOM
OMS/WHO
DR ROB
OMS

Ebola Virus Disease: How the illness begins

Incubation Periods

Variable	All Countries	
	no. of days	no. of patients with data
Incubation period		
Single-day exposures		
Observed†	9.4±7.4	500
Fitted‡	9.1±7.3	500
Multi-day exposures		
Observed†	11.4±NA	155
Fitted‡	9.7±5.5	155

http://www.nejm.org/doi/pdf/10.1056/NEJMoa1411100

Ebola Virus Disease – Signs, Symptoms

General **malaise**

Fever with chills

Joint pain, muscle pain, and chest pain

Nausea, diarrhea, and vomiting…leading to hypovolemia, hypo perfusion-related organ dysfunction

Occasional respiratory involvement

Occasional **bleeding**, particularly pre-terminal gastrointestinal

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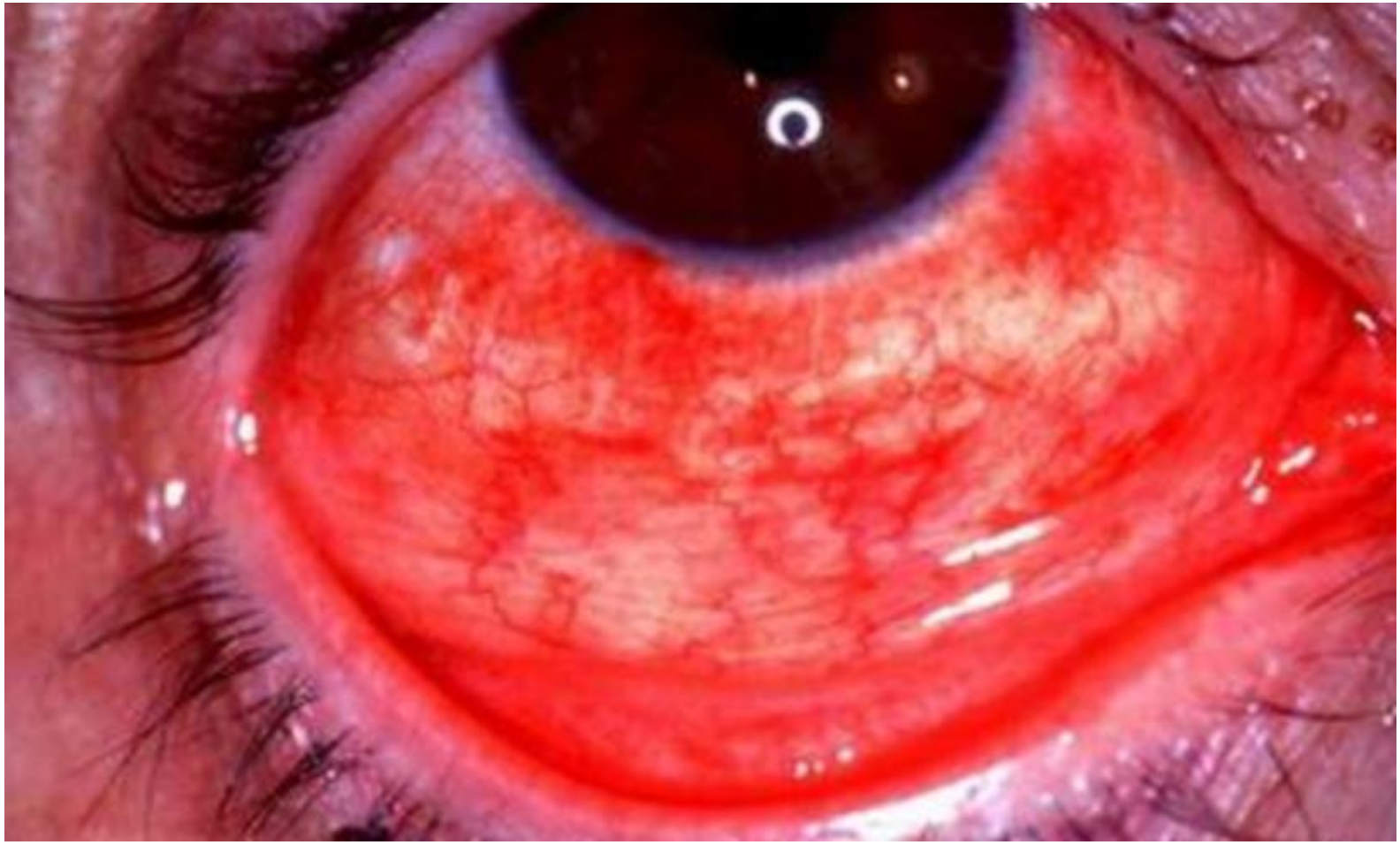
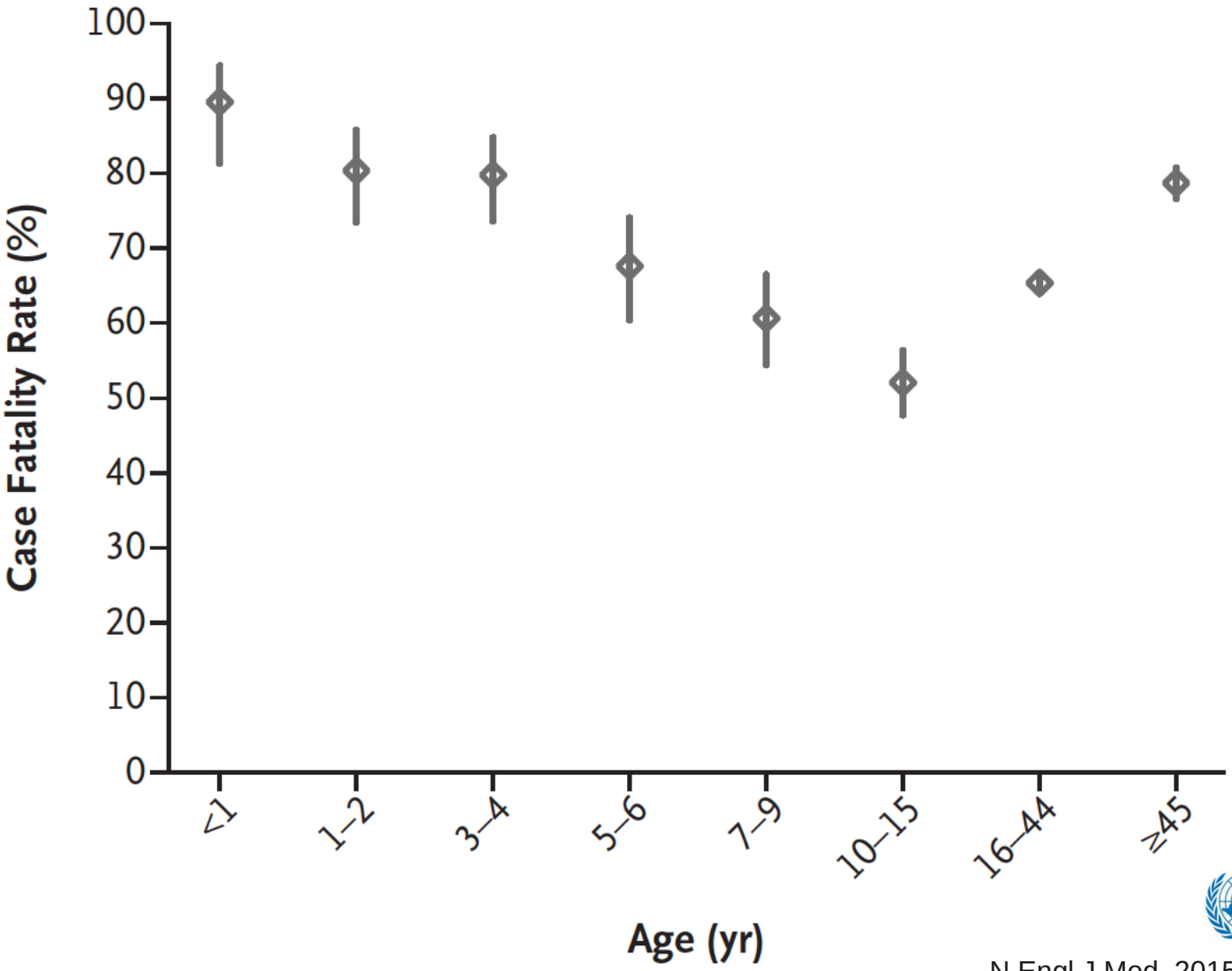
Ebola Virus Disease – Signs, Symptoms



Ebola Virus Disease – Epidemiology

Case Fatality by **Age**



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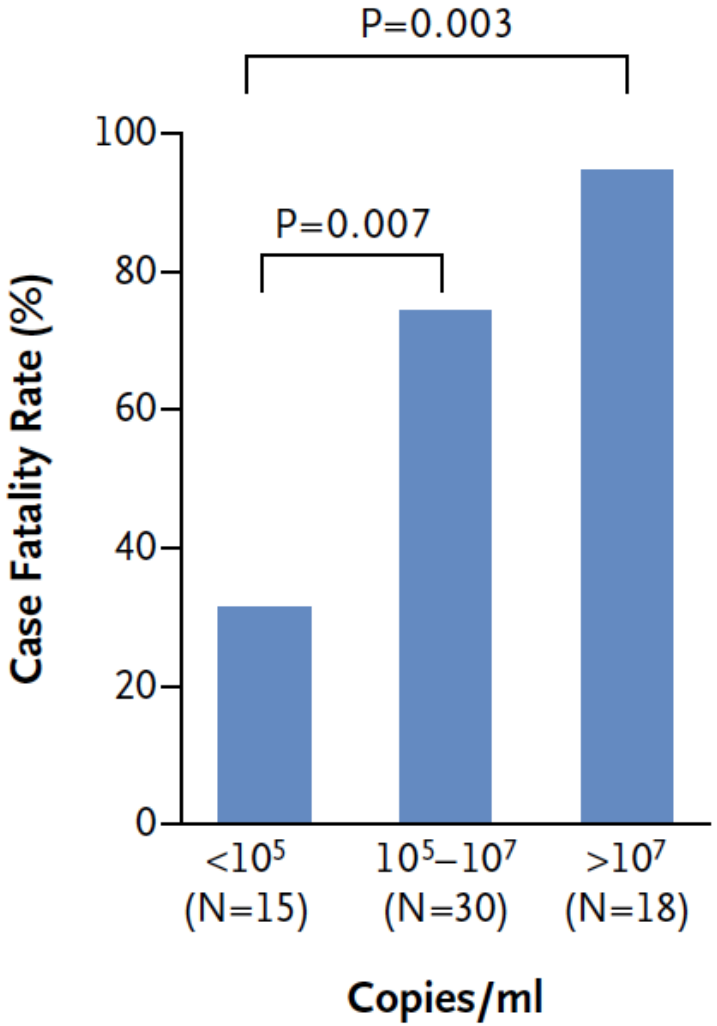
N Engl J Med. 2015;372(13):1274–77

