

EUROPEAN TISSUE SYMPOSIUM



European Tissue Symposium

Position on the hygiene of electric air dryers versus paper hand towels - November 2022

Introduction

ETS is the European Tissue Paper Industry Association. The members of ETS represent the majority of tissue paper producers throughout Europe and around 90% of the total European tissue production. ETS was founded in 1971 and is based in Brussels.

This document outlines ETS's position supporting the use of paper hand towels for hand drying after washing for the promotion of good hand hygiene within the general population.

Although the general population's awareness regarding the necessity of hand hygiene continues to increase after the recent pandemic, most people do not understand the importance of optimal hand drying. Many scientific studies have demonstrated that the use of absorbent single use towels, for example paper hand towels, to dry the hands offers the optimal level of both hand and washroom hygiene.

Steps in hand hygiene

- **Hand washing**

The purpose of hand washing is to reduce the number of microbes on the hands and therefore to prevent harmful microbes from directly entering the body via the hands or indirectly via food. **Hand washing is a key element of personal hygiene.**

- **The drying method**

Washing of the hands loosens these micro-organisms on the surface of the skin and brings them from the deeper layers of the skin to the surface. Rinsing the hands with water does not remove these micro-organisms: drying plays a crucial role in microbe removal by removal of microbes suspended in water droplets.

'Clean hands are safer hands' states the WHO (World Health Organisation). In the 'hand-washing techniques with soap and water' published in the WHO's global guidelines to reduce contamination, the instructions end with 'rinse hands with water' and '**dry thoroughly with a single use towel**'. See

http://apps.who.int/iris/bitstream/10665/44102/1/9789241597906_eng.pdf

The Evidence

Scientific studies have demonstrated that the use of absorbent single use towels, for example paper hand towels, to dry the hands offers the optimal level of both hand and washroom hygiene.

1. Numbers of microbes on the hands

Regarding hand hygiene, warm air and jet air dryers, are not as effective in removing microbes from the hands as single use towels. The friction generated by rubbing hands against a towel and the high absorption qualities of tissue mean that paper is very effective in reducing the microbial loads on the hands. Indeed, scientific studies carried **out both in the laboratory and under real-life conditions** have shown that the use of warm air and jet air dryers can actually increase the number of micro-organisms on the hands after drying, as well as contaminating the washroom environment (Ref 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12).

2. Washroom hygiene and aerosolization of microbes

When washroom hygiene is considered, four recent peer reviewed scientific laboratory studies have confirmed marked differences in the extent of aerosolization of microbes during the use of jet air dryers, warm air dryers and paper towels as hand dryers. (Ref 5, 6, 7, 12). The first study (5) demonstrated the higher level of airborne microbe dissemination by jet air dryers, particularly if hand washing is suboptimal. The jet air dryer dispersed liquid and microbes from users' hands further and over a greater range (up to 1.5 m) than the other two drying methods. The height distribution of the liquid and microbes were also measured and for electric driers the greatest number of droplets were observed at a height of 0.6 and 1.2m which equates approximately to the height of a child's face.

The second study (Ref 6) showed that, when paint droplets were used as a model for water droplets on the hands, drying with jet air dryers and warm air dryers contaminated both the user of the dryer and a bystander. Most droplets were observed in the region of the chest and the greatest numbers were seen when the jet air drier was used. In contrast, no paint droplets were seen on the user and bystander when they used paper hand towels to dry the hands. This study also found that air bacterial counts were four and 27 fold higher in the immediate vicinity of jet air dryers than in those of warm air dryers and paper towel dispensers, respectively. A similar pattern was found for bacterial counts at one meter away from the hand drying devices. In contrast, few (2.2 cfu) bacteria were detected in the air following paper towel usage. In addition, the aerosolized bacteria were seen to remain in the air for up to 15 minutes after hand drying.

The third study (ref 8) compared the potential of three hand drying methods; paper towels, a warm air dryer and a jet air dryer to disperse viruses and contaminate the immediate environment during use, by using a MS2 bacteriophage model. The results of the study show that the **use of jet air dryers leads to significantly greater and further dispersal of viral particles** from artificially contaminated hands **than warm air dryers and paper towels**.

In particular, over a height range of 0.15–1.65 m, the jet air dryer dispersed an average of over 60 and 1300-fold more viral particles than warm air dryers and paper towels, respectively. At all distances tested up to three meters, the jet air dryer dispersed an average

of over 20 and 190-fold more viral particles in total compared to the warm air dryer and paper towels, respectively. In addition, air samples collected around each hand drying device fifteen minutes after use showed that the jet air dryer dispersed an average of over 50 and 100-fold more viral particles than the warm air dryer and paper towels, respectively.

