Rationale and Testing of Degerming Procedures

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ABSTRACT

The rationale of degerming procedures is the elimination of undesirable microorganisms from sites serving as potential starting points for the transmission of infections, eg, secretions, excretions, and vehicles. The significance of transmission of infection is well-established for some sites, such as the hands, but debatable for others such as surfaces. No general agreement exists on the efficacy of the different procedures used to prevent hospital infections. Since frequently multiple factors intervene and the final effect is due to the interaction of several preventative measures, it is very difficult to ascertain the efficacy of any given procedure. However, to prevent the formation of germ depots outside the organism is a classical postulate of hygiene not yet invalidated.

Rationale and testing of degerming procedures are closely linked. From tests one expects an answer, if and to what extent a degerming procedure fulfills the requirement fixed by the rationale.

It is essential to distinguish between the degerming agent as the active principle and the degerming procedure, which is comprised of additional factors in the application. [Infect Control 1984; 5(1):28-31.]

Degerming procedures are practiced with the intention of eliminating undesirable microorganisms from sites serving as potential starting points for the transmission of infections, such as secretions, excretions or vehicles of all sorts.

This rationale for the practice of degerming procedures serves also as a rationale for testing them.

To avoid a frequent misinterpretation, it must be emphasized that the testing of a given degerming procedure is made in order to ensure its efficacy on a defined contaminated site. Its value in preventing nosocomial infections is a different problem to be solved by exact epidemiological investigations.

Therefore, test results should be presented in the form of a mere description of the observed effects. Insofar as the results are reproducible under test conditions, they will be accepted by scientists. The evaluation of the results, however, is a separate operation. In fact, the requirements for degerming procedures differ according to the respective conceptions.

Degerming procedures are tested under two aspects: 1) The activity of the degerming *agent* as the active principle includes: the antimicrobial activity (the spectrum of activity against microorganisms and bacteriostatic and bactericidal properties), eventually completed by the fixed time-reduction rate or the velocity constant k, the concentration exponent n, and the temperature coefficient Θ; the interference by other agents, such as water hardness, detergents, albumen, and inhibitors; and the exhaustion of the degerming activity.

These investigations are carried out by in vitro tests. They are performed to characterize the degerming agent, to screen active substances, and to control the end-product. 2) The efficacy of the degerming *procedures*, as the combined effect of degerming agent(s) and accessory factors inherent in the mode of application are designed to recognize the effects of a given degerming procedure and to control its efficacy in use.

The crucial question is whether a given degerming procedure is efficient and to what extent. It can be answered only by testing it in practice. This alone allows the procedure to be applied correctly.

Attempts have been made to test the efficacy on models, which are a reduced representation of the objects to be treated. Unfortunately, it is not always possible to apply the procedure on the model in the identical manner used in practice. A correlation between model and in-practice-test is thus not always present. However, as model tests are simpler and can be performed in the laboratory, efforts

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should be continued to develop model tests, reaching as nearly as possible the conditions of the practice.

In-use-testing presents a series of problems; therefore, it is not routinely carried out.

The test must be performed in a defined standardized situation. Deviations from this can alter the results. The working conditions must be clearly stated and the influence of the most important variables investigated.

The same guidelines are valid for the application mode: spraying does not necessarily give the same results as cleansing. Therefore, the test results are valid only for the conditions under which the test has been made. All extrapolations must be avoided.

Usually, the microorganisms to be studied are not present in the practice situation. They must be introduced by artificial contamination. Reference strains are preferable if the degerming procedure is evaluated for general purposes. Wild strains, especially from nosocomial infections, are used if the efficacy of the degerming procedures is investigated for the special purposes of a hospital. For in-use-controls, one starts with the normal flora.

The implications of an in-practice-test will be shown by the example of testing degerming procedures for surfaces.

TEST PARAMETERS

- the quantitative reduction of microorganisms on the floor
- the carry-over effect by the application method
- the quantitative reduction of germs in the used washing water.

APPLICATION MODE

Wet cleansing

The floor is covered with degerming solution by moving the mop three times forward and backward. The mop is then expressed in a bucket and used to dry off the solution, which is likewise expressed into the bucket.