Case Fatality Rates by Admission **Viral Load**



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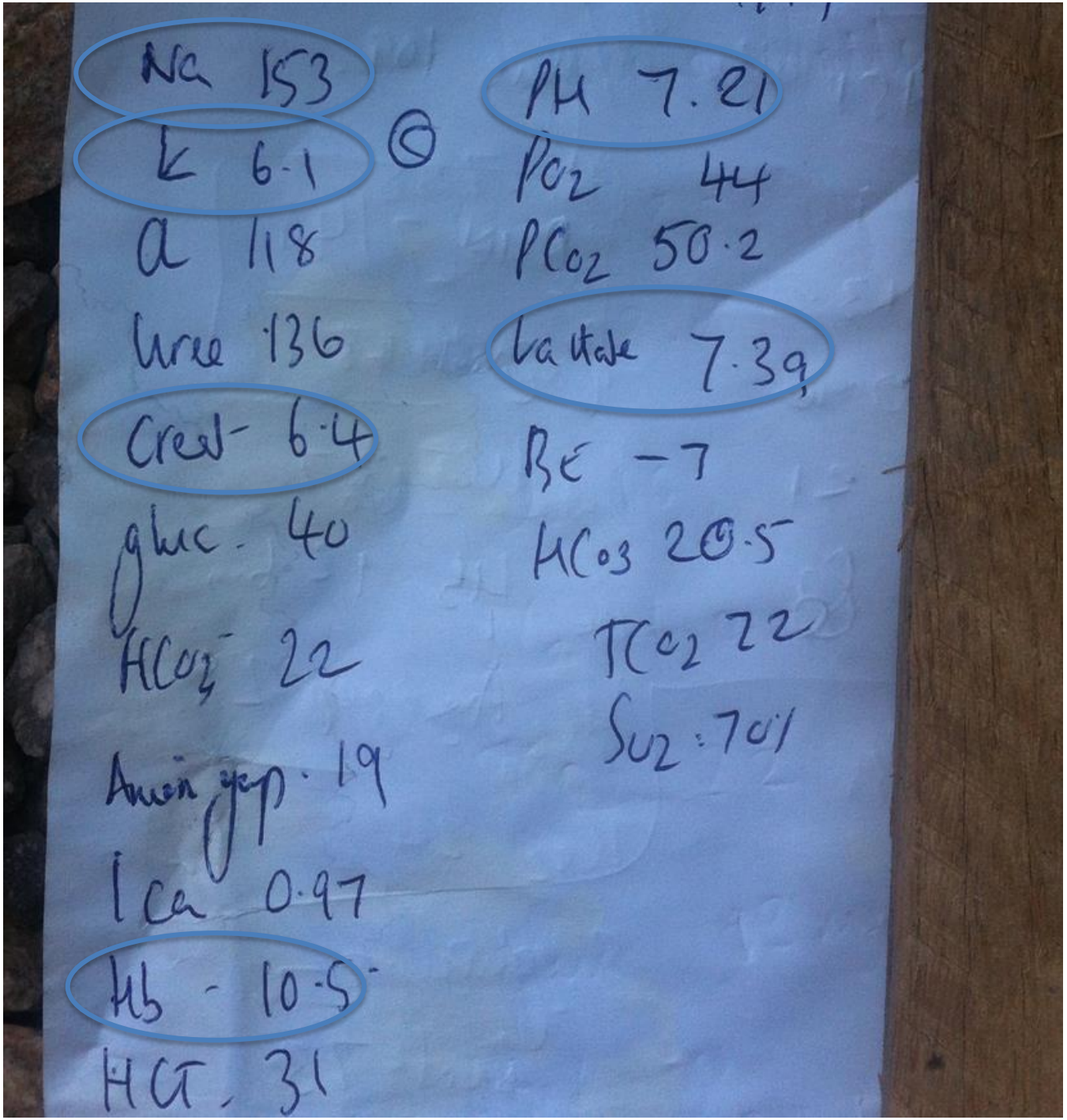
DOI: 10.1056/NEJMoa1411680

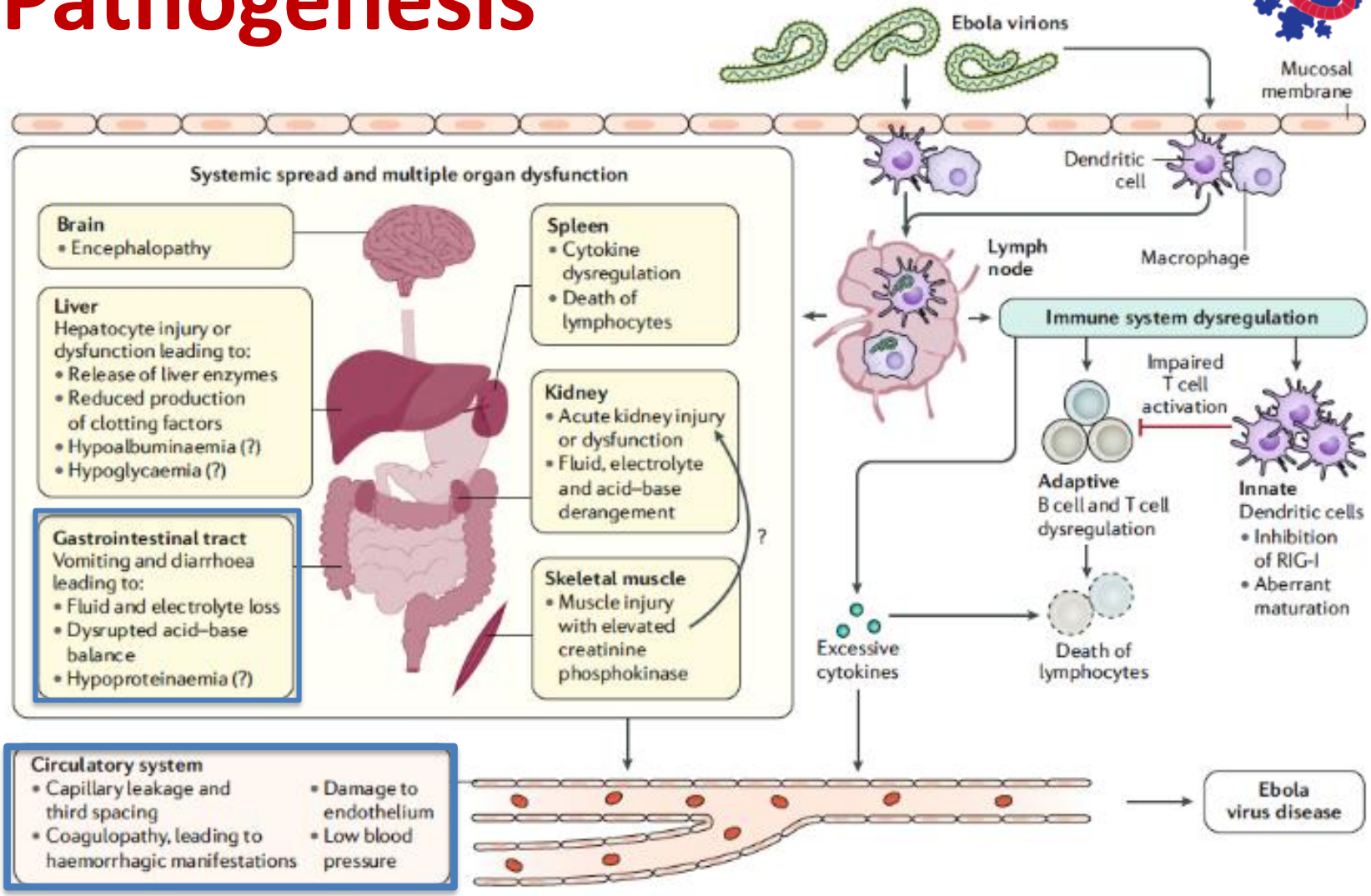
Ebola Virus Disease – Pathophysiology



Na 153
K 6·1
a 118
Urea 136
Creat 6·4
gluc 40
HCO3 22
Anion gap 19
Ica 0·97
Hb 10·5
HCT 31

pH 7.21
PO2 44
PCO2 50·2
Lactate 7·39
BE −7
HCO3 20·5
TCO2 22
SO2 70%

Pathogenesis



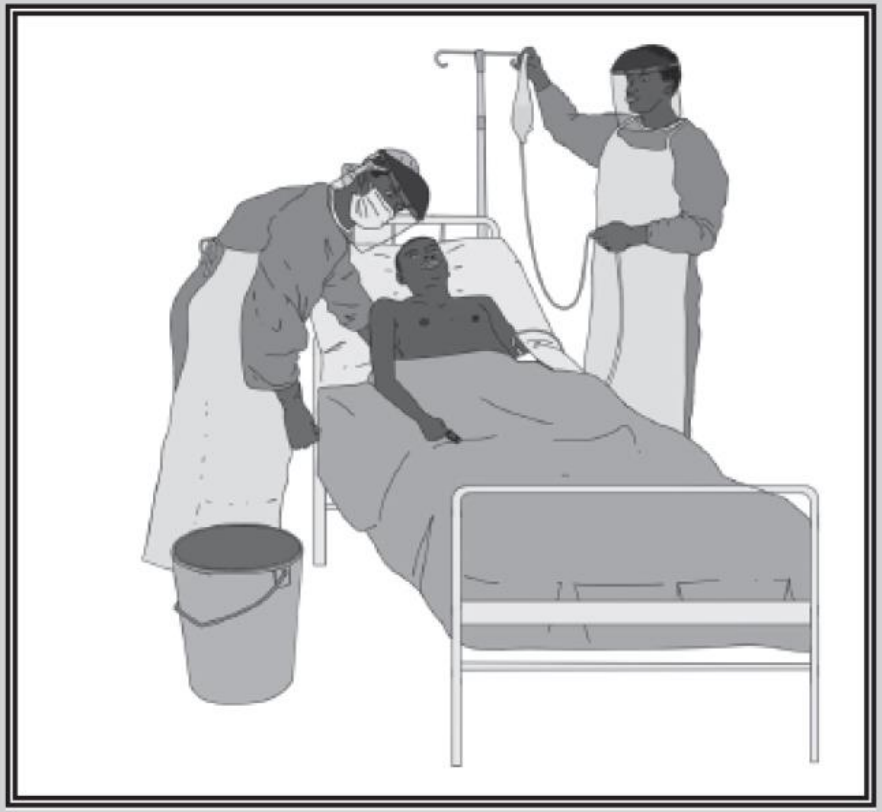
Source: Jacob ST, Crozier I, Fischer WA et al. Ebola virus disease. Nat Rev Dis Primers. 2020;6(13). https://doi.org/10.1038/s41572-020-0147-3.

