[9]. Also, a statin/ARB combination was effective in reducing mortality in patients with Ebola virus disease [9].

During the 2009 influenza A (H1N1) pandemic, more than 90% of the world's people had no access to influenza vaccines. Preparations for the next pandemic focus on increasing global production capacity and demand for seasonal influenza vaccines, but evidence thus far suggests this goal will not be achieved [10]. In the absence of influenza vaccines, statins (perhaps in combination with other drugs such as ARBs) could be useful in treating patients with pandemic influenza. They might also be useful in treating other emerging virus diseases and everyday diseases like seasonal influenza, sepsis and pneumonia [8, 9].

Note

David S. Fedson

References

1. McLean HQ, Chow BD, VanWormer JJ, King JP, Belongia EA. Effect of statin use on influenza vaccine effectiveness. J Infect Dis **2016**; 214:1150–8.
2. Black S, Nicolay U, Del Giudice G, Rappuoli R. Influence of statins on influenza vaccine response in elderly individuals. J Infect Dis **2016**; 213:1224–8.
3. Yilmaz A, Reiss C, Weng A, et al. Differential effects of statins on relevant functions of human monocyte-derived dendritic cells. J Leukoc Biol **2006**; 79:529–38.
4. Leuenberger T, Pfueller CF, Luessi F, et al. Modulation of dendritic cell immunobiology via inhibition of 3-hydroxy-3-methylglutaryl-CoA (HMG-CoA) reductase. PLoS One **2014**; 9:e100871.
5. Fedson DS. Influenza vaccination effectiveness, unmeasured confounding, and immunomodulatory treatment. J Infect Dis **2014**; 209:1300–1.
6. Petrie JG, Ohmit SE, Cheng CK, et al. Influenza vaccine effectiveness against antigenically drifted influenza higher than expected in hospitalized adults: 2014–2015. Clin Infect Dis **2016**; 63:1017–25.
7. Singla S, Jacobson JR. Statins as a novel therapeutic strategy in acute lung injury. Pulm Circ **2012**; 2:397–406.
8. Fedson DS. Treating influenza with statins and other immunomodulatory agents. Antiviral Res **2013**; 99:417–35.
9. Fedson DS. Treating the host response to emerging virus diseases: Lessons learned from sepsis, pneumonia, influenza and Ebola. Ann Transl Med **2016**; 4:421.
10. Palache A, Oriol-Mathieu V, Fino M, Xydia-Charmanta M; Influenza Vaccine Supply task force (IFPMA IVS). Seasonal influenza vaccine dose distribution in 195 countries (2004–2013): Little progress in estimated global vaccination coverage. Vaccine **2015**; 33:5598–605.

Management of Ebola Virus Disease: Is Environmental Decontamination Effective?

To the Editor—The West African Ebola virus (EBOV) disease (EVD) outbreak was the most extensive and devastating EVD outbreak in history. Effective case management is a key component of EVD control, involving the care of infectious patients in an environment that limits ongoing transmission. We read with interest the recent article by Poliquin et al [1], which adds information on Ebola viral contamination of clinical settings where patients with EVD were managed. The authors cite a prior study by Bausch et al [2], conducted in Uganda, as the only previous study in this area. However, we are aware of 3 other studies examining environmental contamination of EVD clinical facilities [3–5]. Given how important this issue is for the safety of health workers and patients, we would like to highlight this other relevant evidence.

Our group performed an audit of environmental decontamination practice at Connaught Hospital's Ebola holding unit (EHU), also in Freetown, Sierra Leone, conducted in January 2015 (Youkee et al [3]). We sampled extensively in a clinical area (EVD holding unit ward–EHU) where patients with EVD were managed, collecting 173 swab samples for evidence of EBOV RNA by RT-PCR analysis, using Σ-Virocult™ swabs. Sample collection was temporally related to EHU decontamination, after an EVD-positive patient was transferred out to the EVD Treatment Centre and before admission of a new patient with suspected EVD. We sampled the clinical environment immediately after the departure of patients with EVD from the bedside before cleaning, and then 30 and 60 minutes after routine decontamination with 0.5% chlorine solution, according to our protocols, to assess the efficacy of decontamination procedures and the effect of time on EBOV RNA persistence. We repeated the process after a period of refresher training for hygiene staff.

Our results showed EBOV RNA contamination of the immediate patient bedside area and of visibly soiled sites and equipment, before decontamination. There was no evidence of contamination of environmental surfaces outside the patient's direct contact area in the ward. We demonstrated that routine decontamination procedures reduced evidence of EBOV RNA contamination at 30 and 60 minutes after decontamination, in all but a few locations. The bed frame and floor near the bed were areas where routine decontamination did not consistently remove EBOV RNA. Similarly, Poliquin et al [1] reported that bedrails, which were not visibly soiled, and concrete floors were areas of EBOV RNA persistence.

In a report from Italy by Puro et al [4], swab samples from the floor under the bed and table of a patient with EVD were positive for EBOV RNA by RT-PCR, after routine cleaning. This was an area that had been heavily contaminated with body fluids. Repeated sampling after more extensive cleaning yielded negative results, and Vero cell culture of the PCR-positive sample was negative. A study at Jui-SL China Friendship Hospital, in Sierra Leone, found no RT-PCR evidence of EBOV RNA in swab samples taken from the clinical area around a convalescent patient with EVD [5].

