The Ebola Epidemic: Lessons Learned from the Frontline Clinical Response

Dr. Sharmistha Mishra, Canadian ID physician, WHO Clinical Consultant, at the first Port Loko District Ebola Survivors Clinic, Sierra Leone, March 2015

AMMI 2015, Charlottetown, PEI
The 2014 Ebola epidemic was unprecedented

Ebola deaths by outbreak, as of March 15, 2015

- 2014-2015 W. Africa outbreak: 10,194
- All 24 previous outbreaks combined: 1,590

The 10 deadliest outbreaks before 2014:
- 1976 DRC (280)
- 1995 DRC (254)
- 2000 Uganda (224)
- 2007 DRC (187)
- 1976 Sudan (151)
- 2003 Congo (128)
- 2001 Gabon (53)
- 1996 Gabon (45)
- 2001 Congo (44)
- 2007 Uganda (37)

SOURCE: World Health Organization
Guinea, Sierra Leone, Liberia

Poor access to healthcare and limited healthcare infrastructure, resources, and HRH
<table>
<thead>
<tr>
<th>Country</th>
<th># cases</th>
<th># confirmed</th>
<th># deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guinea</td>
<td>3,548</td>
<td>3,117</td>
<td>2,346</td>
</tr>
<tr>
<td>Liberia</td>
<td>10,042</td>
<td>3,151</td>
<td>4,486</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>12,201</td>
<td>8,563</td>
<td>3,857</td>
</tr>
<tr>
<td>TOTAL</td>
<td>24,872</td>
<td>14,831</td>
<td>10,689</td>
</tr>
</tbody>
</table>

WHO Sit Rep April 15, 2015
Dr. Rob Fowler, Canadian Critical Care physician, WHO Clinical Lead, exiting the red zone at AHS Waterloo Holding Centre/Treatment Unit, Sierra Leone, December 2015
1. Why did this happen and how can we fix it?:
   “Staff, supplies, space and systems”

Number of doctors per 100,000 population

LIBERIA: 1.4
SIERRA LEONE: 2.2
GUINEA: 10

UNITED STATES: 245.2

Source: WHO

2. Supportive clinical care saves lives

<table>
<thead>
<tr>
<th>Year</th>
<th>Country</th>
<th>Ebolavirus species</th>
<th>Cases</th>
<th>Deaths</th>
<th>Case fatality</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>Democratic Republic of Congo</td>
<td>Bundibugyo</td>
<td>57</td>
<td>29</td>
<td>51%</td>
</tr>
<tr>
<td>2012</td>
<td>Uganda</td>
<td>Sudan</td>
<td>7</td>
<td>4</td>
<td>57%</td>
</tr>
<tr>
<td>2012</td>
<td>Uganda</td>
<td>Sudan</td>
<td>24</td>
<td>17</td>
<td>71%</td>
</tr>
<tr>
<td>2011</td>
<td>Uganda</td>
<td>Sudan</td>
<td>1</td>
<td>1</td>
<td>100%</td>
</tr>
<tr>
<td>2008</td>
<td>Democratic Republic of Congo</td>
<td>Zaire</td>
<td>32</td>
<td>14</td>
<td>44%</td>
</tr>
<tr>
<td>2007</td>
<td>Uganda</td>
<td>Bundibugyo</td>
<td>149</td>
<td>37</td>
<td>25%</td>
</tr>
<tr>
<td>2007</td>
<td>Democratic Republic of Congo</td>
<td>Zaire</td>
<td>264</td>
<td>187</td>
<td>71%</td>
</tr>
<tr>
<td>2005</td>
<td>Congo</td>
<td>Zaire</td>
<td>12</td>
<td>10</td>
<td>83%</td>
</tr>
<tr>
<td>2004</td>
<td>Sudan</td>
<td>Sudan</td>
<td>17</td>
<td>7</td>
<td>41%</td>
</tr>
<tr>
<td>Year</td>
<td>Country</td>
<td>Species</td>
<td>Males</td>
<td>Females</td>
<td>Total</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------------</td>
<td>---------------</td>
<td>-------</td>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>2003 (Nov-Dec)</td>
<td>Congo</td>
<td>Zaire</td>
<td>35</td>
<td>29</td>
<td>83%</td>
</tr>
<tr>
<td>2003 (Jan-Apr)</td>
<td>Congo</td>
<td>Zaire</td>
<td>143</td>
<td>128</td>
<td>90%</td>
</tr>
<tr>
<td>2001-2002</td>
<td>Congo</td>
<td>Zaire</td>
<td>59</td>
<td>44</td>
<td>75%</td>
</tr>
<tr>
<td>2001-2002</td>
<td>Gabon</td>
<td>Zaire</td>
<td>65</td>
<td>53</td>
<td>82%</td>
</tr>
<tr>
<td>2000</td>
<td>Uganda</td>
<td>Sudan</td>
<td>425</td>
<td>224</td>
<td>53%</td>
</tr>
<tr>
<td>1996</td>
<td>South Africa (ex-Gabon)</td>
<td>Zaire</td>
<td>1</td>
<td>1</td>
<td>100%</td>
</tr>
<tr>
<td>1996 (Jul-Dec)</td>
<td>Gabon</td>
<td>Zaire</td>
<td>60</td>
<td>45</td>
<td>75%</td>
</tr>
<tr>
<td>1996 (Jan-Apr)</td>
<td>Gabon</td>
<td>Zaire</td>
<td>31</td>
<td>21</td>
<td>68%</td>
</tr>
<tr>
<td>1995</td>
<td>Democratic Republic of Congo</td>
<td>Zaire</td>
<td>315</td>
<td>254</td>
<td>81%</td>
</tr>
<tr>
<td>1994</td>
<td>Cote d'Ivoire</td>
<td>Tai' Forest</td>
<td>1</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>1994</td>
<td>Gabon</td>
<td>Zaire</td>
<td>52</td>
<td>31</td>
<td>60%</td>
</tr>
<tr>
<td>1979</td>
<td>Sudan</td>
<td>Sudan</td>
<td>34</td>
<td>22</td>
<td>65%</td>
</tr>
<tr>
<td>1977</td>
<td>Democratic Republic of Congo</td>
<td>Zaire</td>
<td>1</td>
<td>1</td>
<td>100%</td>
</tr>
<tr>
<td>1976</td>
<td>Sudan</td>
<td>Sudan</td>
<td>284</td>
<td>151</td>
<td>53%</td>
</tr>
<tr>
<td>1976</td>
<td>Democratic Republic of Congo</td>
<td>Zaire</td>
<td>318</td>
<td>280</td>
<td>88%</td>
</tr>
</tbody>
</table>
Probability of Survival vs Days since Onset of Symptoms