Therapy

Clinical Management of Patients with Viral Haemorrhagic Fever:

A Pocket Guide for the Front-line Health Worker

30 MARCH 2014



Interim emergency guidance- generic draft
for West African adaptation

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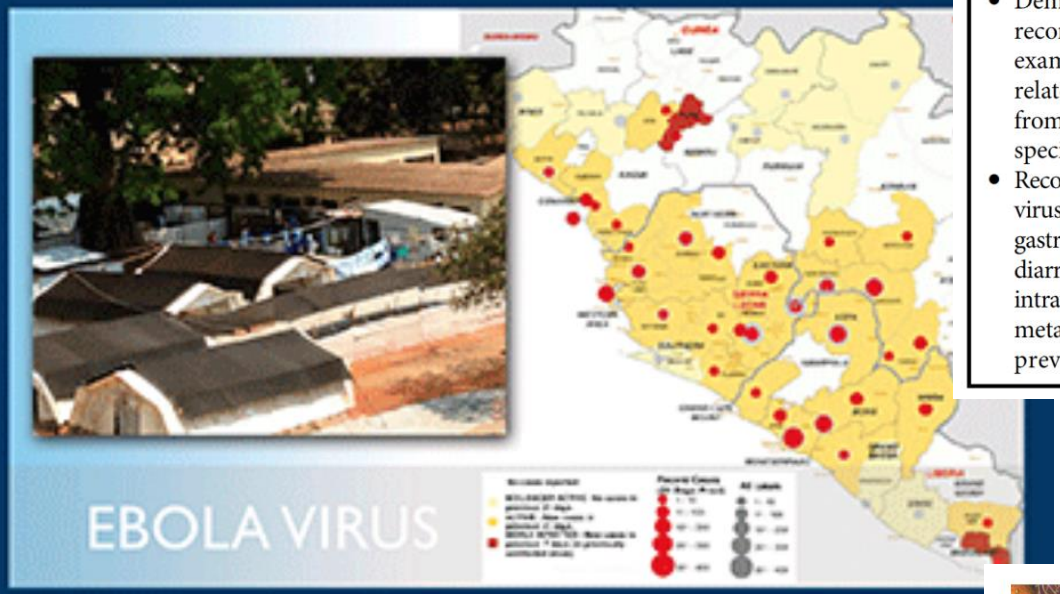

IN THIS ISSUE

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Matrix Metalloproteinase-19 Promotes Metastatic Behavior In Vivo and Is Associated with Increased Mortality in Non-Small Cell Lung Cancer (See page 780)

Long-Term Effects of Caffeine Therapy for Apnea of Prematurity on Sleep at School Age (See page 791)

Vascular Receptor Autoantibodies in Pulmonary Arterial Hypertension Associated with Systemic Sclerosis (See page 808)

CRITICAL CARE PERSPECTIVE

Caring for Critically Ill Patients with Ebola Virus Disease

Perspectives from West Africa

Robert A. Fowler[1], Thomas Fletcher[2], William A. Fischer II[3], Francois Lamontagne[4], Shevin Jacob[5], David Brett-Major[6], James V. Lawler[7], Frederique A. Jacquerioz[8], Catherine Houlihan[9], Tim O'Dempsey[2], Mauricio Ferri[10], Takuya Adachi[11], Marie-Claire Lamah[12], Elhadj Ibrahima Bah[12], Thierry Mayet[13], John Schieffelin[14], Susan L. McLellan[14], Mikiko Senga[15], Yasuyuki Kato[16,17], Christophe Clement[18], Simon Mardel[19], Rosa Constanza Vallenas Bejar De Villar[15], Nahoko Shindo[15], and Daniel Bausch[20]

How Critical Care Medicine Can Improve the Outcomes of Ebola Virus Infection

- Demystify Ebola virus disease by reconsidering it as one of the many examples of transmissible infection-related critical illnesses that benefit from goal-directed supportive and specific intensive care.
- Recognize that the predominant Ebola virus disease clinical syndrome is gastrointestinal—nausea, vomiting, and diarrhea—and can lead to profound intravascular volume depletion and metabolic abnormalities and require prevention and treatment.
- Appreciate the important role for basic biochemistry and laboratory markers to diagnose metabolic abnormalities and guide the response to therapy.
- Advocate that these therapies truly can and should be available to all patients in resource-constrained and resource-rich environments.
- Understand that the fundamental skills of critical care clinicians represent the fundamental needs of patients with Ebola virus disease.
- Anticipate that with better supportive care, the outcomes of infection will improve. ■

The NEW ENGLAND JOURNAL of MEDICINE

Perspective

Doing Today's Work Superbly Well — Treating Ebola with Current Tools

François Lamontagne, M.D., Christophe Clément, M.D., Thomas Fletcher, M.R.C.P., Shevin T. Jacob, M.D., M.P.H., William A. Fischer II, M.D., and Robert A. Fowler, M.D.C.M., M.S.(Epi)

Evidence-based guidelines for supportive care of patients with Ebola virus disease

François Lamontagne, Robert A Fowler, Neill K Adhikari, Srinivas Murthy, David M Brett-Major, Michael Jacobs, Timothy M Uyeki, Constanza Vallenas, Susan L Norris, William A Fischer 2nd, Thomas E Fletcher, Adam C Levine, Paul Reed, Daniel G Bausch, Sandy Gove, Andrew Hall, Susan Shepherd, Reed A Siemieniuk, Marie-Claude Lamah, Rashida Kamara, Phiona Nakyeyune, Moses J Soka, Ama Edwin, Afeez A Hazzan, Shevin T Jacob, Mubarak Mustafa Elkarsany, Takuya Adachi, Lynda Benhadj, Christophe Clément, Ian Crozier, Armando Garcia, Steven J Hoffman, Gordon H Guyatt

The 2013–16 Ebola virus disease outbreak in west Africa was associated with unprecedented challenges in the provision of care to patients with Ebola virus disease, including absence of pre-existing isolation and treatment facilities, patients' reluctance to present for medical care, and limitations in the provision of supportive medical care. Case fatality rates in west Africa were initially greater than 70%, but decreased with improvements in supportive care. To inform optimal care in a future outbreak of Ebola virus disease, we employed the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) methodology to develop evidence-based guidelines for the delivery of supportive care to patients admitted to Ebola treatment units. Key recommendations include administration of oral and, as necessary, intravenous hydration; systematic monitoring of vital signs and volume status; availability of key biochemical testing; adequate staffing ratios; and availability of analgesics, including opioids, for pain relief.

Lancet 2018; 391: 700–08

	Recommendation	Population	Intervention	Comparator	Outcomes	Strength of recommendation	Confidence*	Comment
1	Oral rehydration	Patients with suspected, probable, or confirmed Ebola virus disease	Administration of oral rehydration solution in adequate amount	Non-standardised rehydration	Mortality; transmission of Ebola virus to health workers	Strongly in favour	Moderate	Rating increased because of large effect size
2	Parenteral administration of fluids	Patients with suspected, probable, or confirmed Ebola virus disease who are unable to drink or who have inadequate oral intake	Parenteral administration of fluids	No parenteral administration of fluids	Mortality; transmission of Ebola virus to health workers	Strongly in favour	Moderate	Rating increased because of large effect size
3	Systematic monitoring and charting of vital signs and volume status	Patients with suspected, probable, or confirmed Ebola virus disease	Systematic frequent monitoring and charting of vital signs and volume status, at least three times per day	No monitoring and charting	Mortality; transmission of Ebola virus to health workers	Strongly[2] in favour	Low	Rating decreased because of inconsistency and indirectness
4	Serum biochemistry	Patients with suspected, probable, or confirmed Ebola virus disease	Measurement and charting of serum biochemistry (eg, electrolytes, glucose, and blood gas) with correction of abnormalities when clinically necessary	No measurement or charting of serum biochemistry or correction of abnormalities	Mortality; transmission of Ebola virus to health workers	Strongly in favour	Low	NA
5	Staffing ratio	Patients with suspected, probable, or confirmed Ebola virus disease	Higher intensity clinician care of patients, with Ebola treatment unit ratio of ≥1 clinician at the bedside per 4 patients, including the following considerations: patient assessment ≥3 times per day, continuous (24 h per day) presence of personnel inside the Ebola treatment unit to allow prompt recognition of and reaction to acute changes in condition	Appreciably lower intensity clinician care, not including elements above	Mortality; transmission of Ebola virus to health workers	Strongly in favour	Moderate	Rating increased because of evidence of a dose-response in observational data
6	Communication with family and friends	Patients with suspected, probable, or confirmed Ebola virus disease	Facilitating communication with family and friends while isolated in the Ebola treatment unit	Not facilitating communication with family and friends while isolated in the Ebola treatment unit	Psychological distress; Ebola virus transmission to family and friends	Conditionally in favour	Low	NA
7	Analgesic therapy	Patients with suspected, probable, or confirmed Ebola virus disease who are in pain	Use of analgesic therapy sufficient to control pain, including parenteral opioids if necessary	No pain medication	Pain; adverse effects of analgesic medications	Strongly in favour	High	NA
8	Antibiotics	Patients with suspected, probable, or confirmed Ebola virus disease with high severity of illness	Prompt administration of broad-spectrum antibiotics	No administration of broad-spectrum antibiotics	Mortality; transmission of Ebola virus to health workers; adverse effects of antibiotics; antibiotic resistance	Strongly in favour	Moderate	Rating increased because of large effect but decreased for indirectness

	Recommendation	Population	Intervention	Comparator	Outcomes	Strength of recommendation	Confidence*	Comment
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2	Parenteral administration of fluids	Patients with suspected, probable, or confirmed Ebola virus disease who are unable to drink or who have inadequate oral intake	Parenteral administration of fluids	No parenteral administration of fluids	Mortality; transmission of Ebola virus to health workers	Strongly in favour	Moderate	Rating increased because of large effect size
3	Systematic monitoring and charting of vital signs and volume status	Patients with suspected, probable, or confirmed Ebola virus disease	Monitoring and charting of vital signs and volume status, at least three times per day	No monitoring and charting	Mortality; transmission of Ebola virus to health workers	Strongly in favour	Low	Rating decreased because of inconsistency and indirectness
4	Serum biochemistry	Patients with suspected, probable, or confirmed Ebola virus disease	Measurement and charting of serum biochemistry (eg, electrolytes, glucose, renal function, liver function) and correction of abnormalities when clinically necessary	No measurement or charting of serum biochemistry and correction of abnormalities	Mortality; transmission of Ebola virus to health workers	Strongly in favour	Low	NA
5	Staffing	Patients with suspected, probable, or confirmed Ebola virus disease	Staffing ratio of ≥1 clinician at the bedside per 4 patients, including the following: ≥3 times per day, continuous (≥8 h per day) presence of personnel inside the Ebola treatment unit to respond to acute changes in condition	Staffing ratio of <1 clinician at the bedside per 4 patients, or less frequent presence of personnel inside the Ebola treatment unit to respond to acute changes in condition	Mortality; transmission of Ebola virus to health workers	Strongly in favour	Moderate	Rating increased because of evidence of a dose-response in observational data
6	Communication with family and friends	Patients with suspected, probable, or confirmed Ebola virus disease	Facilitating communication with family and friends isolated in the Ebola treatment unit	Not facilitating communication with family and friends while isolated in the Ebola treatment unit	Psychological distress; Ebola virus transmission to family and friends	Conditionally in favour	Low	NA
7	Analgesic therapy	Patients with suspected, probable, or confirmed Ebola virus disease who are in pain	Use of analgesic therapy sufficient to control pain, including parenteral opioids if necessary	No pain medication	Pain; adverse effects of analgesic medications	Strongly in favour	High	NA
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1. Oral **rehydration**
2. IV **fluids**
3. Systematic **monitoring** of vital signs & volume
4. Serum **biochemistry** and hematology
5. Appropriate **staffing** ratios
6. **Communication** with family and friends
7. **Analgesic** therapy
8. **Antibiotics & antimalarials** as indicated