TEST SITUATION

The test is made on a normally used floor of clinker-tiles. Parallel experiments on plastified floor have shown that gram-negative bacteria are too easily removed by mechanical cleansing and that staphylococci can be reduced by additives to the plastic material (like tin compounds).

Room temperature 24° C

Relative humidity 50% to 60%

ARTIFICIAL CONTAMINATION

Klebsiella pneumoniae ATCC 27 736 and *Staphylococcus aureus* Wood 46, cultivated according to SN 195 922.

One ml of an overnight culture is added to 9 ml equal parts of 0.9% NaCl and 1.5% albumin solution, so that 1 ml of the final suspension averages 10^8 cfu/ml.

DEGERMING AGENT

A commercial product containing 37% p-chlor-m-cresol with detergents, employed in a concentration of 0.5%, 1.0%, and 3%.

Inactivator: 3% Tween 80, 0.3% Lecithine, and 0.1% Histidine.

COLLECTION OF BACTERIA

A reliable method for collecting germs quantitatively from the floor is an absolute necessity. The "Bakterienkollektor" developed by Thran gives a practically complete recovery of bacteria from surfaces. A jet of saline is directed against a surface of 5 cm^2 with a pressure of 4 bar. The entire resulting germ suspension is then reaspirated according to the Venturi-principle and collected.

CULTURE

Filtration of aliquot parts by membrane filters with 0.45 μm pore diameter or by plating 0.1 ml of the suspension. Medium: Standard Methods Agar with Lecithin and Polysorbate 80, BBL 11'643. Incubation 37° C during 48 hours.

TEST PROCEDURE

The floor is divided into three sectors sufficiently large to allow an easy application of the procedure. In the first sector, the degerming procedure is applied according to the guidelines. In the second sector, the same procedure is executed but with water of standardized hardness instead of the degerming agent. The third sector is not treated at all, serving as control for the number of applied germs.

In each sector, five areas with a diameter of 5 cm are contaminated by using a stencil plate, with 0.1 ml of suspension spread with a pencil.

After 60 minutes of dessication, the degerming procedure is applied. One hour after this, the inoculation points are relocated with the stencil plate and sampled with the collector. Sampling is repeated on five other points not contaminated in order to detect the carry-over.

From the recovered washing water, bacterial counts are carried out after five minutes and after 30 minutes.

RESULTS

From 53 tests on four brands of degerming agents, only the results with the product containing p-chlor-m-cresol on *Staphylococcus aureus* were reported (mean of three tests).

Two hours after the application of 5×10^7 cfu, 3.05×10^5 cfu could be recovered from the untreated sector.

Cleansing with water of standardized hardness alone reduced the number of staphylococci by 1.8 log, the degerming procedure by an average of 3.6 log (Table 1, Figure 1).

The reduction increased with the concentration of the degerming agent, from 3.36 log (0.5%) to 3.99 log (3.0%). The net reduction caused by the degerming agent (log reduction of the degerming procedure minus log reduction of the procedure with water) increased also from 1.28 log (0.5%) to 2.25 log (3.0%).

On the contaminated sites, between 39 and 116 cfu/25 cm^2 were recovered after the degerming procedure.

Despite the degerming procedure, a carry-over was found on the 5 non-contaminated points: after the procedure with water, 1'519 cfu of *Staphylococcus aureus* were

