

DISINFANTS

BODE SCIENCE CENTER



Series: High-Risk Areas
Beyond routine:
Care of premature babies

Which disinfection measures are necessary when there is reasonable indication of an ebola fever infection?

After the ebola outbreak in West Africa, volunteers with suspected or confirmed ebola virus disease (EDV) from the regions have also been treated in European and North American healthcare facilities. For handling those cases the World Health Organisation (WHO) and healthcare authorities in different countries recommend applying targeted hand disinfection, surface disinfection and protective equipment measures.



If there is good reason to suspect an ebola infection, medical staff must adhere to strict hygiene and isolation protocols.

Recommended hygiene measures

When treating an infected patient, suitable personal protective equipment (PPE) must be worn, especially gloves [1-4]. Wearing two pairs of gloves is recommended during patient care, especially when dealing with large volumes of body fluids and excretions. This helps to reduce any residual risk posed by possible micro perforations in the gloves. In a recently published recommendation (current as of October 20, 2014) the Centers for Disease Control and Prevention (CDC) recommends two pairs of gloves as a standard protection measure [2].

It is essential that all health workers decontaminate their hands after removing the gloves or after having contact with body fluids or excretions/ secretions of ebola patients. The WHO, CDC and the German Robert Koch Institute (RKI) recommend decontamination of hands using an alcohol-based hand rub [2-5]. The RKI recommends alcohol-based hand rubs with a proven efficacy against at least enveloped viruses [4,5], as for example Sterillium. Many hand disinfectants are known to be broadly effective against enveloped viruses. The WHO recommends decontamination of visibly soiled hands using soap and water [3], however we believe that hand washing alone is not the most effective decontamination method.

Recommendations for the decontamination of surfaces in patient rooms

There is evidence that surfaces close to the patient are rarely contaminated with the ebola virus. Ebola belongs to the family of filoviruses (Filoviridae). These can remain

infectious between five days and three weeks. The following recommendations apply to the surface disinfection for ebola virus:

- CDC and RKI recommend surface disinfection in patient rooms, including surfaces that are not visibly contaminated [1,2,5].
- WHO recommends cleaning and disinfecting surfaces or objects contaminated with body fluids, secretions or excretions as quick as possible. Before disinfection surfaces should be cleaned. Floors and horizontal work surfaces are to be cleaned with clean water and cleaning agent at least once per day [3].
- RKI recommends removing visible soiling by, for example, blood with a single-use wipe saturated with disinfectant. These areas should be wipe-disinfected twice before the disinfection of the entire surface [5].
- The RKI recommends the use of a pathogen specific disinfectant (effective against enveloped viruses) [4,5]. For smaller surfaces, Bacillol 30 Tissues are well suitable, for larger surfaces Mikrobac forte.

The ebola virus will usually spread via body fluids. Therefore, it is recommended to use the surface disinfectant under dirty conditions. The disinfected areas should only be used after the exposure time specified by the manufacturer has elapsed.

Further information on disinfection measures and the Ebola Virus can be found at www.bode-science-center.com

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3. WHO. Interim Infection Prevention and Control Guidance for Care of Patients with Suspected or Confirmed Filovirus Haemorrhagic Fever in Health-Care Settings, with Focus on Ebola. September 2014.
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5. Robert Koch Institute. Measures regarding disinfection and waste management as pertaining to an at least probable case of Ebola virus infection in Germany, Dated: December 1, 2014

Editorial

Dear Reader,



The ebola outbreak in West Africa shakes the world. Even though the risk of the pathogen spreading in Europe and North America is very low, there also have been several suspected cases here. We provide you with information on necessary disinfection measures.

Employees in high-risk areas also have jobs "beyond routine", which you will learn in our report about the intensive care unit for premature and newborn babies at the University Medical Center Hamburg-Eppendorf (UKE). This article is the first of a whole series dealing with hygiene requirements when treating patients at high risk of infection.

Apart from that, this issue comes with many new details for you to discover, for example in our introduction of new recommendations and studies on cleaning endoscopes with products based on peracetic acid. If you want to know why norovirus is particularly active during this season, visit our website at www.bode-science-center.com, where additional tips and checklists are waiting for you.

I wish you an insightful reading,

Claudia James
Director BODE SCIENCE CENTER

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Beyond routine: Care of premature babies

Exceptions are the only constant in the intensive care unit for premature and newborn babies at the University Medical Center Hamburg-Eppendorf (UKE). The care of the small patients regularly presents the employees with new challenges. This requires maximum commitment – also when it comes to hygiene.