Lancet 2018; 391: 700–08

World Health Organization

MEDECINS SANS FRONTIERES

ORIGINAL ARTICLE

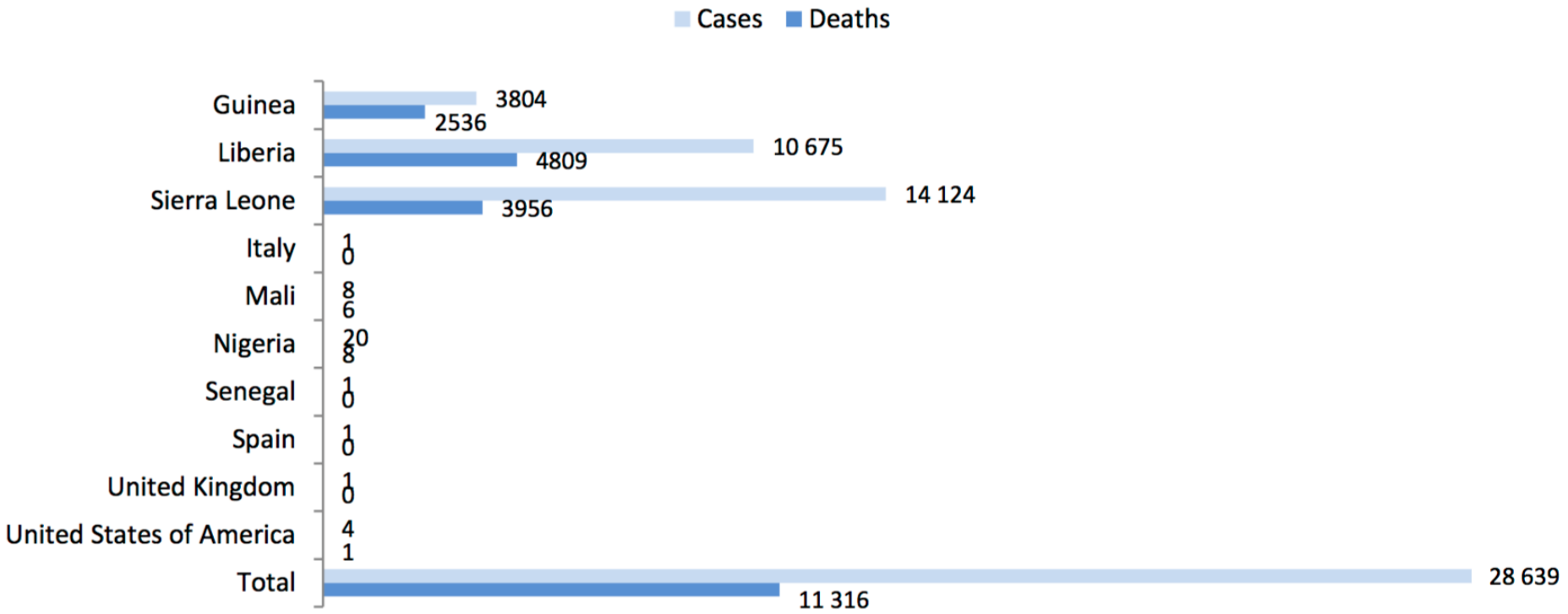
Clinical Presentation of Patients with Ebola Virus Disease in Conakry, Guinea

Elhadj Ibrahima Bah, M.D., Marie-Claire Lamah, M.D., Tom Fletcher, M.R.C.P., Shevin T. Jacob, M.D., M.P.H., David M. Brett-Major, M.D., M.P.H., Amadou Alpha Sall, Ph.D., Nahoko Shindo, M.D., Ph.D., William A. Fischer II, M.D., Francois Lamontagne, M.D., Sow Mamadou Saliou, M.D., Daniel G. Bausch, M.D., M.P.H.&T.M., Barry Moumié, M.D., Tim Jagatic, M.D., Armand Sprecher, M.D., James V. Lawler, M.D., M.P.H., Thierry Mayet, M.D., Frederique A. Jacquerioz, M.D., María F. Méndez Baggi, M.D., Constanza Vallenas, M.D., Christophe Clement, M.D., Simon Mardel, M.D., Ousmane Faye, Ph.D., Oumar Faye, Ph.D., Baré Soropogui, Pharm.D., Nfaly Magassouba, D.V.M., Ph.D., Lamine Koivogui, Pharm.D., Ph.D., Ruxandra Pinto, Ph.D., and Robert A. Fowler, M.D.C.M.

CONCLUSIONS

Patients with EVD presented with evidence of dehydration associated with vomiting and severe diarrhea. Despite attempts at volume repletion, antimicrobial therapy, and limited laboratory services, the rate of death was 43%.

West Africa Ebola Outbreak (‘13-’16)



Cumulative Mortality 39.5%

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CORRESPONDENCE

Ebola in Freetown Area, Sierra Leone — A Case Study of 581 Patients

N Engl J Med 2015; 372:587-588 | February 5, 2015 | DOI: 10.1056/NEJMc1413685

"We have observed a decreasing case fatality rate among inpatients at Hastings,

- **47.7%** for the first 151 patients (Sept 20 –Oct 13)
- **31.7%** for the next 126 patients (Oct 14 - Nov 4)
- **23.4%** for the next 304 patients (Nov 5 – Dec 7)"

What Are the Limits of Increased Levels of Care?


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Ebola virus disease and critical illness

patients

Aleksandra Leligdowicz[1], William A. Fischer II[2], Timothy M. Uyeki[3], Thomas E. Fletcher[4,5], Neill K. J. Adhikari[1,6], Gina Portella[7], Francois Lamontagne[8], Christophe Clement[9], Shevin T. Jacob[10], Lewis Rubinson[11], Abel Vanderschuren[12], Jan Hajek[13], Srinivas Murthy[14], Mauricio Ferri, Ian Crozier[15], Elhadj Ibrahima[16], Marie-Claire Lamah[16], John S. Schieffelin[17], David Brett-Major[18], Daniel G. Bausch[19], Nikki Shindo[19], Adrienne K. Chan[20], Tim O'Dempsey[21], Sharmistha Mishra[22], Michael Jacobs[23], Stuart Dickson[24], G. Marshall Lyon III[25] and Robert A. Fowler[1,6*]

	All	Survived	Died
Treated outside West Africa	27	22 (81.5 %)	5 (18.5 %)
Gender[a] (male)	17 (68 %)	12 (60 %)	5 (100 %)
Median age[b] (range)	40.5 (25–75)	36 (25–59)	56 (42–75)
Mean hospital length of stay (days, confidence interval)	19 (±11.5)	22 (±10.2)	5 (±2.4)
Evacuated from West Africa	20 (74 %)	16 (80 %)	4 (20 %)
Infected outside West Africa	3 (11 %)	3 (100 %)	0

Outcome
Survived
Survived
Died
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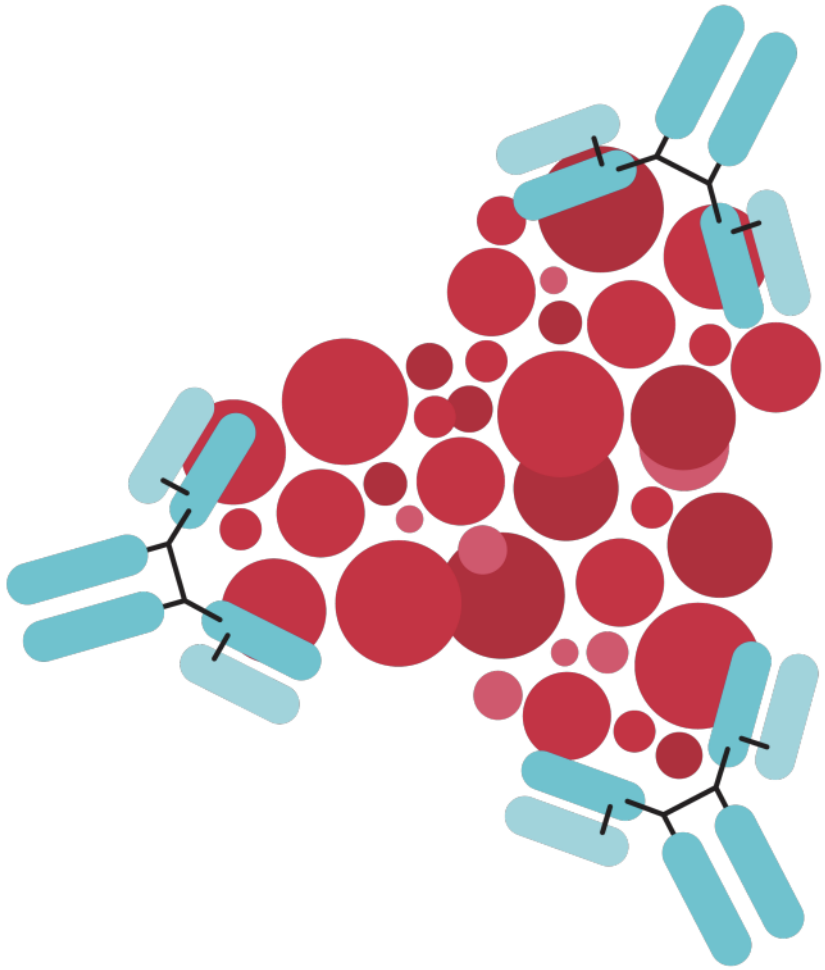
Leligdowicz *et al. Critical Care* (2016) 20:217
DOI 10.1186/s13054-016-1325-2


