

EUROPEAN TISSUE SYMPOSIUM



September 2018

European Tissue Symposium

Position on the use of electric air dryers versus paper hand towels

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.

Summary

This document outlines ETS's position in favour of 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, most people do not understand the importance of optimal hand drying. 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.

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).

When washroom hygiene is considered, three 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). 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 of 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 new 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.'

Finally, a study reported in the Mayo Clinic Proceedings (Ref 10), systematically reviewed the published research in English between January 1970 and March 2012 on the hygienic efficacy of four different hand-drying methods: jet air dryers, warm air dryers, cloth towels, and paper hand towels. Out of 446 records that were identified, the review focused on the twelve most important studies and assessed their conclusions on the different hand drying methods' effectiveness (speed of drying, degree of dryness, and effective removal of bacteria) and prevention of cross-contamination.

The study found little agreement in the reviewed research regarding the relative effectiveness of electric air dryers (jet air dryers and warm air dryers). However, **most of the research reviewed suggested that paper towels can dry hands efficiently, remove bacteria effectively, and cause less contamination of the washroom environment than electric air dryers.**

Context

Hygiene is one of the most important factors in the development of modern society. Good health, together with an improved quality of life, is directly related to good hygiene. One of the most important products for good hygiene is tissue paper, developed for all kinds of wiping and cleaning.

Hand hygiene is now generally recognized by the World Health Organisation as a very important element in infection control in hospitals. The impact of antibiotic resistant microorganisms on both health and the health economy, demonstrate that hand hygiene, economics and the ever improving quality of life are directly related. Keeping hands clean is one of the most important steps we can take to avoid sickness and spreading microorganisms in the environment. These can easily be avoided by washing and drying the hands thoroughly.

Although the necessity of this basic hygienic activity has been generally accepted, non-conclusive discussions continued until recently as to what is the most efficient and effective manner of drying hands, in order to arrive at the best hand hygiene.

Health and Hand Hygiene – The Link

All kinds of micro-organisms attach themselves to the skin on the hands. These micro-organisms are present both on the surface and deep in the skin. In addition, the hands regularly attract transient microbes (bacteria, viruses, fungi and various

spores) by touching contaminated surfaces or materials, or from the general environment. Although most microbes are vital for the good functioning of the human body, many of these micro-organisms can be a threat to our health. Some microbes can cause illness and be harmful to human beings, particularly when they are transferred to food or directly into the mouth or nose.

The First 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.

The Evidence

'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 role of correct hand drying after washing recently has been recognised as a key factor in the whole process of hand hygiene.

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.

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

- The number of bacteria present on the hands decreases by 58% on average when using paper to dry the hands, by 45% when using cloth and is increased by 255% when using hot air dryers.

<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>

- The number of bacteria on the surface of the hands decreases after washing and then drying with paper or cloth towels. TÜV demonstrated an average reduction of 24% in the number of most bacterial types present on the hands when using paper, compared with a decrease of 4% for cloth and an increase of 117% when the hands were dried with hot air.
- This same TÜV-study also published **their specific findings on the presence of micro-organisms after hand washing.**
 - On hands dried with cloth or paper towels, only fixed (permanent) microorganisms were still present due to the high absorption properties of the materials.
 - On hands dried using hot air dryers, there was still a mixture of transient bacteria to be found on the hands after drying because these bacteria are not absorbed.

As demonstrated in this study, towels, and especially paper towels, remove the bacteria together with the water through absorption. While only very small bacterial populations were detectable on the paper towels before use, their number on the paper towels increases greatly after use.

This finding not only corresponds to that of previous studies, but also indicated that, when using a hot air dryer, additional bacteria may be deposited on the hands by the contaminated air stream.

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>

- After washing and drying hands with the warm air dryer, the total number of bacteria was found to increase on average on the finger pads by 194% and on the palms by 254%
- Drying with the jet air dryer resulted in an increase on average of the total number of bacteria on the finger pads by 42% and on the palms by 15%;
- After washing and drying hands with a paper towel, the total number of bacteria was reduced on average on the finger pads by up to 76% and on the palms by up to 77%.

Ref 4 - A.M. Snelling, T. Saville, D. Stevens and C.B. Beggs. 'Comparative evaluation of the hygienic efficacy of an 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>

The study performed by the University of Bradford, confirmed that:

- Hand drying is an essential part of hand washing procedures as a diverse mixture of bacteria remain on the hands after washing.
- Rubbing hands together in an electric hand dryer increased the bacterial numbers on the hands.
- Paper towels proved to be more efficient than the electric driers tested, halving the bacterial count because paper towels actually remove the bacteria.

