

Keywords

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Disinfection in the domestic area – what is really meaningful?

Summary

Routine use of disinfectants at home has to be rejected in general although advertisements often describe the domestic environment as a permanent source of infection and thus danger. In some situations, however, a targeted application mainly of a hand disinfectant may be useful. One example is the protection of persons which are highly susceptible to infection by permanent or transient immunosuppression, e.g. by chemotherapy, radiation therapy, HIV or after solid organ transplantation. More and more patients are discharged early from the hospital but still require professional care. Persons with invasive devices such as tracheostomy, vascular or urinary catheter also have a higher risk of infection. And there is an increasing number of elderly people with chronic wounds which need professional care at home. Care providers, but also relatives and visitors should perform a hand disinfection before direct contact with any of these devices, wounds or non-intact mucosa. In addition, the targeted disinfection may be useful in multi-person households when specific infectious diseases occur in order to prevent transmission to healthy persons. Before direct contact of an infected person to a healthy person as well as after direct contact of a healthy person with an infected person hand disinfection is indicated. Targeted surface disinfection should only be considered in exceptional cases if contamination of a surface is likely and contact of hands with the surface is conceivable. Safety aspects must be considered with the use of disinfectants in any setting and at any time.

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Background

Commercials – often showing children to stir up emotions of worried parents – repeatedly suggest that the domestic environment “bustles with” numerous pathogens, and that disinfectants are the only remedy for reducing the risk of infection at home. The viewer quickly gains the impression that the risk of infection lies in the wait everywhere. Consequently, shops offer many disinfectants or cleaners with antimicrobial activity for bath tiles, toilets, dishes, laundry, and for treating hands. However, does a bacterial contamination under the toilet seat really pose an infection risk? And does touching a doorknob at home or the escalator hand rail in a department store? This article describes the situations in the domestic environment, in which – from a scientific point of view – disinfection measures seem to be reasonable.

Persons with infections (protection of other persons in the same household)

According to the German Robert Koch-Institute (RKI), the most common pathogens triggering an infectious gastroenteritis are noroviruses (110 846 notified cases in 2009), *Campylobacter* spp. (65 376 notified cases in 2009), salmonellae (33 263 notified cases in 2009), and *E. coli* (6 956 notified cases in 2009) [1]. The number of unreported cases is estimated to be much higher. Unfortunately, there are no representative figures on the frequency of colds in the domestic environment. In 2009, there were 24 926 reported cases of “seasonal flu” [1]. Also here,

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These infected persons might spread pathogens quite easily to other household members or visitors via the classical transmission paths – mostly via direct or indirect contact [2]. For example, 65 % of the hands of persons having a cold are colonised by rhinoviruses [3]. In persons with rotavirus infections, this agent can be found even more often on hands [4]. Many of these pathogens can be passed on relatively easily from one person's hand to another (Table 1). For this reason, contaminated hands play a major role in the transmission of infections to other persons. The following sets out which targeted disinfection measures are best suitable and reasonable for which risk patients and for which infection risks, respectively.

Persons with high risk of infection (self-protection)

For different reasons, some groups of people probably have a higher risk of infection than an average person. These include:

1. Immunosuppressed or immunocompromised people (e.g. under chemotherapy, under radiation therapy, after organ transplantation, or when suffering from HIV/AIDS)

Following the Robert Koch-Institute, there were around 70 000 persons with HIV/AIDS living in Germany at the end of 2010 [5]. The extent of immunosuppression, and with it the susceptibility to infection, very much depends on the number of T_{CD4} helper cells. When the count drops below 250/μl, the patient is considered having an intermediate immunosuppression [6]. In Germany, approximately 37 000 patients per year undergo radiation therapy [7]; until 2003 there had been slightly more than 60 000 organ transplantations [8]. In many cases, the significantly reduced immune defence (e.g. in form of neutropenia) is the key risk factor for infection. Here, the recommendations of the RKI Commission for Hospital Hygiene and Infection Control (KRINKO) on hygiene requirements in the health care of immunocompromised patients defines three risk levels of the degree of immunosuppression (intermediate, severe, and very severe) [6]. Hence, these patients need extra protection – even in their own domestic environ-

Table 1: Rate of hand-to-hand transmission of different pathogens from contaminated hands to uncontaminated hands.