Kerrytown, SIERRA LEONE
UK Ministry of Defense
Treatment Centre, Dec 2014

Courtesy of Prof Antonio Pesenti & Dr. Gino Strada

Targeted



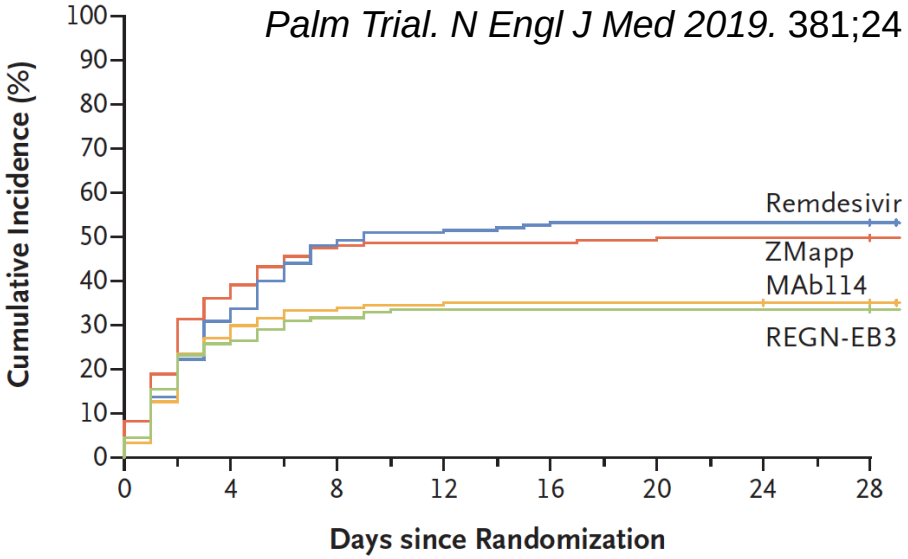
Therapeutics for Ebola virus disease

19 August 2022

Co-Chairs: Richard Kojan (ALIMA, Democratic Republic of the Congo); Robert Fowler (University of Toronto)

World Health Organization

Mulangu S, Dodd L, Davey R et al Palm Trial. N Engl J Med 2019. 381;24



No. at Risk

ZMapp	169	137	108	96	89	87	87	87	87	86	86	85	85	85	85
Remdesivir	175	151	121	105	91	86	86	85	83	82	82	82	82	82	82
MAb114	174	152	127	119	116	114	114	113	113	113	113	113	113	112	112
REGN-EB3	155	131	115	110	106	104	103	103	103	103	103	103	103	103	103

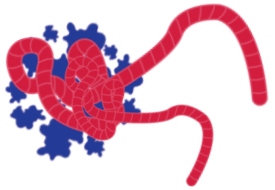
Mortality with specific ab Rx

MAb114	**35.1%**
REGN-EB3	**33.5%**

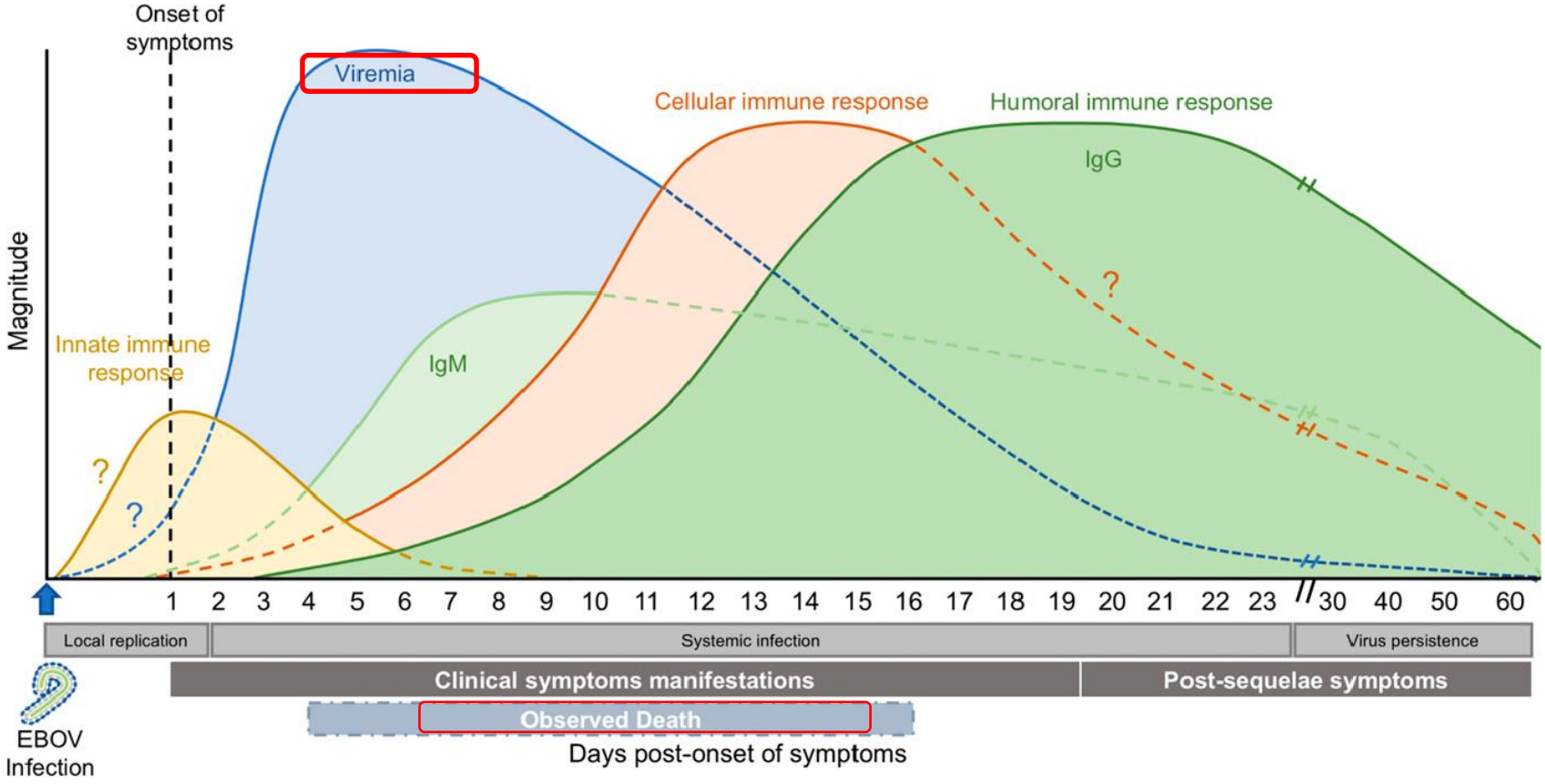
ZMapp	49.7%
Remdesivir	53.1%

Vaccination

Immune responses to EBOV/SUDV infection



Schematic representation of EBOV/SUDV /BDDV infection and the evolution of the immune response in human survivors



World Health Organization

HEALTH EMERGENCIES programme


Ebola Zaire vaccine (rVSVΔG-ZEBOV-GP, live attenuated). Titer ≥ 5x10^7 pfu/mL/ vaccin vivant atténué contre le virus Ebola-Zaire (rVSVΔG-ZEBOV-GP), titre ≥ 5x10^7 pfu/mL
10 Dose Vial, 1.0 mL Dose/ Flacon contenant 10 doses, dose de 1.0 mL
Sterile Solution for I.M. Injection./ solution stérile pour injection I.M.
Protocol/Protocole N° V920
Administer as directed
Store at ≤ -60°C
Protect from light.
Administrer selon les instructions.
À conserver à ≤ -60°C
Protéger de la lumière.
Manufacture Date/ Date de fabrication :
09Mar2016

ORIGINAL ARTICLE

Randomized Trial of Vaccines for Zaire Ebola Virus Disease

Author: PREVAC Study Team* Author Info & Affiliations

Published December 14, 2022 | N Engl J Med 2022;387:2411-2424 | DOI: 10.1056/NEJMoa2200072

Two randomized, placebo-controlled trials:

- one involving adults
- one involving children

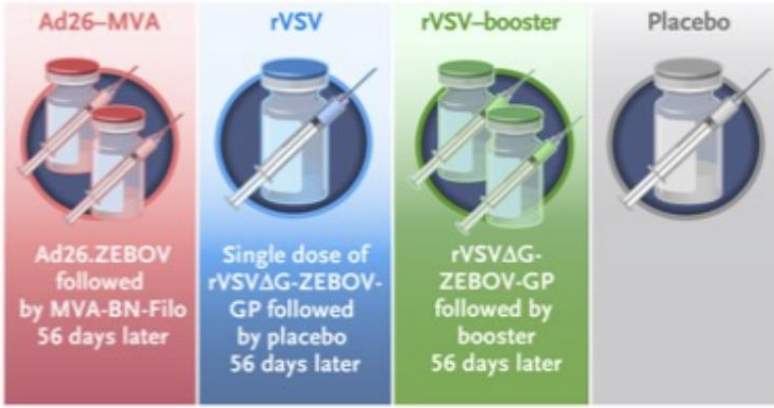
To evaluate the safety and immune responses of vaccine regimens against Ebola virus disease:

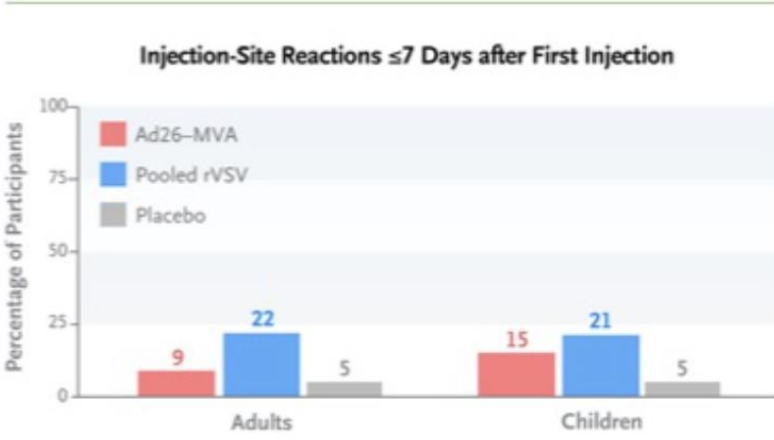
1. Ad26.ZEBOV followed by MVA-BN-Filo
2. rVSVΔG-ZEBOV-GP followed by placebo
3. rVSVΔG-ZEBOV-GP followed by rVSVΔG-ZEBOV-GP

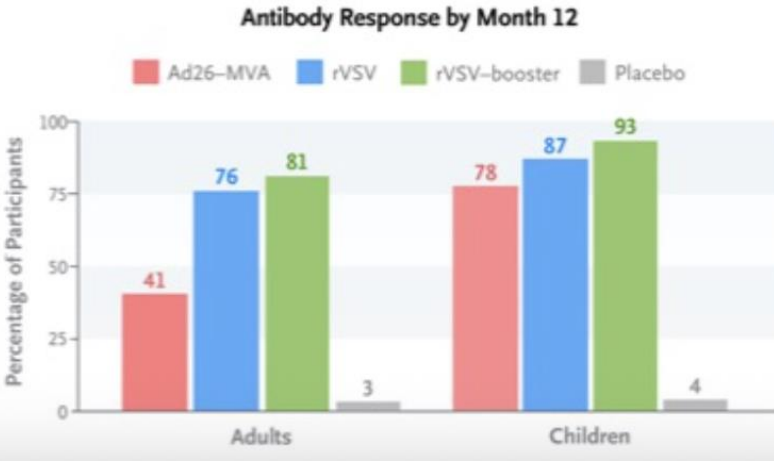
1400 adults and 1401 children randomized.