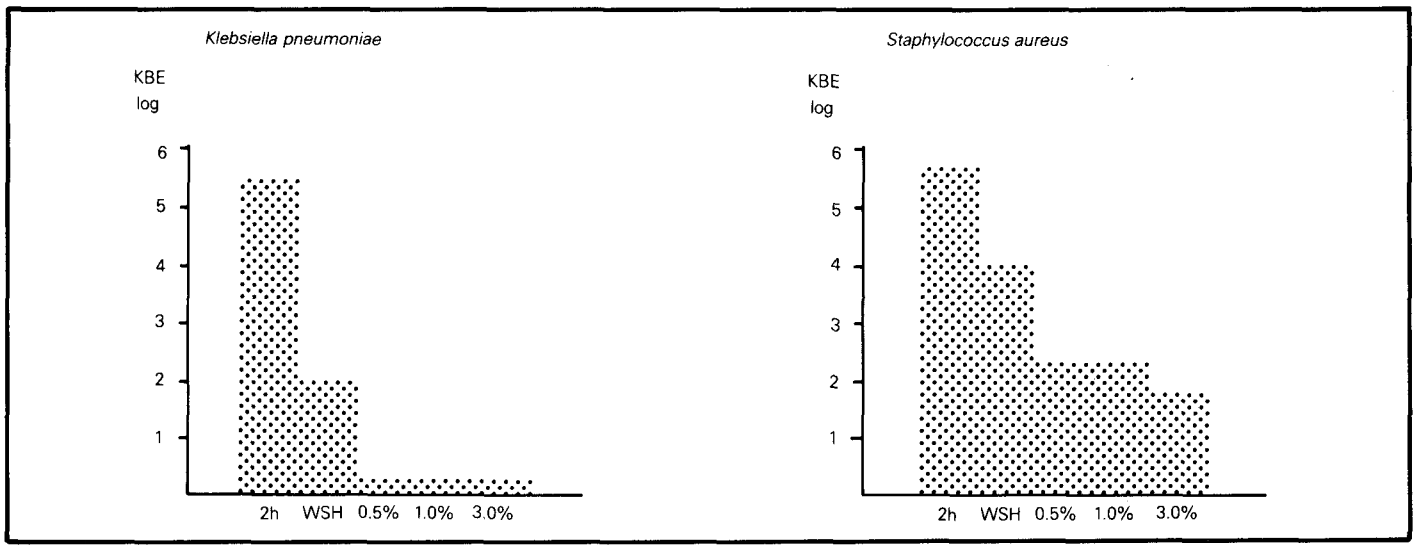

Figure 1. *Klebsiella pneumoniae* ATCC 27'736 and *Staphylococcus aureus* Wood 46 recovered from 25 cm² clinker tiles 2 hours after dessication (2 hours), after wet mopping with water of standardized hardness (WSH) and after wet mopping with a solution of 0.5%, 1.0% and 3.0% of p-chlor-m-cresol (37%) + detergents, temperature: 24°C, relative humidity: 50% to 60%.

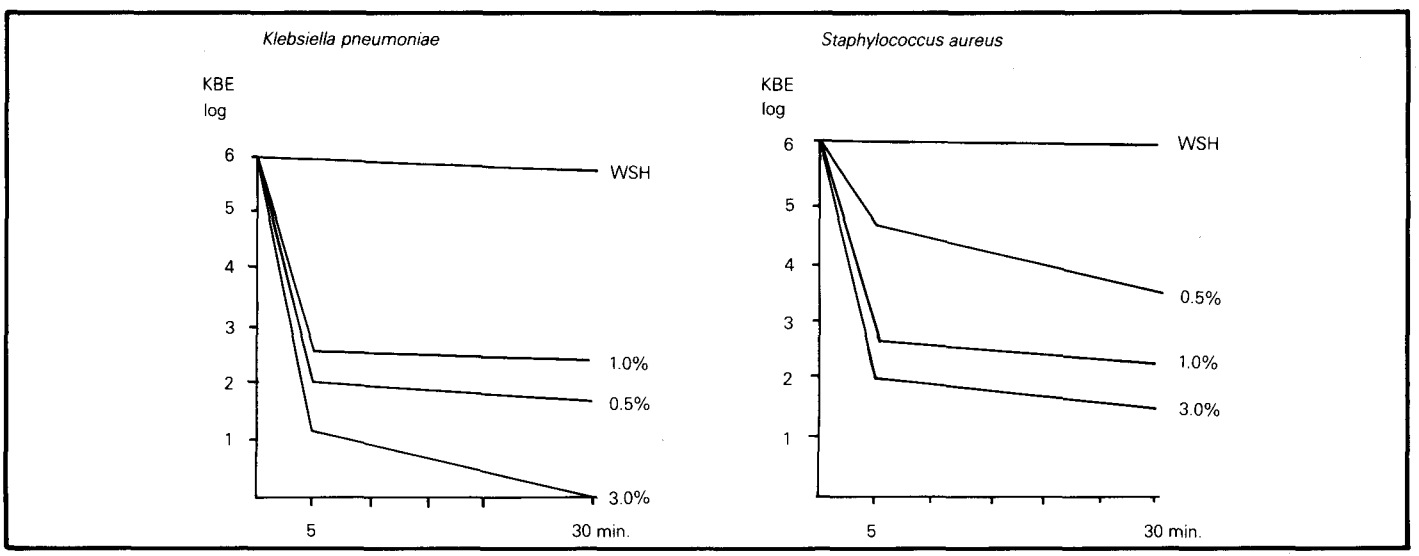

Figure 2. Log-reduction of *Klebsiella pneumoniae* ATCC 27'736 and *Staphylococcus aureus* Wood 46 in washing water five minutes and 30 minutes after wet mopping with water of standardized hardness and with detergents 0.5%, 1.0% and 3.0%, temperature: 24°C, relative humidity: 50% to 60%.