Sunlight floods in through the large windows of the hallway of the intensive care unit for premature and newborn babies. There is an atmosphere of calm and warmth. But this is only partly true. The UKE's intensive care unit for premature and newborn infants is also a place of extreme situations making great demands on staff, parents and the small patients in every sense.

High risk of infection for preemies

"On average, we have more than one premature baby with less than 1 500 g per week," explains Prof. Dr. med. Dominique Singer, Director of Neonatal and Paediatric Intensive Care. This year, there have been 60 so far. Most of them were born before the 30th week of pregnancy, some of them even between the 24th and 26th week of pregnancy. These infants particularly are at risk of infection, as their immune system is not yet fully developed, which is, for example, reflected by the skin's and mucous membranes' premature barrier function. One of the

potential consequences: microorganisms penetrate the intestinal wall and spread in the whole body within a very short time.

But this is far from being the only risk of infection the preemies are exposed to. Further threats arise from the intensive care treatments, which are often absolutely necessary due to the preterm delivery. Venous accesses, artificial respiration, drains, and skin lesions may serve dangerous pathogens as portal of entry. "Strictly speaking, these very small premature babies are a group of high risks," summarises Prof. Dr. med. Dominique Singer. To minimise the risk of infection and ensure best possible patient protection, the unit has a comprehensive and well-integrated hygiene management.



Mentors for safe hygiene

One important hygiene module is the UKE's mentor model. Mandy Lange, specialist paediatric nurse and head nurse of the intensive care unit for premature and newborn babies explains: "Our ward has two hygiene mentors, who permanently deal with our hygiene and check what we can further optimise." The mentors are nursing staff members, who routinely work in the ward and have completed a special, several-day hygiene training including final examination at UKE. They are the contact persons for the unit management and the infection control practitioners. "I am always impressed how quickly any hygiene uncertainty is clarified and how excellent the network at UKE is," pinpoints Mandy Lange.

Recognising multi-resistant pathogens early

Another hygiene aspect that the unit's employees are intensively concerned with at the moment is how to deal with multidrug-resistant pathogens, which are increasingly carried in from outside these days – a high-risk situation for the small patients, who have a severely weakened immune system and undergo an antibiotic treatment already. Also it is often the case that expectant mothers carry multidrug-resistant microorganisms. Hence, to protect the preemies, regular swabs are taken from pregnant women at risk before birth. In the intensive care unit, the premature babies are screened once per week. Specific instructions and SOPs (standard operating procedures) on how to deal with multidrug-resistant pathogens in individual cases do not only contribute to infection protection but also help nursing and medical staff carry out their tasks.

Checklists, hygiene flyers and more

One of Mandy Lange's tasks is to perform a hand disinfection test with her colleagues once every three months. Using a checklist that includes questions on the indications for hand disinfection or on necessary exposure times, she spontaneously tests the knowledge of her colleagues. The regular positive results prove: the hygiene-related sensitivity and sense of responsibility is extremely high in the intensive care unit for premature and newborn babies at UKE. In addition, part of the hygiene management is a hygiene file, in which at any time the employees can find descriptions of all special ward tasks, and SOPs on how to deal with different disease patterns in the Intranet. And also the parents are trained in hygiene right from the start: the intensive care unit for premature and newborn babies has developed a hygiene flyer for the parents. All this shows: even with all these challenging and often difficult requirements in daily routine, the ward is well positioned when it comes to hygiene.

Risks of infection for immunocompromised patients

The number of patients with severe underlying diseases associated with immunodeficiency due to illness or treatment continuously increases. And the chance of survival of neonatal intensive care patients having a low birth weight has improved distinctly. All these patients have one thing in common: the considerable higher risk of acquiring nosocomial infection. Hence, they require very good compliance with hygiene protocols.



Good clinical practice in terms of hospital hygiene and infection control should be a matter of fact in all patient care areas. This is what the Robert Koch-Institute emphasises in its recommendation on preventing nosocomial infection (NI) in neonatal intensive care patients having a birth weight below 1 500 g as well [1].

And the high nosocomial infection rate among these patients proves that infection control demands particular attention here: only 1.2 % of all newborn

babies have less than 1 500 g when born and require intensive care, but as much as 61 % of all NI in newborn infants occur in neonatal intensive care.

High risk of infection

This vulnerability to infection is specific to both neonates and immunocompromised patients, for example, patients in intensive care, burn and haematological oncology units. Infections even worsen the already reduced health-related quality of life and often become severe, sometimes even life-threatening. Apart from additional treatment and extra costs,

infections may require relevant deviations from the therapy plan, jeopardising the therapy of the underlying disease, for example, when infections may lead to losing the graft after organ transplant.