No safety concerns were identified.

All three vaccine regimens, immune responses were seen from day 14 through month 12.







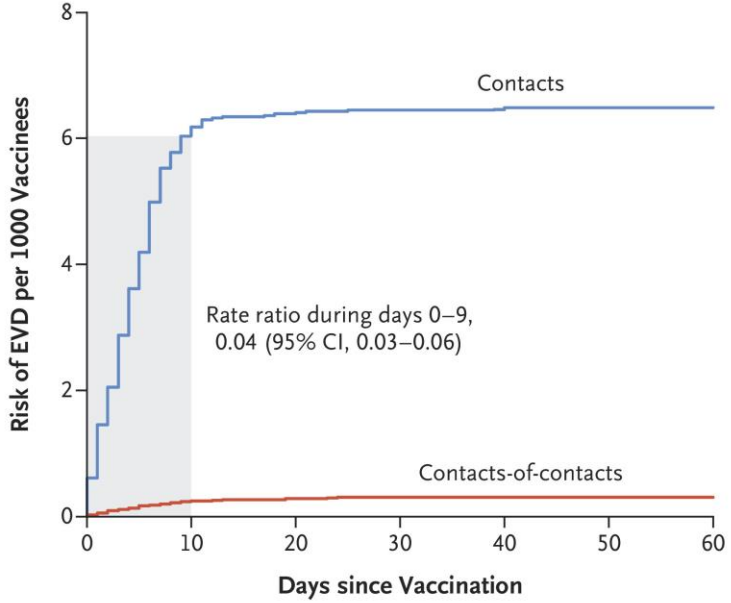
ORIGINAL ARTICLE

Ebola Outbreak Response in the DRC with rVSV-ZEBOV-GP Ring Vaccination

Authors: Jean-Jacques Muyembe, M.D., Ph.D., Hongchao Pan, Ph.D., Richard Peto, F.R.S., Abdourahamane Diallo, M.D., Alhassane Touré, M.D., Placide Mbala-Kingebene, M.D., Stéphane H. Bateyi Mustafa, M.D., +16 , for the Ebola Ring Vaccination Team in the DRC Author Info & Affiliations

Published December 18, 2024 | N Engl J Med 2024;391:2327-2336 | DOI: 10.1056/NEJMoa1904387

- 2018–2020 Ebola outbreak in **DRC**
- **265,183 were vaccinated** with **one dose of rVSV-ZEBOV-GP**
- Among **contacts & contacts-of-contacts:**
  - 434 cases of EVD (0.2 per ring) were diagnosed, almost all within 0 to 9 days (380 cases) or 10 to 29 days (32 cases) after vaccination.
  - EVD onset during days 10 to 29 was 0.16 per 1000, much lower than prior vaccinations
- No safety concerns were identified.



No. Vaccinated

Contacts	57,563
Contacts-of-contacts	136,836

No. with Onset of EVD	Days 0–9	Days 10–29	Day 30 or later
Contacts	347	24	9
Contacts-of-contacts	33	8	13

ORIGINAL ARTICLE

A Randomized, Controlled Trial of Ebola Virus Disease Therapeutics

Authors: Sabue Mulangu, M.D., Lori E. Dodd, Ph.D., Richard T. Davey, Jr., M.D., Olivier Tshiani Mbaya, M.D., Michael Proschan, Ph.D., Daniel Mukadi, M.D., Mariano Lusakibanza Manzo, Ph.D., +10 , for the PALM Consortium Study Team* Author Info & Affiliations

Published November 27, 2019 | N Engl J Med 2019;381:2293-2303 | DOI: 10.1056/NEJMoa1910993

Multivariable Logistic Regression for death at 28 Days - *Patients with Ebola*

	Variable	Odds Ratio (95% CI)
	Assignment to remdesivir vs. ZMapp	0.99 (0.46–2.14)
*	Assignment to MAb114 vs. ZMapp	0.24 (0.10–0.61)
*	Assignment to REGN-EB3 vs. ZMapp	0.21 (0.08–0.53)
	Duration of symptoms before admission to treatment center, per each additional day	1.12 (1.00–1.24)
	Baseline nucleoprotein Ct value per 1-unit increase	0.67 (0.59–0.76)
	Years of age per 1 yr increase	1.02 (1.00–1.04)
	Creatinine level per 1 mg/dl increase	1.36 (1.18–1.58)
	AST level per 100 U/liter increase	1.00 (0.92–1.07)
	ALT level per 100 U/liter increase	0.96 (0.79–1.17)
	Patient-reported vaccination, yes vs. no	0.47 (0.21–1.01)

Healthcare Worker Environmental Challenges

viruses

MDPI

Article

Establishing Healthcare Worker Performance and Safety in Providing Critical Care for Patients in a Simulated Ebola Treatment Unit: Non-Randomized Pilot Study

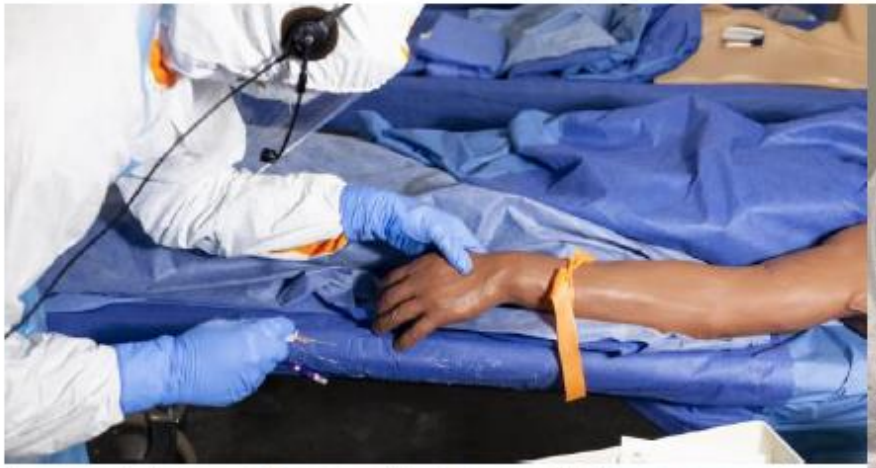
Peter Kiiza [1], Sarah I. Mullin [2], Koren Teo [3], Len Goodman [4], Adic Perez [1], Ruxandra Pinto [1], Kelly Thompson [5], Dominique Piquette [6], Trevor Hall [7], Elhadj I. Bah [8], Michael Christian [9], Jan J. Hajek [10], Raymond Kao [11], François Lamontagne [12], John C. Marshall [13], Sharmistha Mishra [14], Srinivas Murthy [15], Abel Vanderschuren [16], Robert A. Fowler [17,*] and Neill K. J. Adhikari [17,*]

- Designed a **simulated Ebola Treatment Unit**
  - Assess **performance** and **safety** of healthcare workers
  - Wearing **personal protective equipment**
    - Peripheral IV insertion
    - Midline/central IV insertion
    - Endotracheal intubation
  - **Hot** (35 C, 60% relative humidity) vs
  - **Thermo-neutral** (20 C, 20% relative humidity) conditions.

DRDC RDDC

CIHR IRSC Institute of Circulatory and Respiratory Health / Institut de la santé circulatoire et respiratoire

Establishing Healthcare Worker Performance and Safety in Providing Critical Care for Patients in a Simulated Ebola Treatment Unit: a Pilot Trial



Viruses 2021, 13, 2205

Establishing Healthcare Worker Performance and Safety in Providing Critical Care for Patients in a Simulated Ebola Treatment Unit: a Pilot Trial

Participant task completion times

	Total Time in Chamber (n = 18)	PIV Catheter (n = 18)	Midline Catheter (n = 17)	Endotracheal Intubation (n = 17)
All	68.5 (10.3)	15.7 (5.7)	33.3 (4.9)	15.6 (7.9)
Hot conditions (n = 10)	69.7 (9.5)	18.0 (4.9)	35.2 (3.3)	14.0 (5.3)
Thermo-neutral conditions (n = 8)	67.0 (11.9)	12.9 (5.8)	31.3 (5.7)	17.4 (10.2)
Nurses (n = 5)	65.6 (8.3)	13.9 (3.9)	33.4 (4.4)	13.1 (2.2)
Physicians (n = 13)	69.6 (11.1)	16.5 (6.3)	33.3 (5.3)	16.6 (9.2)

[1] All times are in minutes (mean (SD)).

Tasks Generally Took Longer in Hot & Humid Conditions

Health-assessment triggers, minor breaches, and near-miss incidents

Type of Event	Condition	No. of Events (Participants)	Donning, n	Doffing, n	PIV, n	MLC, n	ETI, n
Health-Assessment Trigger	Hot	7 (4)	0	0	0	4	3
	Thermo-neutral	1 (1)	0	0	0	0	1
Minor Breach	Hot	26 (9)	1	14	2	5	2
	Thermo-neutral	21 (7)	0	17	1	1	2
Near-Miss Incident	Hot	21 (7)	0	0	8	11	2
	Thermo-neutral	23 (8)	0	0	11	1	0

ETI, endotracheal intubation; MLC, midline catheter; PIV, peripheral intravenous catheter.