found on 225 cm². After degerming 1'084 cfu were found: 720 cfu alone in one experiment.

In the washing water without degerming agent, practically the total number of applied staphylococci was recovered (Table 2). Using the degerming procedure, one establishes after five minutes a reduction by 1.7 log (0.5%) to 3.9 log (3.0%). After 30 min, the reduction attains 2.6 resp. 4.8 log, so that 1.47×10^3 respectively 1.5×10^1 cfu remains finally in 400 ml washing water.

Working with *Klebsiella pneumoniae*, the results obtained differ slightly.

Cleansing with water alone reduces the number of klebsiella on the floor by 3.5 log, with the degerming procedure by 5.1 log, so that only 1 cfu to 2 cfu remain on 25 cm² (Table 3, Figure 1).

The carry-over amounts to about the same dimension. Likewise, the germ-reduction in the washing water is more pronounced (Table 4, Figure 2).

CONCLUSIONS

The described test method allows the testing of degerming procedures quantitatively under various conditions in practice. Owing to its flexibility, the method is adaptable to a range of diverse problems to be investigated, on various surfaces contaminated with the normal flora or with reference or wild strains and by using different application modes. In addition to the reduction of microorganisms on the floor, the determination of the carry-over and of the reduction of microorganisms in the

TABLE 1
LOG-REDUCTION ON POROUS STONE CONTAMINATED WITH 5 × 10^7 CFU *STAPHYLOCOCCUS AUREUS* WOOD 46 WET MOPPING, T 24°C, RELATIVE HUMIDITY 50% TO 60%

P-Chlor-Meta-Cresol Sol. 37% + Detergents	Log Reduction Uncleansed	Water	Degerming	Degerming-water
0.5%	5.432	2.084	3.365	1.281
1.0%	5.433	1.570	3.556	1.986
3.0%	5.587	1.743	3.994	2.251

TABLE 2
LOG-REDUCTION OF *STAPHYLOCOCCUS AUREUS* WOOD 46 IN WASHING WATER FROM FLOOR TREATED WITH P-CHLOR-M-CRESOL, WET MOPPING

P-Chlor-Meta-Cresol Sol. 37% + Detergents	Untreated Washing Water After 5 Min	30 Min	Log Reduction by Degerming After 5 Min	30 Min
0.5%	6.060	5.776	1.725	2.610
1.0%	6.009	6.043	3.434	3.725
3.0%	6.019	5.986	3.904	4.814

TABLE 3
LOG-REDUCTION ON POROUS STONE CONTAMINATED WITH 5 × 10^7 CFU *KLEBSIELLA PNEUMONIAE* ATCC 27736 WET MOPPING, T 24°C, RELATIVE HUMIDITY 50% TO 60%

P-Chlor-Meta-Cresol Sol. 37% + Detergents	Log-Reduction Uncleansed	Water	Degerming	Degerming −Water
0.5%	5.411	3.873	5.252	1.389
1.0%	5.190	3.480	5.031	1.551
3.0%	5.188	3.356	5.088	1.732

TABLE 4
LOG-REDUCTION OF *KLEBSIELLA PNEUMONIAE* ATCC 27736 IN WASHING WATER FROM FLOOR TREATED WITH P-CHLOR-M-CRESOL, WET MOPPING

P-Chlor-Meta-Cresol Sol. 37% + Detergents	Untreated Washing Water After 5 Min	30 Min	Log Reduction by Degerming After 5 Min	30 Min
0.5%	5.668	5.204	3.732	3.995
1.0%	5.484	5.352	3.163	3.154
3.0%	5.722	5.695	5.199	5.695

treated washing water provide the elements for evaluating the efficacy of the degerming procedure.

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