The authors say '***The use of paper towels for drying hands consistently outperformed all the other drying techniques tested, especially with regard to the removal of bacteria from the palms and fingertips.***'

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>

This study assessed the potential for airborne microbe dispersal of four hand drying methods (paper towels, cloth roller towels, warm air, and jet air dryer) by using three different experimental models (lemon juice as an acid indicator, yeast dispersal, and bacterial transmission from hands). The study demonstrated the higher levels of airborne microbe dissemination by jet air dryers, particularly if hand washing is suboptimal. The jet air dryer dispersed liquid and yeast from users' hands further and over a greater range (up to 1.5 m) than the other drying methods tested. The height distribution of the liquid and microbes were also measured and the greatest number of droplets for jet air dryers were observed at a height of 0.6 and 1.2m which equates approximately to the height of a child's face.

Both types of towels (paper towels and cloth roller towels) performed better than electric dryers (jet air dryers and warm air dryers) in terms of droplet dispersal, presumably as the use of towels generates minimal air currents.

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>

This study confirmed marked differences in the extent of aerosolization of bacteria during the use of jet air dryers, warm air dryers and paper towels as hand dryers in public bathrooms.

The first part of the study compared the propensity of jet air dryers, warm air dryers, and paper towels to contaminate an enclosed environment by measuring

amounts of a test bacterium in the air both in the vicinity and one meter away from the hand drying devices. The study found that air bacterial counts were four and 27 fold higher in the immediate vicinity of jet air dryers than in that of warm air dryers and paper towel dispensers, respectively. A similar pattern was found for bacterial counts at one meter away of the hand drying devices. In contrast, **few (2.6cfu) bacteria were detected in the air following paper towel drying**, and the low numbers were similar in the vicinity and one meter away (2.6cfu and 2.2cfu respectively) from the point of hand drying.

In the second part of the study, hands were coated with water based black paint to allow visualization of water droplets on the hands after washing. The hands were then dried with the three different hand drying methods and the number of droplets on users and bystanders wearing disposable suits were counted. The study showed that, when jet air dryers and warm air dryers were used, paint droplets contaminated both the user of the dryer and a bystander. Most droplets were observed in the region of the chest and the greatest number 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.**

The study therefore demonstrates 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. The authors say that: "***These results suggest that air dryers may be unsuitable for use in healthcare settings as they may facilitate microbial cross-contamination via airborne dissemination and droplet dispersion to the environment or bathroom visitors***".

ETS believes that results of the study are also particularly relevant when considering the implementation of hand drying methods in sensitive public environments, where there is a naturally enhanced risk of viral and bacterial contamination.

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>

This study 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.

The authors recommend that **the choice of hand-drying device be considered carefully in areas where infection prevention concerns are paramount**, such as healthcare settings and the food industry.

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>

This pilot study examines prospectively the levels of real-life environmental bacterial contamination in hospital washrooms associated with two hand-drying methods: paper hand towels and jet air dryers. This study showed that significantly lower levels of bacterial contamination were found in the washroom with paper hand towels; in general, the floor, dryer unit and dust were more heavily contaminated in the washroom with a jet air dryer.

Ref 9: Best E, Parnell P, Couturier J, Barbut F, Le Bozec A, Arnaldo L, Madia A, Brusaferrero 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 in the press

[https://www.journalofhospitalinfection.com/article/S0195-6701\(18\)30366-9/pdf](https://www.journalofhospitalinfection.com/article/S0195-6701(18)30366-9/pdf)

A multicentre, internal-crossover study comparing bacterial contamination levels in washrooms with hand-drying by either paper towels (PT) or jet air dryer (JAD) was performed. There were 120 sampling sessions over 12 weeks in each of 3 hospitals (UK/France/Italy). Bacteria were cultured from air, multiple surfaces and dust. Washroom footfall (patients/visitors/staff) was monitored externally. Footfall was nine times higher in UK washrooms.

The results showed that bacterial contamination was lower in PT vs JAD washrooms; contamination was similar in France/UK, but markedly lower in Italy washrooms. Total bacterial recovery was significantly greater from JAD versus PT dispenser surfaces at all sites (median 100-300vs0-10 CFU; all $p < 0.0001$). In UK/France, significantly more bacteria were recovered from JAD washroom floors (median 24vs191 CFU, $p < 0.00001$). In the UK, MSSA recovery was 3x more frequent and 6-fold higher for JADs vs PTs surfaces (both $p < 0.0001$). The UK MRSA recovery was 3x more frequent (21vs7 occasions) from JAD versus PT surfaces or floors. Significantly more enterococci and ESBL-producing bacteria were recovered from UK JAD versus PT washroom floors ($p < 0.0001$). In France, ESBL-producing bacteria were recovered from dust twice as often during JAD versus PT use.

The study showed that multiple examples of significant differences in surface bacterial contamination, including by faecal and antibiotic resistant bacteria, were observed, with higher levels in JAD versus PT washrooms. The authors concluded that the hand-drying method

affects the risk of (airborne) dissemination of bacteria in real world settings.