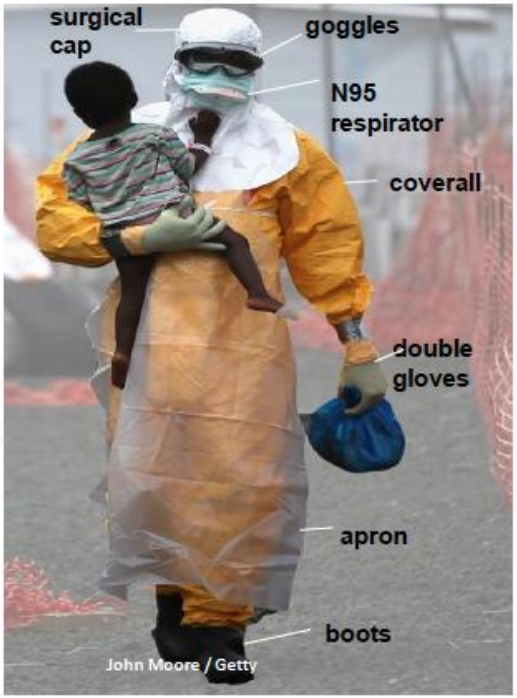
Substantially more Health Triggers in Hot & Humid Conditions

Viruses 2021, 13, 2205

Evolution of ('Smart'-er) PPE

CURRENT PPE

- Too hot and inappropriate for hot and humid tropical climates
- Doffing of the PPE is time consuming
- Built-up humidity inside the suit (goggles) & reduced vision field
- Poor reusability and too expensive



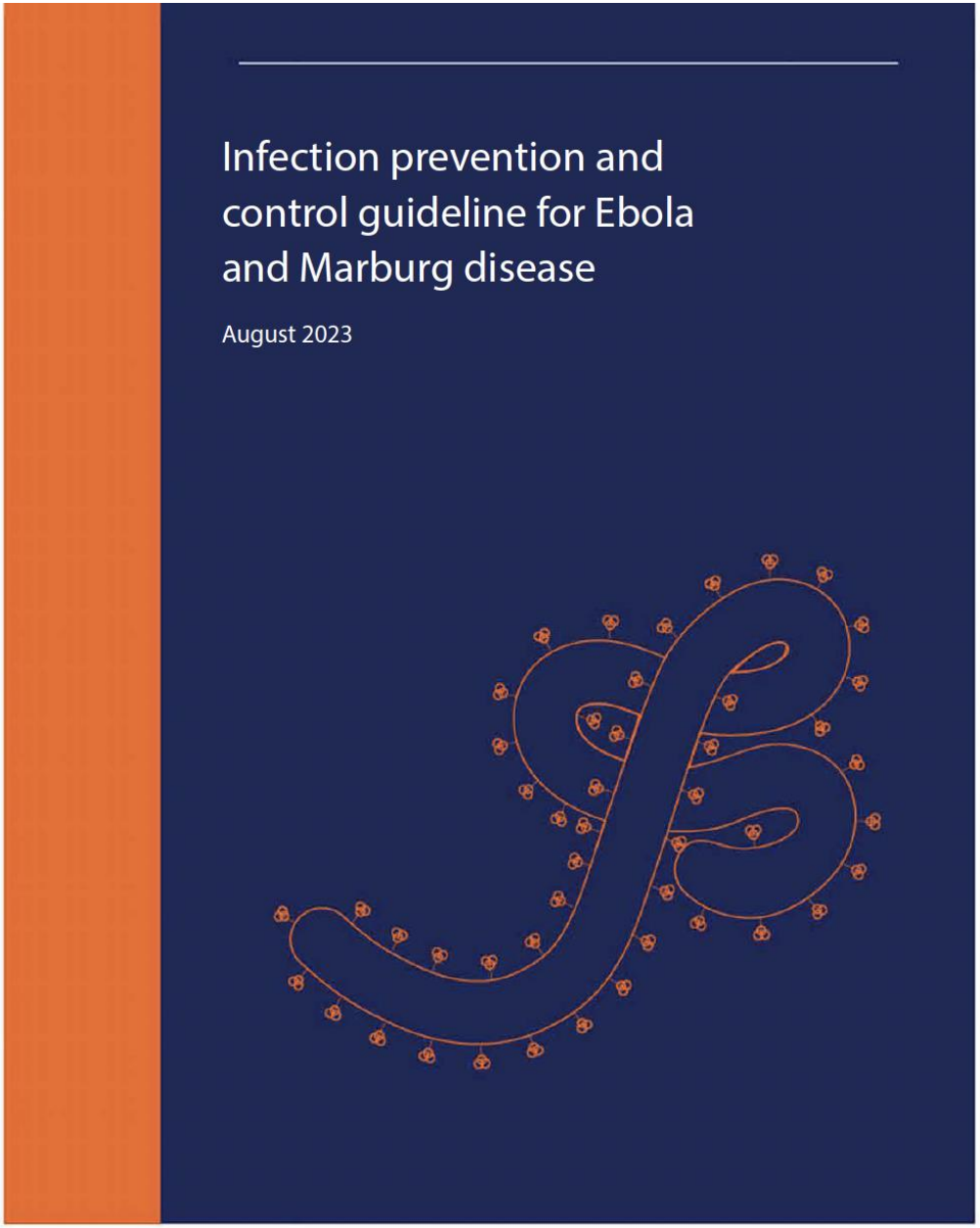
SmartPPE

- One-piece suit
- Personal cooling system
- Positive pressure
- Large face shield
- No protective mask
- Immediate, watertight seal
- Fully reusable

MEDECINS SANS FRONTIERES

World Health Organization

CIHR IRSC Institute of Circulatory and Respiratory Health / Institut de la santé circulatoire et respiratoire



www.who.int/publications/i/item/WHO-WPE-CRS-HCR-2023.1

World Health Organization

Bottom line: **meticulous attention to our usual IPAC procedures** for contact precautions (with *a few* important VHF-specific caveats)

WHO IPAC Recommendations for the Care of Patients with Ebola or Marburg Virus Disease	Strength
• Perform hand hygiene, by an **alcohol-based hand rub or soap and running water**	Strong
• The **mucous membranes of eyes, mouth and nose should be completely covered** by PPE.	Strong
• Use either a **face shield or goggles**.	Strong
• Use a **fluid-resistant medical or surgical mask with a structured design that does not collapse** against the mouth (e.g. duckbill or cup shape).	Strong
• Use a fluid-resistant particulate **respirator during procedures that generate aerosols** of body fluids.	Strong
• **Nitrile gloves** are preferred over latex gloves.	Strong
• The choice of PPE for covering clothing: disposable gown & apron or a disposable coverall & apron.	Conditional
• Health workers with contact with patients who have Ebola or Marburg disease wear: ○ A **medical mask in combination with eye protection (face shield or goggles)** ○ A **fluid-resistant coverall** (versus a fluid-resistant gown) ○ A **head-and-neck covering as part of their PPE** in addition to covering their mucous membranes ○ **Two pairs of gloves** ○ Either a **disposable or reusable apron to cover the coverall** (or gown, if used)	Conditional
• Health workers with direct contact and/or indirect contact with patients with Ebola disease or Marburg disease wear eye protection (**goggles or a face shield) under the head-and-neck covering** versus over	Conditional
• WHO **recommends against the spraying** of health and care workers who have direct or indirect contact with patients who have Ebola disease or Marburg disease during the removal of personal protective equipment.	Strong
• Health workers providing direct and/or indirect care **wash/disinfect the outer pair of gloves, remove the outer pair of gloves and wash/disinfect the inner pair of gloves and put on a new outer pair of gloves between patients**	Conditional
• Persons should be **screened using a no-touch technique** at the first point of contact with any health-care facility to enable early recognition of suspected cases and rapid implementation of source control measures.	GPS
• Patients, should be **triaged to the severity of their illness, identify those in need of immediate care**	GPS
• Patients should be isolated, preferably in a **single room,** and workers should wear appropriate PPE.	GPS
• **Interaction with family and visitors should be facilitated** while providing education, preventing direct contact.	GPS
• Where IPAC measures can be maintained, **PPE is not required during screening activities** in health-care settings **where a distance of at least 1m can be guaranteed** and a no-touch approach is followed.	GPS
• If health workers are **not able to maintain a distance of least 1m, wear: a medical mask in combination with eye protection; a fluid-resistant gown; one pair of gloves**	Conditional

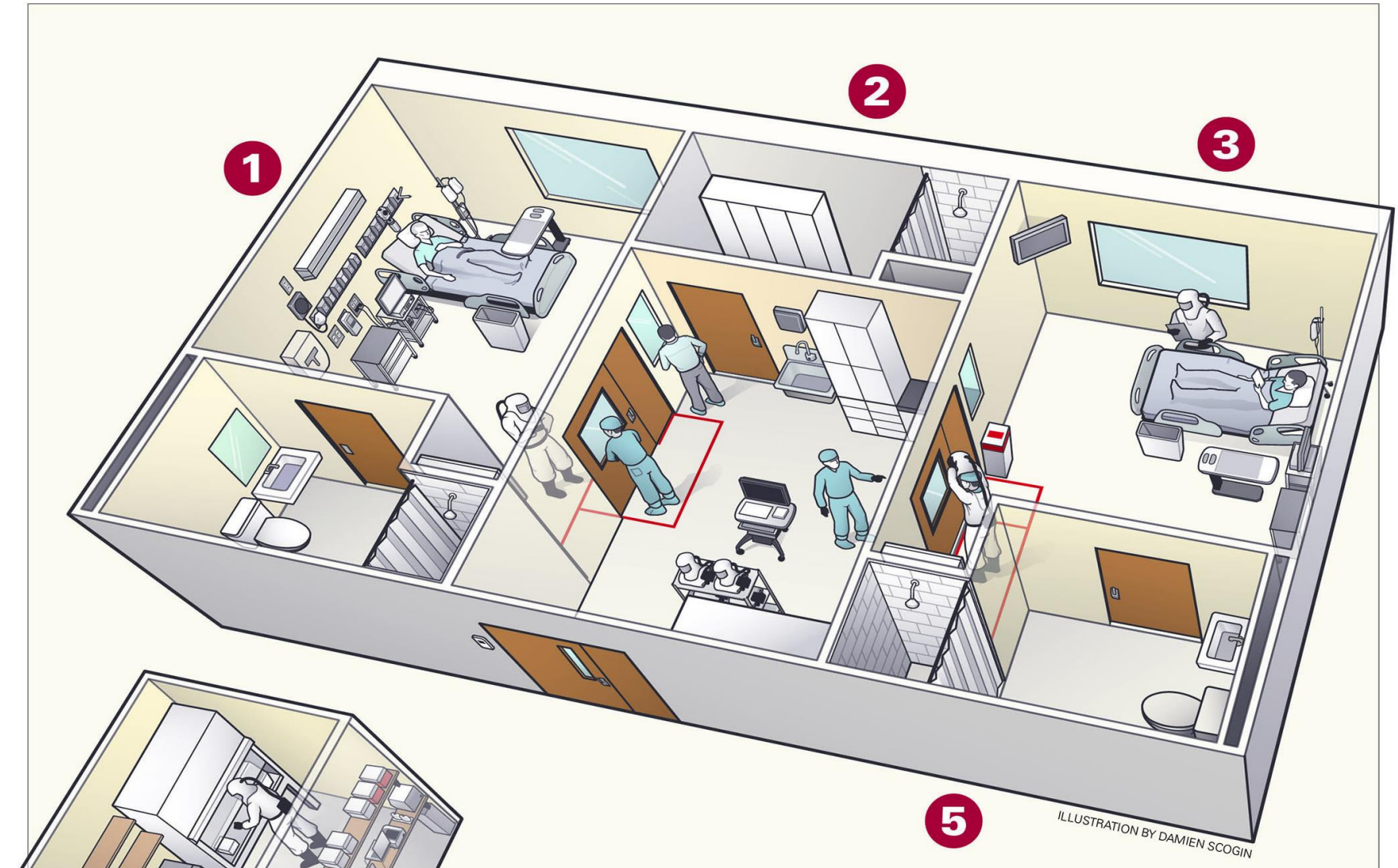
www.who.int/publications/i/item/WHO-WPE-CRS-HCR-2023.1