The serious consequences infections in high-risk patients potentially have call for particular attention to possible transmission paths and pathogen reservoirs. This, for example, includes that low immunity facilitates facultative pathogenic microorganisms to colonise the patient and considerably extends the duration of excretion of communicable pathogens such as VRE, RSV, norovirus and rotavirus.

Disinfection of contact surfaces

Therefore, in addition to hand hygiene, the disinfection of near-patient surfaces is of particular importance in high-risk areas. This includes notebooks and electronic reading devices with hand contact surfaces that are often made available to increase the quality of life of high-risk patients and are used by several patients and caregivers [2].

Transmission paths and pathogen reservoirs in areas with particular high risk of infection

Transmission path/Reservoir	Examples
Contact infection (reservoir: animate and inanimate surroundings)	VRE, MRSA, ESBL-forming <i>Enterobacteriaceae</i> , Norovirus, rotavirus, EHEC, <i>Clostridium difficile</i>
Airborne infection	respiratory viruses such as respiratory syncytial virus (RSV) and many other
Airborne infection	<i>Aspergillus fumigatus</i> , varicella zoster virus, measles virus, <i>M. tuberculosis</i>
Water-associated infection (reservoirs: Inhalation equipment, drinking water installations, recooling plants)	<i>P. aeruginosa</i> or other nonfermenters, <i>Legionella pneumophila</i>
Blood-borne infection (reservoirs: contaminated medications; example: <i>Ralstonia pickettii</i> has repeatedly been described in conjunction with heparin flushing of central venous catheters)	HBV, HCV
Contaminated food	<i>S. aureus</i> , <i>Salmonella enteritidis</i> , <i>Campylobacter jejuni</i> , <i>Yersinia enterocolitica</i>

Source: Robert Koch-Institute [2]



Sources:

1. Mitteilung der Kommission für Krankenhaushygiene und Infektionsprävention beim Robert Koch-Institut. Empfehlung zur Prävention nosokomialer Infektionen bei neonatologischen Intensivpflegepatienten mit einem Geburtsgewicht unter 1500 g. [Recommendation for the prevention of nosocomial infections in neonatal intensive care patients with a birth weight less than 1 500 g. Report by the Commission for Hospital Hygiene and Infectious Disease Prevention at the Robert Koch-Institute (RKI)]. Bundesgesundheitsbl 2007, 50:1265–1303.
2. Empfehlung der Kommission für Krankenhaushygiene und Infektionsprävention beim Robert Koch-Institut (RKI). Anforderungen an die Hygiene bei der medizinischen Versorgung von immunsupprimierten Patienten. [Requirements for hygiene in the medical care of immunocompromised patients. Recommendations of the Commission for Hospital Hygiene and Infectious Disease Prevention at the Robert Koch-Institute (RKI)]. Bundesgesundheitsbl 2010, 53:357–388

Routine use of gloves in addition to hand hygiene* reduces nosocomial infection in premature babies

A study conducted in a neonatal intensive care unit in Virginia concludes that the combination of hand hygiene and wearing gloves when touching the patients and their catheters leads to a considerable reduction of the infection rate. A hygiene regime from which other patient groups may also benefit.

Premature babies with an extremely low birth weight (< 1 000 g) often contract a nosocomial infection. By definition, these late onset infections occur 72 hours after birth and are associated with high lethality and neurodevelopmental disorders.

In terms of pathogen transmission, the employees' hands are a risk. Studies in neonatal intensive care units show that every shift involves around 37 direct contact between staff and child. Even after correct hand hygiene, 50 % of the cultures from the hands of medical staff were positive for microorganisms. This means that a few colony-forming units (CFUs) of the transient bacterial flora and greater amounts of microorganisms of the resident flora may survive after hand hygiene. These microorganisms may put premature babies at risk, as their natural immune system and particularly the skin's and mucous membranes' barriers are underdeveloped.

Underdeveloped immune system

The stratum corneum of infants born in the 26th week of pregnancy has only 3 layers with a very thin keratin layer. Normally, after birth, the babies' upper layer of the epidermis has 15 layers, several of which are keratin layers. Also the mucous layer of the gastrointestinal tract of premature babies is not yet fully developed. The deficits of the natural skin and mucous membrane barrier increase the permeability for pathogens and facultative pathogens.

Studies have shown that examination gloves are able to significantly reduce the bacterial count on the staff's hands during different nursing activities. Also for adult patients studies concluded that gloves are an effective measure to prevent contamination of the staff's hands with *C. difficile* and VRE.