Ref 10 - Huang C. et al., "The Hygienic Efficacy of Different Hand-Drying Methods: A Review of the Evidence,"

***Mayo Clinic Proceedings* 87(8) (2012):791-798**

<http://dx.doi.org/10.1016/j.mayocp.2012.02.019>

This study systematically reviewed the published research in English between January 1970 and March 2012 on the hygienic efficacy of four different hand-drying methods: jet air dryers, warm air dryers, cloth towels, and paper hand towels. Out of 446 records that were identified, the review focused on the twelve most important studies and assessed their conclusions on the different hand drying methods' effectiveness (speed of drying, degree of dryness, and effective removal of bacteria) and prevention of cross-contamination.

There was little agreement in the twelve studies regarding the relative effectiveness of electric air dryers (jet air dryers and warm air dryers). However, **most of the studies reviewed suggested that paper towels can dry hands efficiently, remove bacteria effectively, and cause less contamination of the washroom environment than electric air dryers.** In particular, the study **made the following points:**

- ✓ Hand washing is the most important measure to reduce the burden of health care-associated infection.
- ✓ Because the transmission of bacteria is more likely to occur from wet skin than from dry skin, the proper drying of hands after washing should be an essential component of hand hygiene procedures.
- ✓ The hygienic efficacy of hand drying includes drying efficiency, the effective removal of bacteria, and the prevention of cross-contamination.
- ✓ **From a hygiene viewpoint, paper towels are superior to electric air dryers.**
- ✓ Drying hands thoroughly with single-use, disposable paper towels is the preferred method of hand drying in health care.
- ✓ The provision of paper towels should be considered as a means of improving hand hygiene adherence among health care workers.

In ETS's view, all of these results suggest that the use of electric air drying devices 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.

Consensus Statement of a Panel of Experts on Hygienic Hand Drying

The European Tissue Symposium has sponsored scientific panels on hygienic hand drying with eminent microbiologists and hospital hygienists from across Europe at the Catholic University of Leuven on 20 March 2013, on 11 June 2014, 14 April 2015, 10 March 2016 and 15 November 2017. Panelists were asked to review the science on hand drying and the hygienic performance of hand drying devices, such as paper towels, textile towels, and hot air dryers, and to make recommendations for future scientific research and public policy.

After a review of the key scientific literature, the experts prepared a Consensus Statement on hygienic hand drying, the document can be accessed here:

<http://europeantissue.com/hygiene/consensus-statement-on-hygienic-hand-drying/expert-consensus-statement/>

User-Preference

Last but not least: users themselves have expressed a strong preference for hand drying with single use paper towels.

- An Intermetra consumer survey commissioned by ETS (2008) in a number of European countries identified users' preference among different hand drying systems in public restrooms. This survey confirmed that about 2 consumers out of 3 prefer paper tissue towels (while the remaining 1/3 is split among air dryers and textile rolls) and that their key motivation is hygiene, in addition to the speed of drying and driest feeling.

<http://www.europeantissue.com/pdfs/090415%20Intermetra%20Users%20preference%20study%204%20countries%202008%20Report%20June%202008.pdf>

- An **extensive observational study at ISSA/Interclean 2016** confirms that the vast majority of users prefer Paper Towels to Jet Air Dryers

Some of the washrooms at ISSA/Interclean Amsterdam 2016 were equipped with **BOTH, Paper Towels and Jet Air Dryers**, one on top of the other.

The behavior of **3.879** Visitors (2.474 Men and 1.405 Women) **drying** their hands was observed, in four washrooms, equipped with both **Paper Towels** and **Jet Air Dryers**.

Among Men, the preference for using Paper Towels was significant: **90%** vs. **13%** using the Jet Air Dryers.

The total is above 100%, because some of the users of the Jet Air Dryers, **also used Paper Towels to finish the drying job.**

Among Women, the preference for using Paper Towels was even stronger: **91%** vs. **11%** using the Jet Air Dryers.

<http://europeantissue.com/about-tissue/away-from-home/properties-of-tissue/user-preference-observational-study-issainter-clean-amsterdam-2016/>

Conclusions

The level of awareness regarding the importance of hygiene, especially hand hygiene continues to increase. However, one of the major factors in achieving better hand hygiene culture is that the population correctly understands the optimal way to dry the hands.

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. As physical tests have demonstrated, paper towels can absorb up to nine times their own weight in moisture. This absorptive capacity or moisture absorption of paper towels during hand drying is therefore important for the removal of microbes suspended in water droplets.

The Future

The European tissue paper producers will continue to do the following:

- Invest in the development of high quality and innovative paper products that will help achieving an ever better level of hygiene for all.
- Invest in innovation that not only increases the creation of better paper products, but also hygienic and user friendly dispensers, thus contributing to delivery systems that provide hygiene consistency throughout the hand cleaning process;

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Note on Paper Towels and Sustainability

Sustainability is one of the ultimate goals in the minds of the European Tissue Paper Industry. Hence ETS has extensive information and several position papers

on the sustainability aspects of tissue related to Production, Environment, Health & Safety and Product Safety.

These documents can be found on:

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

And

<http://www.europeantissue.com/position-papers/position-papers/environment/>