

Safe hand drying

Recent studies suggest that single-use paper towels are the safest way to dry hands – jet air dryers are efficient but can disperse microbes widely and create aerosols that could be inhaled

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According to a 1997 study, approximately 30% of people did not wash their hands after using the toilet and more than 50% washed without using soap, failing to cleanse and disinfect their hands, Keith Redway (Emeritus Fellow, Department of Biomedical Sciences, University of Westminster, UK) told the audience at a satellite symposium at the FIS/HIS conference.

A series of studies has since compared the different patterns of dispersal of droplets and micro-organisms when different hand drying methods are used. Three methods of hand drying have been studied: single-use paper towels (PT); warm air dryer (WAD); and a jet air dryer (JAD). The main objective of all the studies was to determine the relative levels of microbe dispersal rather than the absolute values.

The first study looked at dispersal of droplets by means of acidic liquid, and dispersal of micro-organisms using yeast and bacteria (normal flora). In each case there was much more dispersal with the JAD.

A more recent study examined the dispersal of virus particles during hand drying. A bacteriophage was used for the study as this could represent the type of dispersal patterns that could be seen with the influenza virus, rotavirus or Norovirus, said Mr Redway. The bacteriophage was grown in host *Escherichia coli* (*E. coli*) to produce a concentration of 10^{10} plaque-forming units per ml. For this study, lawns of



“Limiting dispersal of micro-organisms is a fundamental principle in infection control”

E. coli were prepared on agar plates. The plates were then used to detect dispersed virus particles. Virus particles landing on the plates cause clear plaques to appear where the bacteria have been lysed. Gloved hands were washed in 50ml of the virus suspension for 10 seconds and then dried for 10 seconds using a paper towel or JAD, or for 20 seconds using a WAD.

Vertical plates were positioned at six different heights near to the dryers. The results showed that the mean total numbers of plaques were 1.6, 34.4 and 2218.7 for PT, WAD and JAD, respectively. Put another way, the WAD and JAD results were 60-fold and 1300-fold greater than the PT, said Mr Redway. The WAD deposited most organisms at the lowest level, and the JAD deposited most

at chest height, reflecting the directions of airflow of the two types of device. Chest height for an adult would be head height for a young child, noted Mr Redway.

When the distance of dispersal was investigated, some virus particles were detected next to the paper towel dispenser (that is, at zero metres) when PT was the drying method and some within 0.5m when WAD was used. The JAD, which blows air upwards and outwards, deposited virus particles in significantly higher numbers than the other drying methods as far away as three metres.

An air sampler was used to measure aerosol particles of the virus suspension over a 15-minute period. The sampler nozzle was positioned 0.1m and 1.0m away from the operator, and also behind the operator. The results showed that there were few aerosol particles in the air after use of PT or WAD. When the JAD was used, levels were very high initially and fell exponentially during the 15-minute sampling period but remained higher than levels seen with the other two methods. This means that if there had been residual virus on the hands it could remain in the air and potentially be inhaled for some time afterwards, commented Mr Redway.

The air speed of JADs is estimated to be 600km/hour (more than 400 miles/hour). Hands are dried by stripping the water off them rather than allowing rapid evaporation; in the process micro-organisms and skin squames are also stripped away, he explained.

Mr Redway recommended that the choice of drying method or device should be carefully considered for areas where cross-contamination is critical, such as hospitals, clinics, care homes, food handling establishments and, possibly, cruise ships.

Real-life studies

The chance observation that droplets of water were spattered on to his face when using a jet air hand dryer had first alerted his interest in the potential infection control risks posed by electric hand dryers. Mark Wilcox (Professor of Medical Microbiology, University of Leeds, UK) told the audience.

There has been much emphasis on the role of handwashing in infection control but little on hand-drying, despite the fact that it is well known that wet hands transmit micro-organisms more efficiently than dry ones. He noted that the current National Health Service guidance document, *Health Building Note: Infection control in the built environment*,¹ offers little help. It says:

"Hot-air hand dryers reduce paper waste and may be considered for use in public areas of healthcare facilities, but should not be installed in clinical areas as they are noisy and could disturb patients."