Goal: increased safety for preemies

Physicians in a neonatal intensive care unit of UVA Children's Hospital in Virginia, U.S. examined the question of whether hand hygiene and the subsequent use of non-sterile gloves for every contact with neonates and intravenous catheters leads to a reduction of nosocomial infections or of the rate of necrotising enterocolitis [1].

The study was conducted as prospective unblinded randomised clinical study with 120 premature babies less than 8 days of age with a birth weight below 1 000 g, who were born before the 29th week of pregnancy. The neonates' susceptibility to infection is highest during the first four weeks after their birth.



Hence, the intervention took place at least for four weeks after birth and was extended for those patients, who required an intravenous catheter even after this period of time. The study lasted 30 months from December 2008 until June 2011.

For the examinations, the neonates were divided into two groups with 60 patients each: in group A, every contact with the premature infants and every contact with catheters involved prior hand hygiene* and donning of non-sterile examination gloves. In group B, these activities were only preceded by hand hygiene*. In both groups, the hand hygiene was carried out either with an alcohol-based rub or an antimicrobial soap (handwashing), and was based on the WHO's 5 Moments model for hand hygiene. During the entire intervention, the compliance was observed and was 79 %.

Hand hygiene + gloves = less infections

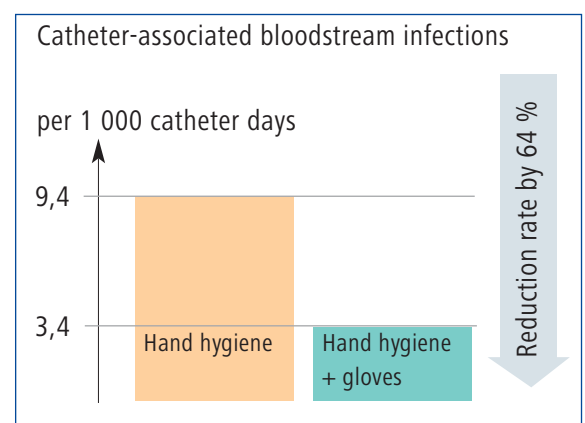
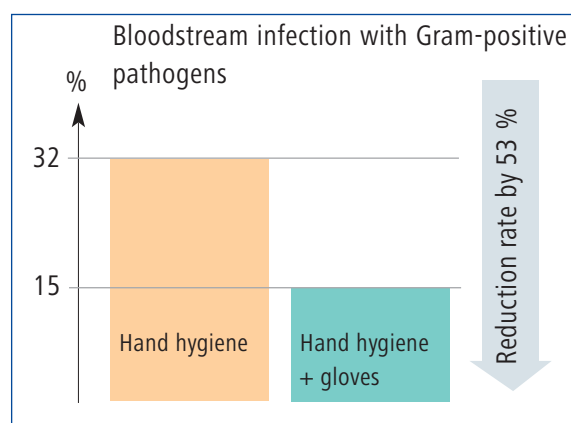
The study concludes that the procedure in group A – hand hygiene and use of gloves – results in a considerable reduction of infection rates among the examined risk group. Many infections are caused by Gram-negative bacteria. In group A, 53 % less bloodstream infections occurred with these bacteria than in the comparison group. The number of catheter-associated infections could be reduced by 64 %.

The results confirm other investigations with children and adult patients that described significant reductions of infection rates by wearing gloves in addition to hand hygiene. Example: the general use of examination gloves during the RSV (respiratory syncytial virus) season could reduce the infection rate by 25 % in a paediatric ward.

The authors conclude that also other patient groups, for example patients at high risk of infection, could benefit from this hygiene regime. And gloves could also reduce risks caused by mistakes during hand disinfection such as too short exposure times and too small volumes of hand rub.

1. Kaufman DA et al. Nonsterile Glove Use in Addition to Hand Hygiene to Prevent Late-Onset Infection in Preterm Infants Randomized Clinical Trial. JAMA Pediatrics. Published online August 11, 2014

Low rates of nosocomial infections through hand hygiene combined with non-sterile gloves





Is norovirus a survivalist?

Utterly environmentally stable, extremely flexible and highly contagious: norovirus – a pathogen of superlatives? How can we ever put a stop to this virus? The answer is as simple as pragmatic: by hygiene measures – above all by consistent hand disinfection with a preparation geared to the risk potential.

Every year in the winter, noroviruses virtually overtake community facilities, often including hospitals and nursing homes. Particularly from November to April, the highly infectious virus occurs regularly. So it is no surprise that the number of norovirus cases increases enormously in this period.

