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Bioterrorism Agents and Hospital Infection Control: No Time to Drop the Guard

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The hospital setting represents the sounding board for several infections, both from the community and from healthcare facilities, including highly communicable and emerging agents that cause severe and lethal infections. The US cases of anthrax in 2001 [1] and the recent outbreaks (severe acute respiratory syndrome, H1N1 flu, avian flu, Shiga toxin producing *E. coli*, etc.) have heightened the need for preparedness and response to naturally emerging and re-emerging infections or deliberately released biological agents. However, there are some critical points to be discussed.

Currently there is less pressure by the media on bioterrorism threats; therefore a fall of attention on the preparedness towards them could be possible. In other words, can we promptly recognize threats represented by newly emerging or deliberately released highly communicable infections? In the hospital setting, an initial step for a prompt recognition and identification of such infections is represented by the implementation of hospital surveillance aimed at early detection of cases and clusters of severe unexplained infections that might signal the emergence or re-emergence of public threat. Focus of this kind of surveillance is represented by transmissible diseases clustering and by novel or unusual illnesses, even as sporadic case.

However, hospital infection control activities are often more addressed to alert microorganism or active surveillance for endemic pathogens, whereas bioterrorism or outbreak surveillance is poorly represented. In a survey of infection control resources in New York State Hospitals, 2007, the time dedicated by infection prevention and control professionals for emergency/bioterrorism problems was 8.5% of their overall time [2]. In a recent Italian survey, less than 30% of Italian Infection Control Committees had ongoing outbreak surveillance [3].

Whenever the alert is done, the hospital infection control unit should be promptly notified in order to organize an appropriate response and management. Each healthcare institution should have protocols/recommendations to implement transmission-based precautions. However, are healthcare workers enough prepared?

Following the anthrax attack in the USA, the crucial role of nurses was acknowledged. Nurses are the front-line healthcare workers in case of a bioterrorist event, because they may be the first to recognize a deliberate release, and because they are the keystone for the practical application of organizational policies for the protection of patients and personnel.

In a recent review of qualitative and quantitative studies on the hospital nurse's role in responding to a bioterrorist event, Smith et al. [4] evidenced how nurses feel themselves unprepared although they are willing to respond to it. In these studies, the lack of education in areas as infection control for bioterrorism agents is one of the most relevant reasons for this feeling. They do not feel adequately trained, supported or informed with regard to emergency plans, and in some cases they believe hospital plans for responding to a bioterrorism event are inadequate.

Another critical point is represented by the practical infection control measures to be adopted. The agents most likely to be used in a bioterrorist attack are anthrax, plague, botulism and smallpox which can be spread via contaminated food, water, aerosols or entry through skin lesions. Infection control precautions are represented by standard precautions (botulism, tularemia and bubonic plague), droplet precautions (pneumonic plague), contact precautions (anthrax) and airborne precautions (smallpox and hemorrhagic fevers that also require strict contact precautions). Most of these infection, but smallpox, hemorrhagic fevers and pneumonic plague, do not require strict isolation rooms. The basic and most important measure is still represented by hand hygiene and in particular hand washing. How proper is hand washing for bioterrorism agents?

Alcohol-Based Hand Rubs (ABHR) plays a key role in reducing the transmission of pathogens in acute care settings, especially as part of a comprehensive hand hygiene program [5]. The introduction of ABHR as a key component of a hand hygiene program is associated with reduced hospital-associated infection rates, including respiratory tract infections and those caused by Methicillin-Resistant *Staphylococcus aureus* (MRSA).The use of ABHR is currently the standard of care for hand hygiene practice in health care settings when hands are not visibly soiled, as recommended by the Centres for Disease Control and Prevention (CDC) and the World Health Organization, and by most of the international agencies for infection control, including the Society for Healthcare Epidemiology of America (SHEA) and the Association for Professionals in Infection Control and Epidemiology (APIC).

ABHRs reduce hand contamination during routine patient care more effectively than hand washing with soap and water. However, data are equivocal for removal of sporal agents [6]. Indeed, data on alcohol hand rubs and *Clostridium difficile* are scant. Studies on the impact of the introduction of alcohol hand rub policy on *C difficile* incidence are also controversial. Gopal Rao et al. [7] found a consistent, though not significant, reduction in MRSA infection and *C. difficile* associated diarrhoea. King [8] found a reduced MRSA incidence and an increased *C. difficile* incidence, and Boyce et al. [9] found essentially no change in the incidence of *C. difficile* infection.

More recently, in a randomized crossover comparison among 10 volunteers with hands experimentally contaminated by *C. difficile*, Oughton et al. [10] found that hand washing with soap and water showed the greatest efficacy in removing *C. difficile* as compared to alcohol rub and antiseptic wipes. Few weeks later the above mentioned report, another article was published where Jabbar et al. [11] spread

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C. difficile spores on the bare palms of 10 volunteers, and again found that hand washing with soap and water was more effective at removing *C. difficile* spores from the hands than ABHRs. After use of ABHR residual spores were readily transferred by a handshake.

In 2003, Weber et al. [12] evaluated the efficacy of several hand antiseptics, including a waterless rub containing 61% ethyl alcohol, a 2% chlorhexidine gluconate preparation, and an antibacterial microfiber towel that releases hypochlorite versus water and non antimicrobial soap against a surrogate of *B. anthracis*, i.e. *B. atrophaeus*, in healthy volunteers. In this evaluation the only agent that was ineffective in removing spores was the waterless rub containing ethyl alcohol.

How can healthcare workers be exposed to *B. anthracis* in the healthcare setting? The direct contact with cutaneous lesions of anthrax can cause person-to-person transmission, including patient-to-healthcare worker transmission. However, in this case, responsible of the infection is the vegetative state of the organism that is not as resistant as the spore state to antiseptics. A possible healthcare risk derives from persons exposed to *B. anthracis* that arrive at the hospital with contaminated clothes. An unprotected contact with clothes or items contaminated by spores may result in acquisition of infection. Finally, acquisition of infection in the lab is due to direct contact with contaminated surfaces.

Can alcohol-based rubs be routinely used during an anthrax intentional release? In 2002, CDC reported a case of suspected cutaneous anthrax in a worker at laboratory who had been processing environmental samples for *Bacillus anthracis* in support of CDC investigations of the 2001 bioterrorist attacks in the United States. The probable source of exposure was the surface of vials containing *B. anthracis* isolates that the worker had placed in a freezer. The storage vials had been sprayed with 70% isopropyl alcohol, which is not sporicidal, instead of a bleach solution because bleach had caused labels to become dislodged. The worker did not wear gloves when handling the vials. A culture of the vial tops performed at that laboratory tested positive for *B. anthracis*.

Lab workers working with *B anthracis*, emergency/first aid front-line workers and healthcare workers who are likely to face people with contaminated clothes or items should not rely on alcohol-based hand rubs for hand washing. In these cases, water and soap or antiseptics is the best practice for hand washing. However, when hands are not visibly soiled, ABHR remains the standard of care for hand hygiene practice in settings where patients with clinical infections caused by these agents are staying.

In conclusion, the surge capacity of each healthcare institution to rapidly expand beyond normal services in case of bioterrorism threat should be strengthened. Infection control education and training should include also bioterrorism precautions, and innovative educational programs should be implementing to create and maintain the readiness of infection control teams, appropriately trained on events of large scale public health emergency or disasters.

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