Pathogen	Contact time	Rate of hand-to-hand transmission	Source
Rhinovirus	10 sec	71 %	[3]
<i>Candida albicans</i>	Unknown	69 %	[24]
Herpes simplex virus, type 1	Unknown	100 % (wet hands) 60 % (dry hands)	[25]
Rotavirus	Unknown	6.6 %	[26]
Vancomycin-resistant enterococci (VRE)	Unknown	52 % – 70 %	[27]

ment. In case of an gastrointestinal infection, handwashing is not sufficient as sole protective measure. For severely immunosuppressed patients and their relatives it is imperative to perform hygienic hand disinfection then. However, as things stand today, hand or surface disinfectants are practically not available on prescription for outpatients in Germany – even in these cases. Individual cases might also require a disinfection of the contact surfaces after an ill co-resident used the toilet. Additionally, patients should keep distance to co-residents with respiratory infection, who in turn should take appropriate protective measures (disposable handkerchiefs, covering mouth and nose when coughing, distance to patients, hand disinfection, face mask, if necessary).

2. Patients who need home care after early hospital discharge

The German Hospital Federation determined that between 1998 and 2008 the number of treated patients in German hospitals – ranging between 16.5 and 17.4 million – had remained quite stable, but the mean duration of hospitalisation had reduced constantly [9]. In 1998, patients stayed in hospital for an average of 10.1 days; in 2008, only 8.1 days (Figure 1). Presumably, this trend will continue and we will have to face more and more patients in need for temporary care in the domestic environment after discharge. Depending on the underlying disease and prior treatment in hospital, it is imperative to take effective continuative measures to reduce the risk of infection in these cases as well, e.g. hand disinfection before and after changing a dressing or before manipulating a urinary catheter.

3. Persons with invasive devices, e.g. tracheostoma, venous or urinary catheters (in case of incontinence or voiding disorder)

There are no representative figures on how many persons with tracheostoma, venous or urinary catheters need care in the domestic environment. However, before the patient or a third person manipulates this kind of devices, hands have to be disinfected.

4. Persons with open wounds in need of care

There are no representative figures on persons in need of care with chronic, open wounds in the domestic environment. Before and after the patient or a third person manipulates these open wounds, it is reasonable to disinfect the hands (focus on no-touch technique).

Reasonable disinfection measures

Targeted hand disinfection

Targeted hand disinfection using an alcohol-based hand rub in respective situations (for example also during MRSA decolonisation) can effectively prevent many pathogens from being passed on to non-infected persons. Here, hand disinfection has many advantages over handwashing: Its efficacy in inactivating the transient flora is much better [10]. A study in a public administration has also shown that targeted hand disinfection can significantly reduce respiratory and gastrointestinal tract infections [11]. Additionally, the skin tolerability of hand disinfection is better than that of handwashing – especially with frequent use [12]. And it can be carried out independently of washbasins, and therefore is feasible for bedridden people as well. Antimicrobial soaps, which are widely used in the US, have not proved a relevant advantage

over handwashing with normal soap in preventing infections [13].

Therefore, the following will only address hand disinfection with alcohol-based preparations.

Here, it is reasonable that household members or visitors disinfect their hands before having direct contact with severely immunosuppressed patients or with invasive devices – even though the household member or visitor does not show any sign of infection. In addition, it is advisable that infected persons (respiratory tract infection, gastrointestinal infection) try to reduce the contamination of the environment as far as possible by coughing or blowing their nose in a hygienically adequate manner (www.wir-gegen-viren.de), and disinfect their hands before any direct contact with healthy persons. Similarly, healthy persons should disinfect their hands after any direct contact with an infected person or contaminated surfaces. When using hand disinfectants, the applied amount of product should be enough to completely wet and cover both hands for 30 seconds. Here, the ‘responsible application’ has proven best [14].

Targeted surface disinfection

Infectious diseases in the domestic environment involve partially severe contamination of surfaces through vomit, diarrhoea, cough, sneezing, and respiratory secretions. And on surfaces, many pathogens can survive several months [15]. How-

ever, a simple household cleaning can scarcely reduce pathogenic organisms on surfaces. Surface disinfection, in contrast, possesses a much stronger effect [16]. Through touching contaminated surfaces with the hands, pathogens can be passed on to healthy persons. All surfaces that are exposed to vomit, stool or respiratory secretions of infected persons have to be considered relevant. A targeted surface disinfection is reasonable for surfaces that are touched by hands. Disinfecting surfaces that virtually never come into contact with hands, for example inside the toilet, does not necessarily contribute to infection control – the same applies to floors [17]. Here, ready-to-use surface disinfection wipes are a feasible alternative. However, when using such wipes it is important to choose a material that does not adsorb the active ingredient and releases enough of the active ingredient for treating the surface [18].

