Protecting healthcare workers in epidemics and pandemics

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AIMS

- Explain the basics of transmission
- Show potential consequences of healthcare associated infections During epidemics and pandemics
- Discuss minimal requirements to prevent health-care associated infections during epidemic and pandemics

SUMMARY

Health-care associated infections remain to be a major issue in medicine. The European Center of Disease Control (ECDC) estimates that annually 4.100.000 patients acquire such an infection in the EU and that these infections are associated with significant morbidity [1]. It is important to note that these data focus an bacterial infections and that there is only limited surveillance for viral health care associated infections. Still nosocomial outbreaks of endemic viruses in hospitalized or ambulant patients at risk for severe disease are frequently reported [2-8] . Indeed, a recent study from Germany showed that almost 50% of the hospitalized norovirus cases with gastroenteritis were the result of nosocomial infections [9]. These findings leave little to no room for optimism that the global burden of health-care associated viral infections will be limited.

During epidemics and pandemics healthcare associated infections are even more of a concern. In the absence of sufficient infection control, hospitals may catalyze an ongoing outbreak or even start one. The latter was recently illustrated in South Korea with a Middle East Respiratory Syndrome-coronavirus outbreak following a single patient exposure [10, 11]. Besides this risks of healthcare associate outbreaks for the community, health care workers (HCWs) may also suffer from severe disease and in extremis death. This became painfully clear during the recent Ebola outbreak in West Africa. Depending on their occupation in the health service, health workers were between 21 and 32 times more likely to be infected with Ebola than people in the general adult population. Overall from January 2014 to 31 March 2015, health workers accounted for 3.9% (815/20 955) of all confirmed and probable Ebola cases reported [12]. These tragic events continue to have an effect on the local healthcare system, extending the impact of Ebola beyond the timeframe of the actual outbreak. For instance the World bank calculated that in affected countries over 4000 women may die in childbirth as a direct result from the loss of healthcare workers to Ebola alone [13].

In order to prevent disease in HCWs it is pivotal to understand the routes of transmission of a given pathogen. For this PREPRAE/ECDC course I will focus on the transmission of respiratory viruses. The reason for this is that the basic reproduction number is highest for these viruses. (The basic reproduction number is the number of secondary cases which one case would produce in a completely susceptible population [14].) In this respect measles virus may arbitrarily be the most contagious pathogen for humans

[15]. In addition, protection measures effective against highly infectious respiratory viruses usually also protects against viruses with another route of transmission. That does not mean that other pathogens using different routes of infection (i.e. contact, blood or contaminated medical instruments) should be disregarded as possible danger to HCWs [16].

Three major routes play a role in the transmission of respiratory transmissible viruses: First, transmission may occur through small particle aerosols. These can be less than 5 micrometer in diameter and may only contain a sole virus. They are thought to spread following cough or sneeze, but breathing alone may also result in their release [17-19]. Following release they may travel distances far beyond a meter. Their specific physical properties make it that gravity has little or no effect on them and thus these particles may remain airborne for long periods. In addition, activities in the room may redistribute virus in the air. Second, transmission may occur through droplets and larger particles. These are again spread following sneeze and cough, but do not travel very far [17]. Usually not more than a meter and thus transmission requires close person-to-person contact. Finally, virus may be spread through fomites. This does require viral stability on surfaces [17, 20]. Overall Respiratory tract viruses can be transmitted by all these routes, but the level to which this happens depends on the virus involved and behavioral factors of the host [18, 21, 22].

It is of note that some of the above mentioned concepts on small particle and droplet transmission are now challenged by the ground breaking work of Bourouiba and co-workers and perhaps some revision may be necessary in the near future [23].

For protection of HCWs the use of personal protection equipment (PPE) is pivotal since use of this equipment can reduce the risk of transmission. A plethora of PPE currently available for use, however, it remains unclear which type of PPE protects best. Recently a Cochrane review was conducted on the use of PPE by HCWs exposed to highly infectious diseases. For their review Verbeek et al. collected data from studies on the risk of infection, contamination, or noncompliance with protocols during outbreaks. In addition, studies on simulated contamination with fluorescent markers or a non-pathogenic virus/bacteria, various ways of donning or removing PPE and the effects of various types of training were included. After selection: nine studies with 1200 participants were found to be eligible for data extraction. Of these studies eight dealt with simulated exposure with a fluorescent marker or virus or bacteria, five evaluated different types of PPE against each other, two compared manners of donning and removing PPE and three evaluated the effect of different types of training. The data extracted showed that despite the use of PPE marker was still detected on the skin of 25% to 100% of the study subjects .The use of breathable clothing did not result in more contamination than non-breathable clothing, but users were more satisfied when wearing them. Gowns led to less contamination than aprons and two pairs of gloves to less contamination than one pair of gloves. Most important, active training led to less errors compared to passive training [24].

In summary, during my presentation I will provide an overview on how and when transmission occurs, show lessons learned from Ebola and MERS and discuss PPE. Finally I will share my thoughts on the minimal requirements to prevent health-care associated infections during epidemic and pandemics. These minimal requirements are summarized below:

- **Have a plan for management of (suspected) patients**
- **Make sure the plan is easily accessible for all HCWs**
- **Have (enough) PPE available and accessible**
- **Train (a dedicated group of) HCW on the use of PPE**

- **Routinely ask for possible infection risk factors (travel etc)**
- **Screen patients for pathogens**
- **Identify possible rooms for isolation**
- **Consider infection before high risk medical procedures**
- **Prepare laboratory for testing of contaminated samples**

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