And once norovirus appears, it normally spreads fast. No wonder: only 10 to 100 virus particles are enough to elicit an infection. Additionally, as nonenveloped virus the pathogen is extremely resistant to chemical and physical procedures and other environmental influences. Hygienic hand disinfection plays a decisive role in preventing and controlling the highly contagious pathogen.



WHO recommendation

To reliably inactivate noroviruses the World Health Organization (WHO) recommends a consistent implementation of the “5 Moments for Hand Disinfection”. Especially after touching a patient, after removing gloves and before leaving the patient room it is imperative to disinfect hands. And a key precondition for being able to adhere to hand disinfection protocols is a sufficient number of dispensers in proper locations. Only this ensures hand disinfectants to be available whenever needed.

Choosing a hand disinfectant

For the hand disinfectant to have the desired effect, it needs to be matched to the risk potential. In case of norovirus outbreaks, WHO recommends using alcohol-based hand disinfectants [1]. Also the European Committee for Standardization (CEN) emphasises the importance of hand disinfection in case of noroviruses. Since October 2013, the murine norovirus (MNV) has been included as test virus (efficacy testing of hand disinfectants) in the EN 14476 [2].

Independent expert opinions confirm that Sterillium med from HARTMANN is active against MNV in the quantitative suspension test [3]. The ethanol-based preparation is active against norovirus within a 30-second hygienic hand disinfection. Top-quality moisturising substances make a particularly good skin tolerability which again contributes to enhanced compliance.


Risk factor surfaces

Also the contact with surfaces entails the risk of infection. Noroviruses are able to remain infectious on inanimate surfaces for up to seven days. Hence, hand hygiene should always be supported by thorough disinfection of surfaces. In case of norovirus outbreaks, the Centers for Disease Control and Prevention (CDC) recommend the routine cleaning and disinfection of frequently touched surfaces and objects, for example toilets, bedframes, door handles in isolation and cohort areas with EPA-approved products (label claim: for use in health care) [4]. The reason: only a systematic combination of necessary hygiene measures can effectively protect against norovirus.

Further information on hand and surface disinfection in case of norovirus, a checklist for the management of norovirus outbreaks and recent studies on norovirus can be found at www.bode-science-center.com.

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3. Steinmann J (2014) Wirksamkeit von Sterillium med gegenüber dem murinen Norovirus im quantitativen Suspensionsversuch nach der EN 14476:2013, MikroLab GmbH, Bremen, 2014.
4. MacCannell T et al. (2011) Guideline for the Prevention and Control of Norovirus Gastroenteritis Outbreaks in Healthcare Settings. Atlanta, GA: US Department of Health and Human Services, CDC.



Background: Surrogate virus MNV

Human norovirus does not replicate in the laboratory. Murine norovirus (MNV), however, can be grown in cell cultures. Hence, and due to its morphological similarities to the human norovirus, efficacy testing of disinfectants is usually carried out with MNV.

Simple clicks to practice

In 2013, the BODE SCIENCE CENTER's "5 Moments E-Learning Tool" was launched with the aim of improving hand hygiene in the daily routine of nursing and medical staff. Mission accomplished! That is the result of a scientifically supported survey among users [1]. 93 % of the respondents could translate the things they had learned into practice. No coincidence, but rather a system: the combination of web-based training and "serious game" is based on latest learning theories.

"Tell me and I'll forget; show me and I may remember; involve me and I'll understand" – the sentiments of Chinese philosopher Confucius (551-479 B. C.) on the acquisition of skills could not be more appropriate here. In view of the ever increasing importance of digital mobility and social media – with all the distraction traps – active and interactive learning becomes more and more important in terms of a long-lasting learning success.

Active learning methods achieve much higher average memory retention than information that is simply conveyed via visible and audible means: only 50 % of the knowledge conveyed by films or demonstrations remain in the memory, own presentations and group discussions already achieve a retention of 70 %. Presentations that are held under real circumstances such as plant visits yield an average memory retention of 90 %. Also forms of e-learning may result in increased retention and motivation to learn, provided that they reflect a realistic and interactive learning environment adapted to individual needs.

Active, more active, interactive

This is also the conclusion of Jacqueline Reiners, who investigated the learning success of e-learning on the basis of BODE SCIENCE CENTER's "5 Moments E-Learning Tool" on hand hygiene [1]. Reiners not only examined recent learning method literature, but also conducted a survey among the users of the "5 Moments E-Learning Tool" that was developed by the BODE SCIENCE CENTER and launched in 2013.