Risks when using disinfectants uncritically

For good reason, experts from a variety of disciplines strictly object to untargeted and uncritical usage of disinfectants at home, as declared in a joint notice of the German Federal Environmental Agency, the Federal Institute for Consumer Health Protection and Veterinary Medicine, and the Robert Koch-Institute in 2000 [19]. A short word on this issue. Disinfectants have to be used in accordance with their directions

for use. The manufacturer should write these instructions clear enough to ensure safe usage – if possible even for untrained people. With some active ingredients, improper use might lead to a formation of resistances or even cross resistances with antibiotics for the harmful organism to be defeated [10, 20–22]. The disinfectants commonly used in Germany, however, are usually applied in high enough concentrations to develop an unspecific effect that affects several cellular target components, hence, making the formation of a true resistance very unlikely when used as directed [23]. Disinfectants have to be applied safely. Particularly concentrates that need to be diluted to a use solution require consequent protective measures such as wearing protective gloves. Disinfectants must be stored safely – especially in households – children and elder confused persons must not have access to them. Depending on the specific product, improper use or e.g. mistakenly swallowing the disinfectant poses a serious risk to health.

Conclusion

Routinely using disinfectants or disinfecting cleaners in the household is not acceptable, as the risks clearly outweigh the benefits. However, in case of certain infectious diseases, targeted disinfection measures, hand disinfection in particular, after contact with infected persons can significantly reduce the risk of a transmission to healthy co-residents. For persons prone to infection, for example, people after chemotherapy or those undergoing radiation therapies, disinfecting hands of third persons before direct contact can reduce the infection risk.

Conflict of interest

The first author is employed by Bode Chemie GmbH, Hamburg.

References

1. Robert Koch-Institut. Infektionsepidemiologisches Jahrbuch meldepflichtiger Krankheiten für 2009. Berlin; 2010.
2. Siegel JD, Rhinehart E, Jackson M, Chiarello L. 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. CDC. Available at: <http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf>.

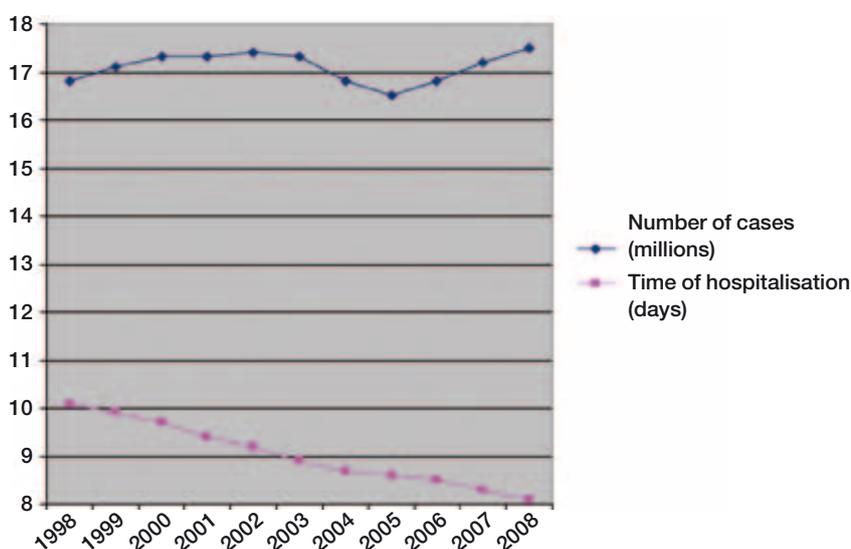


Figure 1: Number of treated patients and their mean time of hospitalisation in German hospitals [9].

