EBOLA TRANSMISSION: HEALTH CARE WORKER PRACTICE MOST IMPORTANT CONSIDERATION

Not long after we learned that a health care worker treating Thomas Duncan has tested positive for Ebola, I ran across this terse tweet from Mackey Dunn, the pen name of Don Weiss, who is "a medical epidemiologist with the New York City Department of Health and Mental Hygiene". The tweet linked to this short but incredibly important blog post. In the post, Weiss notes the baffling development that a health care worker, who wore full personal protective equipment (PPE), contracted Ebola from Duncan even though at this point, none of his family or other close contacts, who did not have full PPE, have developed symptoms of the disease.

That set of facts prompts Weiss to pose the question "So, what does this tell us about Ebola and how we can attain control?" His answer begins:

> One, that Ebola patients become more infectious as the illness progresses. The newly reported case in a healthcare worker had onset on October 10th. If we take 9 days as the mean incubation period for Ebola this means the healthcare worker's exposure was sometime around October 1, which was day 8 of Mr. Duncan's illness. This is similar to what was seen with SARS, that patients become more infectious (and dangerous) with time.

In setting up the circumstances for his question, Weiss had noted that Duncan was hospitalized, ending exposure to family members,

on day 5 of his disease.

Although he doesn't mention it, this aspect of Ebola, where patients produce more virus and become more infectious during the course of a fatal infection, also accounts for why burial practices are so important to containing the spread of Ebola. Patients produce the most virus and are thus at their most infectious at death.

The converse also appears to be true. Duncan was symptom-free when he flew from Liberia to Dallas on September 19 to 20. At 24 days since the end of that trip, we have now passed the incubation period, commonly given as 2-21 days, for Ebola to develop in anyone who could have been exposed during the flights. No infections among those airline passengers have been reported. I have yet to see a major media outlet mention this point, though.

We are now at 16 days since Duncan was hospitalized, ending his family's direct exposure, so we have passed the two-thirds point of the incubation period for them (and well past the 9 days that Weiss gives as the average incubation period for Ebola).

The second part of Weiss' musings on the infection of the nurse is extremely important:

> Second, that only hospitals that are well prepared to care for highly infectious patients should be allowed to do so. Standard practice is to have a staff person dedicated to observing the donning (putting on) and doffing (taking off) of PPE. This observation should continue throughout the period of clinical care (from an ante-room with a window). Perhaps gentle reminders during the doffing can avoid the presumed situation in Spain where the nurse may have touched her face with a gloved hand.
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> When a patient presents to a hospital early in the illness there is time to transfer to such a facility. That's the

> plan here in NYC. Bellevue hospital has a specially equipped ward to care for Ebola patients. Their staff are well trained. The number of healthcare workers entering the room should be kept to a minimum, especially after day 7 of the illness.

Weiss was prescient in his push for an observer for workers putting on and taking off PPE. In today's New York Times, we have this on the CDC's thoughts regarding improving practices for health care workers treating Ebola patients:

> "We have to rethink the way we address Ebola infection control, because even a single infection is unacceptable," Dr. Thomas R. Frieden, director of the C.D.C., told reporters.
>
> /snip/
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> A team of C.D.C. officials — reinforcements sent to Dallas in the aftermath of the second Ebola case diagnosed in the United States — worked through the night at the hospital to identify what was described as a "large group" of health care workers who might be at risk of infection because they treated the original Ebola victim, Thomas Eric Duncan, 42, at the hospital from the time he was admitted on Sept. 28 until he died last Wednesday.
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> And they are now watching hospital personnel as they put on and take off their protective garb, retraining the staff and evaluating the type of protective equipment being used. They were considering using cleaning products that kill the virus to spray down workers who come out of the isolation unit where the nurse is being treated.

I still hope that the other part of Weiss' comments, though, are implemented. At least for

patients who are diagnosed with Ebola early enough, they should be transferred to facilities that already are trained in the handling of highly infectious diseases.

While the current effort by CDC to improve practices at Texas Health Presbyterian Hospital Dallas has now been described as CDC looking to tune up its own guidelines for treating Ebola patients, and that is laudable, I find it unfortunate the Frieden was forced to apologize and back off his original comment that the infection of the nurse had to have been caused by a breach of protocol. The sad truth of the situation is that it is almost entirely certain that a simple breach of safe practices is how the nurse became infected. And that is why relying on only a few specialized treatment centers is best.

Note also that Weiss mentions that best practices at these facilities means that they minimize the number of workers who are at risk of exposure. Despite that, it appears that there may be a group of as many as a hundred workers in Dallas at risk of infection. That suggests to me that the Dallas hospital is entirely out of its element in treating Ebola patients.

For all the wailing in the press that this outbreak of Ebola, and especially the infection of a nurse wearing PPE has occurred, means that the virus has suddenly changed in character to become much more dangerous, known biology of the virus can account for everything that has happened to this point. One mistake is all that it takes for a health care worker to become infected, and in the end it comes down proper technique being observed at all times to prevent infection spreading.

For further proof that actual practices by health care workers are even more important that the type of PPE used, we need only read this fascinating CNN article from September 26 (h/t @Pedinska) about a student in her final year of nursing school in Liberia who treated (at home!) four family members who were infected with

Ebola, with three of them surviving. Her inventive technique is now being taught elsewhere in areas of West Africa where the hospitals are overwhelmed:

> Every day, several times a day for about two weeks, Fatu put trash bags over her socks and tied them in a knot over her calves. Then she put on a pair of rubber boots and then another set of trash bags over the boots.
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> She wrapped her hair in a pair of stockings and over that a trash bag. Next she donned a raincoat and four pairs of gloves on each hand, followed by a mask.
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> It was an arduous and time-consuming process, but Fatu was religious about it, never cutting corners.

All the proof we need that Fatu did not cut corners is in the remarkable fact that she cared for these four patients in a home setting without catching the disease herself. As long as health care workers display Fatu’s level of vigilance, Ebola can be prevented from spreading in health care facilities.