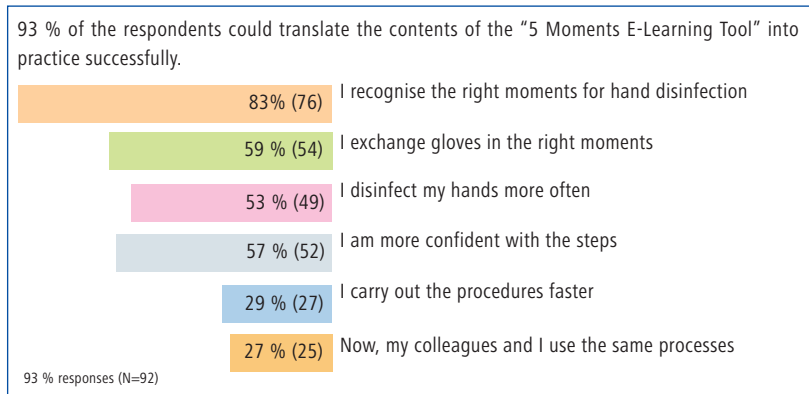
99 out of 670 users returned the questionnaire – a reliable response rate of 15 % and thus a solid basis for the evaluation. In addition to demographic data, the questionnaire contained questions on the medium e-learning, the implementation of the "5 Moments Tool", the influence on hand hygiene behaviour, the benefit for daily routine, reasons for motivation and obstacles to e-learning.

Generation X Y ?

64 % of the respondents had already used e-learning for training purposes. This share also corresponds to survey results of Germany's Federal Statistical Office. One interesting aspect was the participants' age structure: the average user of the "5 Moments E-Learning Tool" was born in 1971 and thus belongs to the Generation X (born between 1965 and 1980) – an age group that did not grow up with digital media and is normally expected to have reservations regarding digital media. According to Reiners, the positive result shows that a well-designed e-learning tool can also address a target group supposedly hard to reach, and be successful across generations.



Putting the 5 Moments e-learning into practice



96 % of the respondents confirm that the "5 Moments E-Learning Tool" is an appropriate training medium. The reasons: the possibility to be able to learn independently of time and place and the playful approach.

Remarkably enough, a high number of respondents stated that they were able to successfully putting the contents of the "5 Moments E-Learning Tool" – the right application of hand hygiene measures – into practice: as many as 93 % confirmed this statement and 83 % said they recognise the right moment for hand disinfection thanks to the e-learning tool – still one of the most important factors for good compliance.

Extrinsic and intrinsic motivation

Foundation for the success of the "5 Moments E-Learning Tool" is a concept that incorporates modern learning theories and promotes the learners' motivation. Extrinsic motivation is driven by external factors such as reward or punishment. The behaviour is not motivated by the pleasure in the activity itself, but by associated pleasant side effects. In e-learning, this form of motivation is supported by playing in groups, rewards (training certificate) and by elements typical for games (level, rankings).

But also the users' intrinsic motivation is promoted, which is based on the need for competence and autonomy. Only 34 % of the respondents stated that it was the competitive character that motivated them to continuously improve their results. This

suggests that they were interested in the training itself and wanted to improve their knowledge. However, elements typically found in games, such as with extrinsic motivation play a minor role.

Own control of learning

One of the key success factors of the e-learning tool on hand hygiene is that the users can individually control the learning process and their interaction with other learners. Thus, the "5 Moments E-Learning Tool" supports the approach of modern constructivist learning theory. Users can decide themselves which learning unit is interesting for them. Learners are not obliged to complete the units in a defined order and have the possibility to build teams to complete learning units together. More than every third respondent used the possibility of team learning.

Reiners' evaluation demonstrates that an e-learning tool, which involves the user actively, can have a long-lasting learning success for the practice. It becomes clear that learning formats such as e-learning can and shall complement, but not replace training sessions by hygiene staff.

For the things learned to remain in memory, knowledge has to be presented in a realistic and problem-oriented manner. The "5 Moments E-Learning Tool" fulfils all these conditions. When completing the individual tasks, 93 % of the users linked the things learned to previous knowledge and translated the knowledge of when to perform hand disinfection into practice.

A major success – not only for the learners, who want to improve their hygiene, but also for patient protection.

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Use of peracetic acid for cleaning flexible endoscopes

Some manufacturers recommend using preparations based on peracetic acid (PAA) for the disinfection step when reprocessing flexible endoscopes. A review of 243 publications on the use of PAA-based cleaners [1] concludes that there is no evidence that PAA products are as effective as conventional cleaners. On the contrary: the data available clearly suggest a fixing effect with biofilm, dried blood and even nerve tissue including prions.