3. Gwaltney JM, Moskalski PB, Hendley JO. Hand-to-hand transmission of rhinovirus colds. *Annals of Internal Medicine*. 1978;88(4):463–467.
4. Akhter J, al-Hajjar S, Myint S, Qadri SM. Viral contamination of environmental surfaces on a general paediatric ward and playroom in a major referral centre in Riyadh. *European Journal of Epidemiology*. 1995;11(5):587–590.
5. Anonym. Zum Verlauf der HIV-Epidemie in Deutschland bis Ende 2010. *Epidemiologisches Bulletin*. 2010(46):453–459.
6. Anonym. Anforderungen an die Hygiene bei der medizinischen Versorgung von immunsupprimierten Patienten. *Bundesgesundheitsblatt*. 2010;53(4):357–388.
7. Anonym. Strahlentherapie. Wikipedia. Available at: <http://de.wikipedia.org/wiki/Strahlentherapie>. Accessed 5.1.2011.
8. Molzahn M, Tuffs A, Vollmann J. Gesundheitsberichterstattung des Bundes Heft 17: Organtransplantation und Organspende. Berlin: Robert Koch-Institut; 2003.
9. Anonym. Krankenhausstatistik. Deutsche Krankenhausgesellschaft. Available at: http://www.dkgev.de/media/file/7330.Foliensatz_Krankenhaeusstatistik_20100129.pdf. Accessed 5.1.2011.
10. Kampf G, Kramer A. Epidemiologic background of hand hygiene and evaluation of the most important agents for scrubs and rubs. *Clinical Microbiology Reviews*. 2004;17(4):863–893.
11. Hübner N-O, Hübner C, Wodny M, Kampf G, Kramer A. Effectiveness of alcoholic hand disinfectants in a public administration: Impact on health and work performance related to acute respiratory symptoms and diarrhoea. *BMC Infectious Diseases*. 2010;10:250.
12. Löffler H, Kampf G, Schmermund D, Maibach HI. How irritant is alcohol? *British Journal of Dermatology*. 2007;157(1):74–81.
13. Aiello AE, Coulborn RM, Perez V, Larson EL. Effect of hand hygiene on infectious disease risk in the community setting: a metaanalysis. *American Journal of Public Health*. 2008;98(8):1372–1381.
14. Kampf G, Reichel M, Feil Y, Eggerstedt S, Kaulfers PM. Influence of rub-in technique on required application time and hand coverage in hygienic hand disinfection. *BMC Infectious Diseases*. 2008;8:149.
15. Kramer A, Schwebke I, Kampf G. How long do nosocomial pathogens persist on inanimate surfaces? A systematic review. *BMC Infectious Diseases*. 2006;6:130.
16. Rutala WA, Weber DJ. The benefits of surface disinfection. *American Journal of Infection Control*. 2004;32(4):226–231.
17. Dettenkofer M, Spencer RC. Importance of environmental decontamination – a critical view. *Journal of Hospital Infection*. 2007;65(S2):55–57.
18. Bloß R, Meyer S, Kampf G. Adsorption of active ingredients from surface disinfectants to different types of fabrics. *Journal of Hospital Infection*. 2010;75:56–61.
19. Anonym. Antibakterielle Reinigungsmittel im Haushalt nicht erforderlich. Bundesinstitute halten Reinigung mit herkömmlichen Mitteln zur Sicherung der Hygiene für ausreichend. Available at: <http://www.bfr.bund.de/cd/890>.
20. Anonym. Triclosan nur im ärztlichen Bereich anwenden, um Resistenzbildungen vorzubeugen. Stellungnahme Nr. 030/2006 des BfR. Available at: <http://www.bfr.bund.de/cd/51057>.
21. Russell AD, Hammond SA, Morgan JR. Bacterial resistance to antiseptics and disinfectants. *Journal of Hospital Infection*. 1986;7(3):213–225.
22. McDonnell G, Russell AD. Antiseptics and disinfectants: activity, action, resistance. *Clinical Microbiology Reviews*. 1999;12:147–179.
23. Meyer B, Cookson B. Does microbial resistance or adaptation to biocides create a hazard in infection prevention and control? *Journal of Hospital Infection*. 2010;76(3):200–205.
24. Rangel-Frausto MS, Houston AK, Bale MJ, Fu C, Wenzel RP. An experimental model for study of *Candida* survival and transmission in human volunteers. *European Journal of Clinical Microbiology and Infectious Diseases*. 1994;13(7):590–595.
25. Bardell D. Hand-to-hand transmission of herpes simplex virus type 1. *Microbios*. 1989;59:93–100.
26. Ansari SA, Sattar SA, Springthorpe VS, Wells GA, Tostawaryk W. Rotavirus survival on human hands and transfer of infectious virus to inanimate and nonporous inanimate surfaces. *Journal of Clinical Microbiology*. 1988;26(8):1513–1518.
27. Hayden MK, Blom DW, Lyle EA, Moore CG, Weinstein RA. Risk of hand or glove contamination after contact with patients colonized with vancomycin-resistant enterococcus or the colonized patients' environment. *Infection Control and Hospital Epidemiology*. 2008;29(2):149–154.