Together, these data inform the important debate on the potential risk to patients of admission to EVD clinical areas. In many EVD clinical care facilities, patients

who had suspected (not confirmed) EVD were managed alongside other patients with suspected or confirmed EVD [6]. This was largely unavoidable during the West African EVD outbreak, owing to the large number of suspected cases, delayed diagnostic confirmation, and a shortage of beds in the treatment center, but this situation raised significant concern about nosocomial transmission—that patients with suspected EVD who were not actually infected could be exposed to EBOV during their admission [6, 7]. Our EHU, like others, was divided into high- and low-risk areas, with individual bed spaces. Staff movement was unidirectional from low- to high-risk areas, with decontamination between individual patient contact episodes. Regular and vigilant personal and environmental decontamination, together with patient supervision to avoid physical interaction between patients, was used to minimize the risk of nosocomial transmission [6].

Our audit results reassured us that there was a low risk of EVD transmission to patients within that environment from fomites or from contact with clinical staff. We conclude that the floor area and bedrails in the immediate vicinity of a patient's bed require extra attention during cleaning. We await the results of epidemiological studies looking at nosocomial transmission inside EHUs, which are also critical to this debate.

Notes

Naomi F. Walker,[1,2] Daniel Youkee,[3] Colin S. Brown,[2,3] Marta Lado,[3] and Oliver Johnson[3]

[1]Department of Clinical Research, London School of Hygiene and Tropical Medicine, [2]Hospital for Tropical Diseases, University College London Hospital, London, United Kingdom; [3]King's Sierra Leone partnership, King's Centre for Global Health, King's College London and King's Health Partners, London, United Kingdom

References

1. Poliquin PG, Vogt F, Kasztura M, et al. Environmental contamination and persistence of Ebola virus RNA in an Ebola treatment center. J Infect Dis **2016**; 214:145–52.
2. Bausch DG, Towner JS, Dowell SF, et al. Assessment of the risk of Ebola virus transmission from bodily fluids and fomites. J Infect Dis **2007**; 196:S142–7.
3. Youkee D, Brown CS, Lilburn P, et al. Assessment of environmental contamination and environmental decontamination practices within an Ebola Holding Unit, Freetown, Sierra Leone. PLoS One **2015**; 10:e0145167.
4. Puro V, Fusco FM, Petrecchia A, et al. Sampling surfaces for Ebola virus persistence after cleaning procedures in high-level isolation settings: the experience with 2 patients at the Lazzaro Spallanzani National Institute for Infectious Diseases. Infect Control Hosp Epidemiol **2016**; 37:723–5.
5. Wu X, Wang H, Yang Y, Zheng Y, Sha L. Investigation for Ebola virus environmental contamination in an Ebola virus disease convalescent ward. J Hosp Infect **2015**; 91:185–6.
6. Johnson O, Youkee D, Brown CS, et al. Ebola holding units at government hospitals in Sierra Leone: evidence for a flexible and effective model for safe isolation, early treatment initiation, hospital safety and health system functioning. BMJ Glob Health **2016**; 1:e000030.
7. Fitzgerald F, Awonuga W, Shah T, Youkee D. Ebola response in Sierra Leone: the impact on children. J Infect **2016**; 72:S6–S12.

DOI: 10.1093/infdis/jiw548

Nitazoxanide Is an Ineffective Treatment of Chronic Norovirus in Patients With X-Linked Agammaglobulinemia and May Yield False-Negative Polymerase Chain Reaction Findings in Stool Specimens

TO THE EDITOR—Thorne et al have recently reviewed antiviral therapeutic approaches for norovirus infection [1]. The authors concluded that nitazoxanide was the only compound to have undergone preliminary trial testing as a potential antiviral therapy for norovirus, having previously been shown to reduce symptom duration in immunocompetent patients, as well as to resolve symptoms in a single chronically infected patient [1, 2]. The use of nitazoxanide as a treatment for chronic norovirus infection, however, has not been reported since. Here we describe the failure of nitazoxanide treatment to eradicate chronic norovirus infection in a chronically infected patient with X-linked agammaglobulinemia (XLA), despite of initial polymerase chain reaction (PCR) analysis of a stool specimen that suggested virus eradication.

Our patient with a genetically confirmed diagnosis of XLA initiated immunoglobulin replacement therapy at 12 weeks of age. At 10 years of age, he first presented with a diarrheal illness, which was confirmed to be norovirus associated, via findings of PCR analysis of a stool specimen. Norovirus infection persisted, resulting in chronic diarrhea and associated complications, including failure to thrive, pubertal delay, and nutritional deficiencies (in Fe, Cu, Zn, and vitamins A, D, E, and K). Multiple endoscopies with biopsy showed subtotal villous atrophy and intraepithelial lymphocytes; these histological findings have previously been described in patients with chronic norovirus infection [3]. Numerous treatment strategies aimed at augmenting the immune system in an attempt to clear norovirus infection or to control the chronic inflammatory process evident on intestinal biopsies have been studied. These strategies include oral budesonide; metronidazole and ciprofloxacin (as an empirical treatment for unidentified giardia or bacterial overgrowth); an increased parental immunoglobulin dose (2 g/kg/month); nasogastrically administered pentaglobin (25 mg/kg every 6 hours for 3 months [with a proton-pump inhibitor]); oral ribavirin; oral prednisolone; and melasalazine. A gluten-free diet (in view of the histological findings characteristically seen in celiac disease evident on duodenal biopsies) failed to provide any symptomatic improvement.