Recently, two studies carried out in operational hospital washrooms have been published (Ref 8, 9). The second study (Ref 9) confirmed the results of a pilot study performed in washrooms at a UK hospital (Ref 8) over 7 non- consecutive days. The new multicentre study, the largest of its type (Ref 8) was carried out over 12 weeks in each of 3 hospitals (UK/France/Italy) and compared the bacterial contamination levels in washrooms with where hand-drying was performed using either paper towels (PT) or a jet air dryer (JAD). Over 120 sampling sessions occurred over the 12 weeks in each of 3 hospitals and bacteria were cultured from air, multiple surfaces and dust.

Bacterial recovery was significantly greater from the external surfaces of JADs at all 3 hospitals. In the UK and France, a similar effect was seen with higher numbers of the bacteria (enterobacteria and enterococci) recovered from the JAD surfaces when compared with the PT dispenser. Low numbers of antibiotic resistant bacteria were also detected and these were most commonly found on floors, dryer surfaces and dust in JAD washrooms. For example, in the UK, the recovery of methicillin resistant *Staphylococcus aureus* was significantly more frequent from the floors of JAD versus PT washrooms (21 versus 7, $p=0.002$).

In the discussion, the authors state:

‘Consequently, we believe that electric hand dryers are not suited to clinical settings, and as such existent (for example, NHS) infection control building guidance needs to be amended and strengthened. Furthermore, it is difficult to justify a hand drying method that is associated with considerably greater propensity for microbe dispersal when potential pathogens are prevalent, including at certain times of the year or in specific settings. For example, during periods of high influenza and norovirus activity, airborne dispersal of pathogens, potentially during hand drying following suboptimal hand washing, is an infection control and/or public health concern.’

A pilot study (Ref 10) to investigate whether microorganisms that remain present on poorly washed hands can be transferred beyond the washroom environment to clinical and patient areas has found that **drying hands with paper towels as opposed to jet air dryers results in lower rates of virus contamination on hands and clothing.** The consequences of these different rates of contamination remaining on hands after drying were measured by sampling a series of surfaces to determine the extent of transmission of a virus beyond the washroom.

A bacteriophage was used to represent microbial contamination following two types of hand drying: one using paper towels, and the other using jet air dryers. Volunteers sanitised their hands before immersion in a liquid containing bacteriophage; they did this twice, once with each hand drying method. Hands were shaken three times to remove excess liquid

before drying. Volunteers also wore plastic aprons in order to be able to measure body/clothing contamination during hand drying.

All surfaces and samples investigated had bacteriophage contamination above the limit of detection following jet air dryer use. Contamination following hand drying with paper towels occurred on only 6 of 11 surfaces. For instance, simulated use of a hospital phone for 10 seconds resulted in detectable contamination following hand drying with jet air dryers. Trunk and clothing contamination was significantly higher following jet dryers use, compared to paper towels. On average, **the levels of contamination of surfaces following hand drying with jet air dryers were 10-fold higher than with paper towels.**

The researchers sampled the palm and fingertips immediately after drying to measure baseline hand contamination levels before environmental sampling. Volunteers then walked from the washroom on a pre-set route that included public and clinical areas. Samples were collected from environmental surfaces following contact with hands or apron. A stethoscope was placed around the neck, leaving the chest piece and earpiece in contact with the apron for some 7 minutes. Volunteers also crossed their arms across their chest for 2 minutes and then rested them on the arms of a chair for 3 minutes. Each surface was swabbed with a sponge-stick moistened with neutralising buffer, and surfaces were disinfected with chlorine wipes both before and after sampling.

The findings suggest **a higher potential for microbial spread through the hospital following jet air dryer use** – likely due to the increased risk of splattering on users. This is concerning because objects and surfaces can serve as reservoirs for microorganisms and be acquired via hand contact. The significantly greater contamination of items in close contact with healthcare professionals and patients – such as phones and stethoscopes – following jet air dryer use is particularly concerning. Minimising the potential for microbe dispersal is a fundamental principle of infection prevention. This study showed that the microbial contamination of the user's hands or trunk following jet air dryer use was directly and indirectly transferred onto surfaces via hand, clothing or skin contact.

The most recent study (Ref 11) used a bacteriophage to investigate whether microorganisms remaining on hands can disperse in the washroom environment and contaminate facemasks of other users. Two bystanders stood in the windowless washroom at a 1m and 2m distance from the dryer. They too wore masks. Following hand drying they replaced them with clean masks and waited a further 5 minutes to explore if air droplets continued to settle on clean masks. The results are as follows:

- Facemask contamination by splattering was 10-fold higher when drying hands with a jet air dryer compared to paper towels. This was the case for both the person drying their hands and the bystanders.
- For both methods, facemask contamination by droplet/aerosols deposition was higher in the first 5 mins following hand drying. Virus load was significantly higher with jet air dryer use.
- Facemask contamination in trials using jet air dryers increased at 15 minutes post-hand drying, suggesting aerosolization of small particles that remain airborne for longer.
- 88% of trials using jet air dryers were positive for bacteriophage recovery – compared with 29% of trials using paper towels.