There is, therefore, little to guide estates departments from the infection control viewpoint and, given the drying efficiency of JADs, it is not surprising that JADs have been installed in some hospitals in toilets and washrooms for the public. Moreover, it is not unusual to find JADs close to urinals or positioned next to children's hand basins, where droplets could be blown into the child's breathing zone, he added.

A study to assess the efficiency of different drying methods and the relative propensities for environmental dispersal of micro-organisms had been carried out. This study used a high inoculum of *Lactobacilli* (the same organisms as in Actimel yoghurt). Air sampling was used to detect aerosolised micro-organisms and settle plates were used to detect those that settled on surfaces.

The results showed a 4.5-fold (significant) difference in the numbers of bacteria in the air when comparing a WAD with a JAD and a 27-fold difference between the JAD and the PTs. Settle plates found the greatest numbers below the WAD, as expected, because of the direction of airflow, said Professor Wilcox.

Another study had attempted to show how far larger droplets are 'spattered' by determining the dispersal pattern for liquids when the three drying methods were used; this was done by using black paint. The researcher and a bystander wore white Tyvek suits (back to front so

Meticulous hand washing

Asked about the risk of recontaminating hands through contact with taps or door handles that could have been touched by previous users who washed less thoroughly or not at all, Professor Wilcox suggested the following procedure:

1. Turn on tap; soap the hands using the soap/detergent dispenser and use to cleanse the top of the tap.
2. Continue to wash the hands then rinse the hands and rinse the tap.
3. Dry the hands using paper towels.
4. Take another paper towel and use it to operate the handle of the door; deposit the towel in first available waste bin.

"The jet air dryer deposited particles as far away as three metres"

as to cover the face) and the walls of a mock-up washroom were covered in white material. When PTs were used, there were no black spots on the researcher or the bystander. When the WAD and JAD were used, there was spatter on the upper body, and when the JAD was used, the bystander was also spattered to a significant extent. Spatter was also evident on the wall near the JAD. Lateral spread of droplets can be up to 1.2–1.4m with a JAD, commented Professor Wilcox. The total mean spot counts (of spattered paint) were zero for the PTs, 65.8 for the WAD and 144.0 for the JAD.

Clearly, the JAD is associated with aerosolisation of liquid on the hands, and the most important question here is whether the use of JADs actually increases the risks of spreading infection, said Professor Wilcox.

A report of an outbreak of Norovirus infection in aircrews after an incident in which a patient had vomited in the main cabin lends weight to the idea that aerosols can spread infection, he suggested. The report showed that members of aircrews who were not present at the initial incident continued to become infected for more than a week afterwards. This suggested that the virus was present in the air or on surfaces in the aeroplane for a prolonged period.

Next, a study was conducted in two similar washrooms used by the public and clinical staff. The two rooms had similar footfalls and the only difference was that one used PTs and the other had JADs. Samples collected from the air and surfaces were examined for total bacterial counts and cultured for specific potential pathogens including *Staphylococcus aureus*, *Enterococci* and gram-negative bacilli. The air sampling results showed that the JAD room was more heavily contaminated. There was also a greater range of bacteria in the JAD room. Dust from the floor was also examined and found to be more heavily contaminated in the JAD room.

In summary, Professor Wilcox said that laboratory and *in situ* studies showed both qualitative and quantitative differences in both droplet and microorganism dispersal according to the three hand-drying methods.

Conclusions

At present, direct evidence of infection transmission as a result of using JADs is lacking and so it would be difficult to justify a complete ban on their use in healthcare establishments. However, limiting dispersal of micro-organisms on hands or in the air is a fundamental principle in infection control, and there are clear differences between the hand drying methods in their capacities to disperse hand-borne microbes, Professor Wilcox concluded. Lastly, he noted that when outbreaks (of, for example, Norovirus infection) are investigated, hand-drying methods are not on the list of standard questions used to determine risk factors for cases. ●

Reference

1. Department of Health. Health Building Note. Infection control in the built environment. www.gov.uk/government/uploads/system/uploads/attachment_data/file/170705/HBN_00-09_infection_control.pdf (accessed November 2016).

FIS/HIS conference

The satellite symposium, *Risk of microbe dispersal during hand drying*, sponsored by the European Tissue Symposium (the European Tissue Paper Industry Association) took place during the joint Federation of Infection Societies Annual Conference and Healthcare Infection Society International Conference in Edinburgh, 6–8 November 2016.