After their use, flexible endoscopes are often highly contaminated with organic material such as blood, proteins, pathogens (mainly Gram-negative and Gram-positive bacteria), and biofilm. A cleaning step that entirely removes the soiling is essential in order to not impair the subsequent disinfection [2] – especially when the disinfectant used is based on peracetic acid (PAA), which is easily inactivated by organic material.

Though to a variable extent, conventional cleaners without biocides are able to effectively remove organic contamination. However, there are also formulations available on the market that are based on the active ingredient peracetic acid (PAA) and are recommended by manufacturers for the cleaning of flexible endoscopes.

Systematic literature search

In August 2013, Kamp et al. conducted a literature search at the National Library of Medicine using combinations of various keywords, including peracetic acid; cleaning; flexible endoscope; endoscope and biofilm; resistance and peracetic acid; fixation and peracetic acid; infection/outbreak and flexible endoscope. Among 471 publications identified a total of 172 studies were considered relevant. A further 71 publications were also included in the evaluation, for example, guidelines, reports on side effects, and additional reviews.

Indications of outbreaks

The evaluation of the studies focussed on finding evidence for recommending PAA-based cleaners for the cleaning step as part of the reprocessing of flexible endoscopes. The studies, for example, investigated the effectivity in removing frequent contaminations such as biofilm and blood and – in view of the “problems with prions” – brain and nerve tissue. In addition, infections and outbreaks associated with biofilms or the use of PAA were assessed. One study for instance described an outbreak linked to bronchoscopy and *Klebsiella pneumoniae*, OXA48 (4MRGN): during reprocessing of the bronchoscope, cleaning and disinfection was performed with PAA.



Pre-cleaning plays a major role for the entire reprocessing process. Peracetic acid can jeopardise the disinfection's success.

Problems with biofilm

Biofilm bacteria form units and thus a protective slime matrix, the extracellular polymeric substance (EPS). By being able to form EPS, these bacterial communities are protected against sufficient efficacy of the disinfectant's active substances. Additionally, many bacteria in biofilms are known to be resistant to antibiotics and also disinfectants. Hence, complete removal of biofilms is imperative for the endoscope reprocessing to be safe.

In the evaluated studies, biofilm cleaning of PAA products differed, resulting in inadequate removal of bacterial colonies depending on the preparation. Also the biofilm fixation rate of different PAA-based formulations varied: some of the PAA products showed biofilm fixation, others not.

Fixation of organic contamination

Blood is a typical type of contamination found on used endoscopes. Surfactant-based cleaners remove dried blood by 88 % to 95 %.

With PAA-based products, this rate is between 8 % and 59 %, depending on the formulation. Fixation of the remaining blood contamination caused by the same PAA formulations, however, was between 19 % and 78 %.

Worth noting is the high protein fixation potential of PAA in studies with brain tissue: the rate was 96 % with PAA products compared to 19 % with products based on glutaraldehyde. One of the study even described nearly complete fixation of vCJD-infected brain tissue due to PAA.

Promotion of cellular changes

Bacteria that are exposed to sublethal PAA concentrations may develop different cellular changes. According to a study, bacteria changed this way are unable to be cultured. Another problem is the development of tolerances to other active ingredients in disinfectants in case PAA does not completely inactivate the bacteria. Thus, the efficacy of the subsequent disinfection is jeopardised, even when other active ingredients are used. A possible consequence: after reprocessing, biofilm forms in the endoscope.

Peracetic acid use for cleaning flexible endoscopes – effects and possible outcomes

Characteristic; reason for cleaning step	Effect of peracetic acid	Possible outcome, compared with classical cleaning
Removal of biofilm	Variable ¹	Insufficient removal of biofilm
Fixation of biofilm	Possible ¹	Fixation of biofilm to variable degrees
Removal of dried blood	Partial ¹	Insufficient removal of dried blood
Fixation of dried blood	Very likely	Fixation of dried blood to variable degrees
Fixation of brain tissue	Very likely	Strong fixation of nerve tissue, including prions
Adaptation of microorganisms surviving the cleaning step	Likely, especially in gram-negative bacteria	Insufficient efficacy of disinfection step, persistence of pathogens, beginning of biofilm formation
Cross-resistance to other biocidal compounds as a result of exposure to sublethal peracetic acid concentrations	Possible	Insufficient efficacy of disinfection step, persistence of pathogens, beginning of biofilm formation

¹ Depending on the formulation

Recommendations of KRINKO confirmed

The studies evaluated by Kampf et al. delivered no evidence that a cleaning step using a PAA-based product is as effective as with formulations without biocidal ingredients. Instead, there were many indications of organic material fixation: all tested PAA-based formulations resulted in fixation of blood and brain tissue, some of them fixed biofilm. The results from the 243 studies assessed show that PAA-based cleaners are not suitable for the cleaning step when reprocessing flexible endoscopes. Both the RKI Commission for Hospital Hygiene and Infection Control (KRINKO) and the German Federal Institute for Drugs and Medical Devices (BfArM) clearly disapprove the use of PAA for the pre-cleaning and cleaning [3] and emphasise the active ingredient's protein-fixing characteristics [4].