Treatment Unit Design

www.who.int/publications/b/73031 2024

Ebola Treatment Facility, Royal Free Hospital, London, UK

Ebola Treatment Facility, Emory Hospital, Atlanta



- All (levels of) care in one area
- Lines of sight for team; ability of family to ‘visit’
- Minimally disrupt rest of hospital functions
- Space! (patients, staff, donning/doffing, storage)


Stericycle
BIOHAZARD

Republic of Rwanda
Ministry of Health

Rwanda Biomedical Centre
Healthy People, Wealthy Nation

#StopMarburg

Marburg Tracking Dashboard Weekly Updates (9-15/11/2024)

Confirmed Cases	Active Cases	Death Cases	Recovered Cases	Cases Fatality Rate	Cases per Known Transmission chains
66	0	15	51	22.7 %	100 %

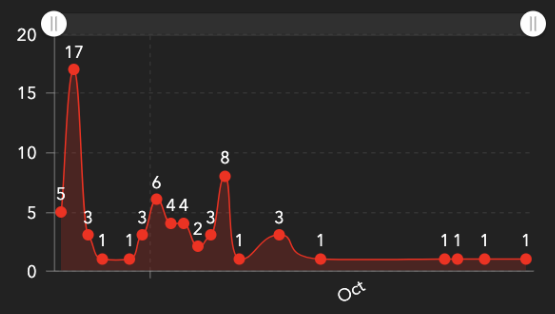
Cumulative Tests

No Data

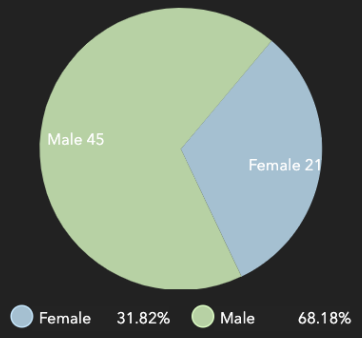
Vaccines Delivered

No Data

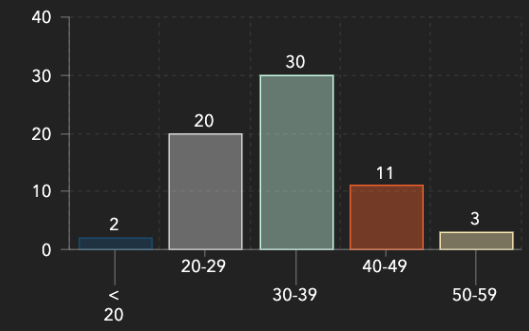
Cases Daily Profile



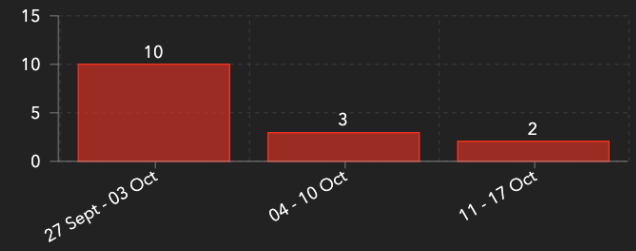
Cases-Gender Distribution



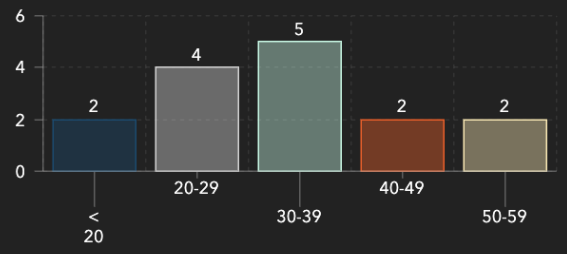
Cases per Age Group



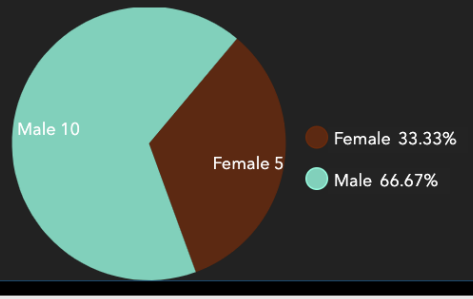
Deaths Profile per Week



Deaths per Age Group



Deaths-Gender Distribution



Conditions in returning travelers

Annals of Internal Medicine

ORIGINAL RESEARCH

Differential Diagnosis of Illness in Travelers Arriving From Sierra Leone, Liberia, or Guinea: A Cross-sectional Study From the GeoSentinel Surveillance Network

Andrea K. Boggild, MSc, MD; Douglas H. Esposito, MD, MPH; Phyllis E. Kozarsky, MD; Vernon Ansdell, MD; Nicholas J. Beeching, MD; Daniel Campion, MB, MPH; Francesco Castelli, MD; Eric Caumes, MD; Francois Chappuis, MD, PhD; Jakob P. Cramer, MD, MSc; Effrossyni Gkrania-Klotsas, PhD; Martin P. Grobusch, MD, PhD; Stefan H.F. Hagmann, MD; Noreen A. Hynes, MD, MPH; Poh Lian Lim, MD, MPH; Rogelio López-Vélez, MD, PhD; Denis J.M. Malvy, MD, PhD; Marc Mendelson, MD, PhD; Philippe Parola, MD, PhD; Mark J. Sotir, PhD; Henry M. Wu, MD; and Davidson H. Hamer, MD, for the GeoSentinel Surveillance Network*

Objective: To define the spectrum of illness observed in persons returning from areas of West Africa where EVD transmission has been widespread.

Design: Descriptive, using GeoSentinel records.

Setting: 57 travel or tropical medicine clinics in 25 countries.

Patients: 805 ill returned travelers and new immigrants from Sierra Leone, Liberia, or Guinea seen between September 2009 and August 2014.

Ann Intern Med. 2015;162:757-764.

Characteristic	All Travelers (*n* = 805)
Sex†	
Male	503 (62.5)
Female	301 (37.4)
Median age (range), *y*	34 (1–95)
Patient type	
Inpatient	219 (27.2)
Outpatient	586 (72.8)
Median travel duration (range), *d*	36 (0–5111)
Pretravel medical encounter	
Yes	420 (52.2)
No	221 (27.5)
Unknown	164 (20.4)
Syndromic diagnoses‡	
Systemic febrile illness	396 (49.2)
Acute diarrhea	158 (19.6)
Other gastrointestinal	94 (11.7)
Respiratory	54 (6.7)
Birth country	
Guinea	
Sierra Leone	59 (7.3)
Other§	584 (72.5)

Table 3. Most Common Diagnoses for Specific Causes Within Syndromic Presenting Symptoms Among 805 Ill Returned Travelers Seen at a GeoSentinel Surveillance Network Site With Diagnoses Related to Travel to Sierra Leone, Liberia, or Guinea, 2009–2014

Diagnosis, by Presenting Symptom	Patients, *n* (%)*	Total Patients With Diagnosis in Database, *n*
Fever (*n* = 267)		
Malaria	182 (58.0)	314
Plasmodium falciparum	142 (58.4)	243
Severe/cerebral	18 (64.3)	28
Plasmodium vivax	2 (100)	2
Plasmodium species unknown	9 (50.0)	18
Plasmodium ovale	8 (50.0)	16
Plasmodium malariae	3 (42.9)	7
Nonspecific viral syndrome	12 (41.4)	29
Systemic febrile illness, unspecified	15 (57.7)	26
URTI	6 (23.1)	26
Acute UTI	3 (33.3)	9
Enteric fever	6 (75.0)	8
Salmonella enterica serotype Typhi	1 (50.0)	2
Typhoid fever, unspecified	5 (83.3)	6
Influenza/ILI	4 (57.1)	7
Pneumonia	4 (57.1)	7
Lobar	3 (50.0)	6
Atypical	1 (100)	1
Acute HIV infection, febrile	4 (80.0)	5
[illegible]	[illegible] (33.3)	3
Pulmonary	0 (0)	2
Extrapulmonary	1 (100)	1
[illegible]	2 (100)	2
Leptospirosis	1 (50.0)	2

There have been dozens of **'suspect' VHF cases in Ontario**

All had a potentially serious medical condition **requiring prompt assessment & treatment**

None have had Ebola

Ontario Ministry of Health Commitment to Health System-Level Planning and Preparedness for VHF

Preparedness for high-risk pathogens (HRP), such as viral hemorrhagic fevers, is an area of focus for the Ministry of Health's' emergency management program. There has been a lot of work done by the Ministry, with key health system partners.

- If a suspect potential high-risk pathogen case is identified in a human, please notify **MOH Health System Emergency Management Branch (HSEMB)** via the **24/7 Health Care Provider Hotline (1-866-212-2272) and your Public Health Unit.**

- Once the MOH HSEMB is notified, the **following steps will be taken in a timely way to trigger appropriate coordination among health partners:**

    - **Within 30 minutes of notification, MOH HSEMB will convene a call** with relevant health partners to assess the situation.

    - Relevant partners include but not limited to implicated hospitals or health care setting, designated hospital/treatment centre, Public Health Units, EMS/Ornge, Public Health Ontario (PHO), Public Health Ontario Laboratory (PHOL), Ontario Health (OH), CritiCall, National Microbiology Laboratory (NML).

    - **Coordination of next steps (e.g., transfer, testing)** appropriate to care needs of the patient.

- **Resources under development by the Ministry of Health:**

    - A **High-Risk Pathogen Notification Pathway for Health Service Providers**: The pathway outlines how health service providers should notify the Ministry of Health of a potential HRP case and details the activities that the notification triggers; and will soon be available on the ministry website.

Ontario Ministry of Health Commitment to Health System-Level Planning and Preparedness for VHF

Additional resources for managing a suspect HRP case is identified:

- If an entity does not have the expertise to conduct an HRP risk assessment, call your Public Health Unit and/or the PHO Laboratory Customer Service Centre to support the assessment.
- Public Health Ontario IPAC Resources for Viral Hemorrhagic Fevers: https://www.publichealthontario.ca/en/Diseases-and-Conditions/Infectious-Diseases/Vector-Borne-Zoonotic-Diseases/Ebola.
- Locate your Public Health Unit: https://www.ontario.ca/page/public-health-unit-locations.
- Public Health Ontario Diagnostic Serology for Viral Haemorrhagic Fevers: https://www.publichealthontario.ca/en/Laboratory-Services/Test-Information-Index/VHF-Diagnostic-Serology.
- Public Health Ontario Laboratory Customer Service Centre: 416-235-6556/1-877-604-4567 during normal business hours; 416-605-3113 after-hours.
- For Ministry of Health guidance regarding high-risk pathogens, refer to: https://www.ontario.ca/page/ministry-health-emergency-management-plans-and-strategies.

rob.fowler@sunnybrook.ca