- Positive assays on bystanders' masks were more than 20% higher in trials using jet air dryers than with those using paper towels.

The authors concluded that hand drying can cause aerosolization of microbial/viral particles, and promote their spread to the washroom environment and contaminate other users up to a 15 min period post hand drying. The risk of facemask contamination was significantly increased when using a jet air dryer compared with paper towels. Based on these observations, hand drying with paper towels is associated with a lower risk of droplet and aerosol dispersion compared with use of a jet air dryer.

In ETS's view, all of these results suggest that the use of electric air driers should be carefully considered in locations where hygiene is of paramount importance, such as hospitals, clinics, schools, nurseries, care homes, kitchens and other food preparation areas.

Using single use towels, for example, paper towels results in a significant decrease in the numbers of bacteria on the hands and is less likely to contaminate other washroom users and the washroom environment as compared to electric air dryers.

Conclusion

ETS believes that clean and absorbent single use towels, for example paper hand towels, are the best solution for drying the hands, as the skin must be thoroughly dried after washing to remove any remaining water droplets containing microbes.

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Note on Paper Towels and Sustainability

Sustainability is a key focus of the European Tissue Paper Industry. Hence ETS has extensive information and several position papers on the sustainability aspects of tissue which are summarized in a sustainability framework.

These documents can be found on:

<http://www.europeantissue.com/sustainability/>

Appendix – details of studies

Ref 1- University of Westminster « Hand drying: a study of bacterial types associated with different hand drying methods and with hot air dryer » (1998).

<http://www.europeantissue.com/wp-content/uploads/5.-IndStudy-AMSTP-study-1994-UoWM.pdf>

Ref 2 - TÜV Produkt und Umwelt GmbH (2005) confirmed the Westminster Study findings.

<http://europeantissue.com/pdfs/090410%20T%C3%9CV%20-%20Study%20of%20different%20methods%20used%20for%20drying%20hands%20Sept%202005.pdf>

Ref 3 - University of Westminster «Changes in the number of different types of bacteria on the hands before and after drying using paper towel, continuous cloth roller towel, warm air dryer and jet air dryer » (2010)

<http://www.europeantissue.com/wp-content/uploads/WU-Study-2010-Report.pdf>

Ref 4 - A.M. Snelling, T. Saville, D. Stevens and C.B. Beggs. ‘Comparative evaluation of the hygienic efficacy of a ultra-rapid hand dryer vs conventional warm air hand dryers.’ first published online: 7 SEP 2010 in the Journal Of Applied Microbiology,110

<http://onlinelibrary.wiley.com/doi/10.1111/jam.2010.110.issue-1/issuetoc>

Ref 5 - E.L. Best, K. Redway, “Comparison of Different Hand-Drying Methods: The Potential for Airborne Microbe Dispersal and Contamination,” *Journal of Hospital Infection* 89 (2015): 215- 217 <http://dx.doi.org/10.1016/j.jhin.2014.11.007>

Ref 6- E.L. Best et al., “Microbiological Comparison of Hand-Drying Methods: The Potential for Contamination of the Environment, User, and Bystander,” *Journal of Hospital Infection* 88 (2014): 199–206

<http://dx.doi.org/10.1016/j.jhin.2014.08.002>

Ref 7: P.T. Kimmitt & K.F. Redway “Evaluation of the Potential for Virus Dispersal During Hand Drying: A comparison of Three Methods” *Journal of Applied Microbiology* 120 (2016): 478- 486 <http://onlinelibrary.wiley.com/doi/10.1111/jam.13014/full>

Ref 8: M.H. Wilcox et al. Pilot Study to Determine whether Microbial Contamination Levels in Hospital Washrooms are Associated with Hand-Drying Method – Letter to the Editor” *Journal of Hospital Infection* 97 (2017) 200-203,

<http://www.sciencedirect.com/science/article/pii/S0195670117303894>

Ref 9: Best E, Parnell P, Couturier J, Barbut F, Le Bozec A, Arnoldo L, Madia A, Brusafferro S, Wilcox MH. Multicentre study to examine the extent of environmental contamination by potential bacterial pathogens, including antibiotic resistant bacteria, in hospital washrooms according to hand-drying method. *Journal of Hospital Infection*

Ref 10 Ines B. Moura Duncan Ewin and Mark H. Wilcox From the hospital toilet to the ward: A pilot study on microbe dispersal to multiple hospital surfaces following hand drying using a jet air dryer versus paper towels

[From the hospital toilet to the ward: A pilot study on microbe dispersal to multiple hospital surfaces following hand drying using a jet air dryer versus paper towels | Infection Control & Hospital Epidemiology | Cambridge Core](#)

**Ref 11. Ines B. Moura, Karen Bentley, Mark H. Wilcox 'Assessment of potential for viral contamination of user and environment via aerosols generated during hand drying'.
Frontiers in Public Health <https://www.frontiersin.org/articles/10.3389/fpubh.2022.1010802/full>**