Also associations and institutions such as ESGE/ESGENA and WGO/WEO do not recommend PAA-based formulations for the cleaning anymore.

* ESGE: European Society of Gastrointestinal Endoscopy; ESGENA: European Society of Gastroenterology and Endoscopy Nurses and Associates, WEO: World Endoscopy Organization (former OMED); WGO: World Gastroenterology Organisation.

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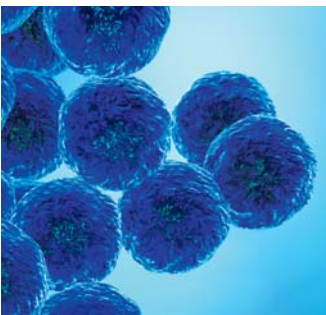
Practical tips to ensure optimal cleaning of flexible endoscopes

Clinical practice tip	Major advantage	Referenz
Clean immediately after use	No drying of organic material such as blood	[1,2]
Follow the instructions of the endoscope manufacturer as closely as possible (e.g. type of brush or cleaning adapter)	Optimum cleaning of an entire channel	
Prefer washer disinfectors with a monitoring system indicating channel blockage	A blocked channel cannot be cleaned adequately and is immediately identified; targeted brush cleaning may be necessary	
Do not switch off the monitoring system for detection of blocked channels	Channels may be blocked and inadequately cleaned; personnel may not detect blocked channels with all possible implications for patient safety	
Support by gastroenterologist	It is strongly recommended that the clinician fully understands the cleaning and disinfection steps and does not inhibit his or her staff's ability to perform them correctly	[3]
Allow external audits by local health authorities on the quality of processing including cleaning	Implementation of guidelines may be more successful if the local health authorities visit the endoscopy units and compare current practices with the relevant guidelines. This effect seems to be more easily achieved in in-patient rather than in out-patient endoscopy units	[4,5,6]

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Practical advice from the BODE SCIENCE CENTER

The BODE SCIENCE CENTER combines science with infection protection practice. In addition to own research projects, for example, on multidrug-resistant pathogens and barriers to compliance, the website of the HARTMANN Group's scientific centre of excellence provides information on recent studies. With its practical recommendations the BODE SCIENCE CENTER supports infection control practitioners in their daily routine.



Today, healthcare facilities are faced with increasingly complex hygiene requirements. Providing well-prepared information on pathogen management, the BODE SCIENCE CENTER bridges gaps in knowledge and contributes to improving infection prevention in clinical practice. For example in case of noroviruses, MRSA, ebola or Clostridia – compact information packages provide hygienists with a reliable basis for their pathogen and hygiene management. The packages contain, for example, study abstracts, expert interviews, guidance and support material on selected topics.

Current information packages

■ MRGN management

Hygiene management in case of multidrug-resistant Gram-negative (MRGN) pathogens including an article on RKI-compliant hygiene measures, studies on MRGN, for example, regarding the efficacy of different surface disinfectant cleaners, and a list of MRGN-effective disinfectants.

■ Basic hygiene in brief

Consistent compliance with standard hygiene in every healthcare facility is the most important prerequisite for efficient infection control. The BODE SCIENCE CENTER explains all necessary measures in detail and provides practical support to all processes, for example with films, posters and series of photographs.

The wipes dispenser system that requires no reprocessing

Wipes dispenser systems with dry fleece rolls that are filled with disinfectants offer many advantages, including time savings due to less time needed for preparation, and greatest possible flexibility in selection of disinfection solution and concentration available for a disposable system.

The X-Wipes fleece roll in the foil bag, which was developed for the BODE X-Wipes dispenser, comes with a white disposable lid. Under normal circumstances (no moisture or soil in the dispenser), the BODE X-Wipes dispenser does not need to be reprocessed as all system components that come into

contact with the disinfection solution are only used once. Hence, the wipes dispenser system with fleece roll in the foil bag is also suitable for high-risk areas.



Normally, does not require reprocessing:
BODE X-Wipes dispenser with X-Wipes fleece roll in the foil bag.

Quality through expert knowledge and decades of application expertise: Based on our scientific know-how, own research projects and an international network, we develop optimised, economically attractive prevention measures. **Research for infection protection..**