- Age <40 yr
- Age ≥40 yr
- Overall

P = 0.002 by log-rank test

No. at Risk
Age <40 yr
19 18 15 15 15
Age ≥40 yr
15 12 6 4 4
3. Finding the balance between safety and patient care is challenging
Health Care Workers at Risk

Sierra Leone, May-Oct 2014:
- 199 cases in HCWs (5.2% of cases) -
- incidence in HCWs 103-fold higher
8,285/100,000 than 80/100,000 in general pop’n.

Kilmarx, MMWR 2014
Different styles of PPE: “WHO” and “MSF”
Red Zone Delivery, MSF Gueckedou ETU, Guinea, October 2014
PPE Doffing Area, Arab Holding Center, Makeni, Sierra Leone, January 2015
4. Resources from the Ebola response should be leveraged to address the collateral damage to the existing health system

No running H2O Maternity Ward
Makeni General Hospital, SL

Piped in 0.5%, 0.05% and bore hole
H2O MSF Kissey ETU, SL
Labour and Delivery, Koidu General Hospital, January 2015
Port Loko, Sierra Leone, DERC Ebola Ambulance Fleet, January 2015
5. Capacity Building: Training must be linked to on-site mentorship and supportive supervision

Systems:
Triage, IPC, inpatient surveillance

Overcoming fear → providing appropriate care for non-EVD conditions in the context of ongoing EVD transmission

Screening and Triage area, PHU, Port Loko District, SL February 2015
WHO Phase 2 “Mock ETU” Training, IOM Ebola Training Academy, Freetown, December 2014
Dr. Ronald Marsh, Hospital Superintendent, General Medical Officer, and Kono DERC Case Management Pillar Lead teaching IPC to staff

Student nurses deployed to help staff a CCC in Kono District are taught how to do phlebotomy by PIH/WHO

Dr. Michael Kamara, IOM Facilitator, Sierra Leone, teaching the WHO Phase 1 Training
1 YEAR LATER:
WHERE ARE WE NOW?
Ebola survivors

- >14,000 known survivors
- Uveitis
- Arthralgias
- Tinnitus
- Psychosocial / mental health
- Viral shedding

Survivors Tree, Maforki ETU, Port Loko, January 2015
Ebola specific therapies: It’s important to find the magic bullet....

- Monoclonal antibodies (Zmapp/Zmab)\(^4,6,7\)
- Convalescent Plasma/Whole Blood – Antibodies\(^2,3,5\)
- Anti-Ebola Specific Equine Polyclonal Immune Globulin (FabEntech)
- Small Antiviral Molecules – Favipiravir,\(^14\) T-705, jk-05
- Small inhibitory RNA molecules
  - TMK 100802 Tekmira\(^8,9\)
  - Sarepta AVI-7537
  - Brincidofovir* (BMC, CMXoo1), BCX4430
- Tissue Factor Inhibitors and Anticoagulants - APC (!)
- Interferons
- Vaccination (Prevention and Therapy)\(^10,11,12,13\)

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...but it’s also important to figure out how to deliver it to where it’s needed.
IT COSTS MORE TO STOP OUTBREAKS THAN TO PREVENT THEM.

COST OF EBOLA RESPONSE (SO FAR) $4.3B

COST TO BUILD UP HEALTH SYSTEMS IN GUINEA, LIBERIA AND SIERRA LEONE $1.58B

内で $100M
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Medical Advisor, Dignitas International
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Trying to get internet hot spot at Liberia MOH in Monrovia

0.05% chlorine at canteen of UK Military HQ, Freetown, Sierra Leone