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Life Science Separation

# ENDSTÄNDIGE STERILFILTER IM SPANNUNGSFELD ZWISCHEN TRINKWASSERVERSORGUNGSANL. UND MEDIZINISCHEN ANFORDERUN

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**WOLFSBURGER TRINKWASSERTAGE**  
**10. SEPTEMBER 2026**

# LEGIONELLEN

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27. Juli 1976 Ray Brannon

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1977 Meldepflicht USA

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2001 Meldepflicht in Deutschland

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Zwischen 2016 und 2025 **stieg die Zahl der gemeldeten Erkrankungen um 126%**

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2021 RKI schätzt die Dunkelziffer auf bis zu 97%

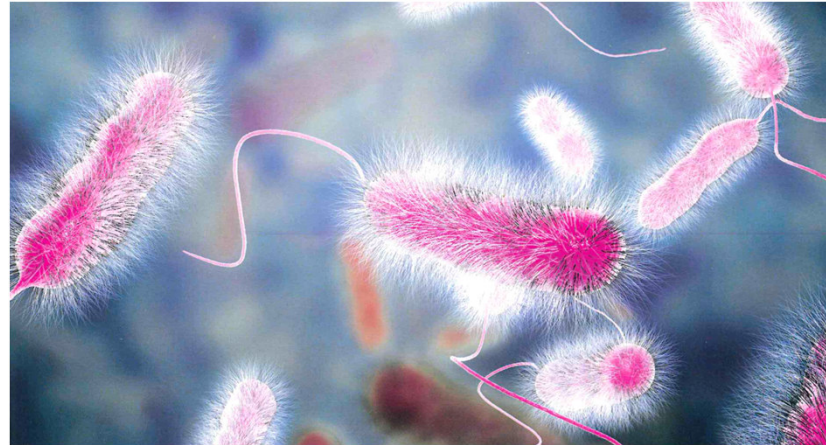
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Mortalität 5% bis 17% je nach Immunstatus.

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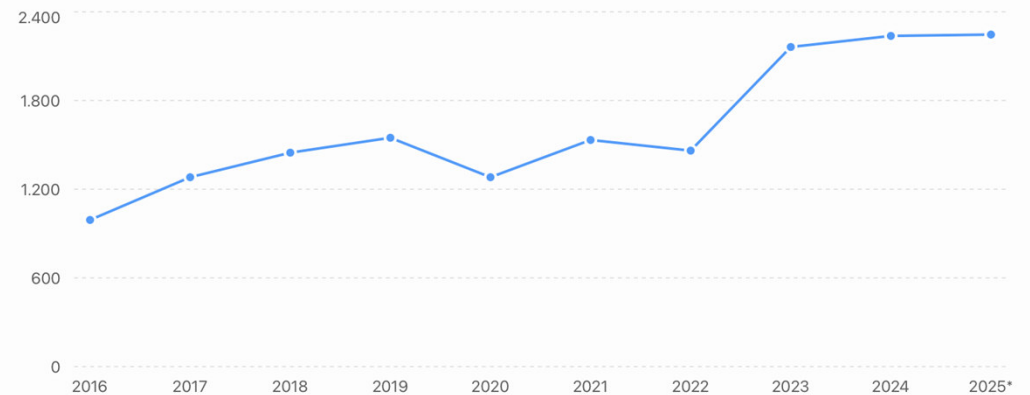
75.000 Erkrankungen D, 7.500 Tote D

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## Legionellose-Fälle in Deutschland 2016–2025

Jährlich gemeldete Erkrankungen nach RKI-Referenzdefinition. 2025 vorläufig.

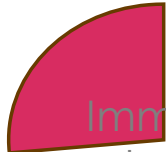


Quelle: Robert Koch-Institut; 2025 noch nicht als finales RKI-Jahrbuch veröffentlicht.

# WASSERQUALITÄT UND GRENZWERTE



Immun-  
status



Immun-  
status

**State of  
Art  
(TrinkwV,  
DVGW).**

- E-Coli < 1/100 ml
- KBE 22° und 36° < 100/ml
- Legionellen 100/100ml als technischer Maßnahmenwert

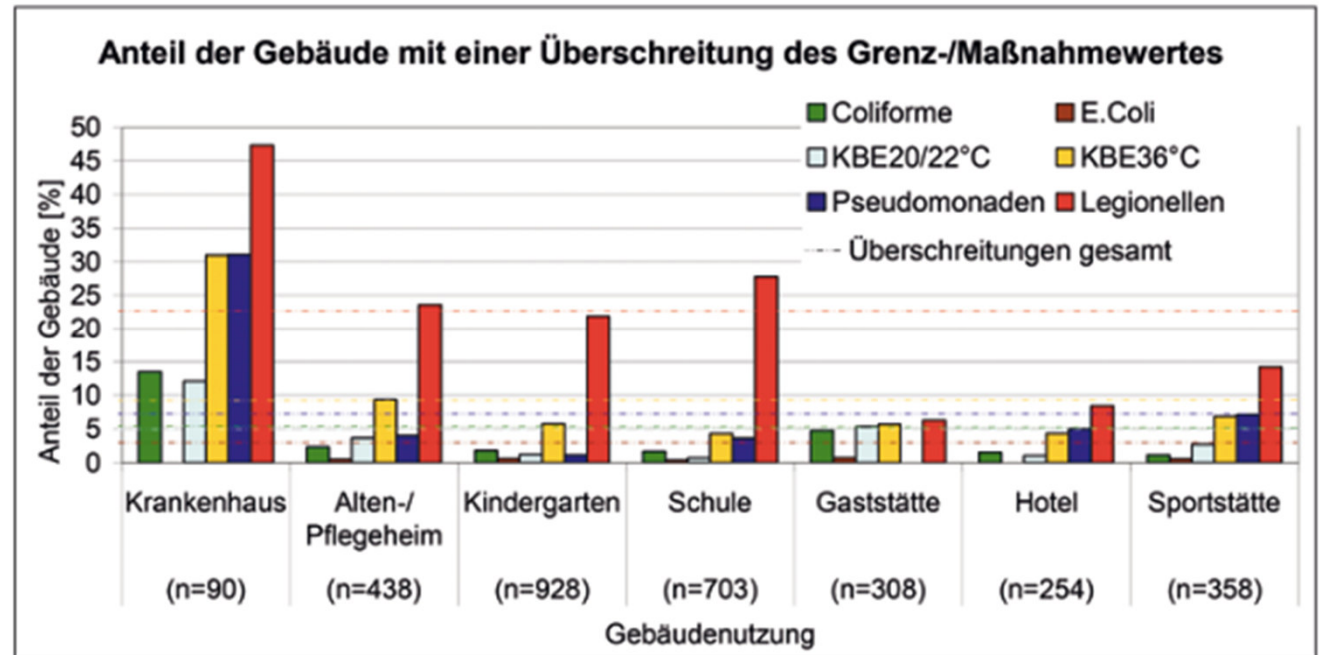
**State of  
Science**

- Legionella spp. < 1/100 ml<sup>1</sup>
- P-aeruginosa < 1/100 ml<sup>1</sup>
- Coliforme < 1/100 ml<sup>1</sup>
- NTM
- Acinetobacter
- Burkholderia
- Ralstonia
- Stenotrophomonas
- MRGN
- VRE

- Empfehlung der Deutschen Gesellschaft für Krankenhaushygiene 2016

# ANTEIL DER GEBÄUDE MIT MINDESTENS 1 ÜBERSCHREITUNG DES GRENZWERTES ZWISCHEN 2003 UND 2009

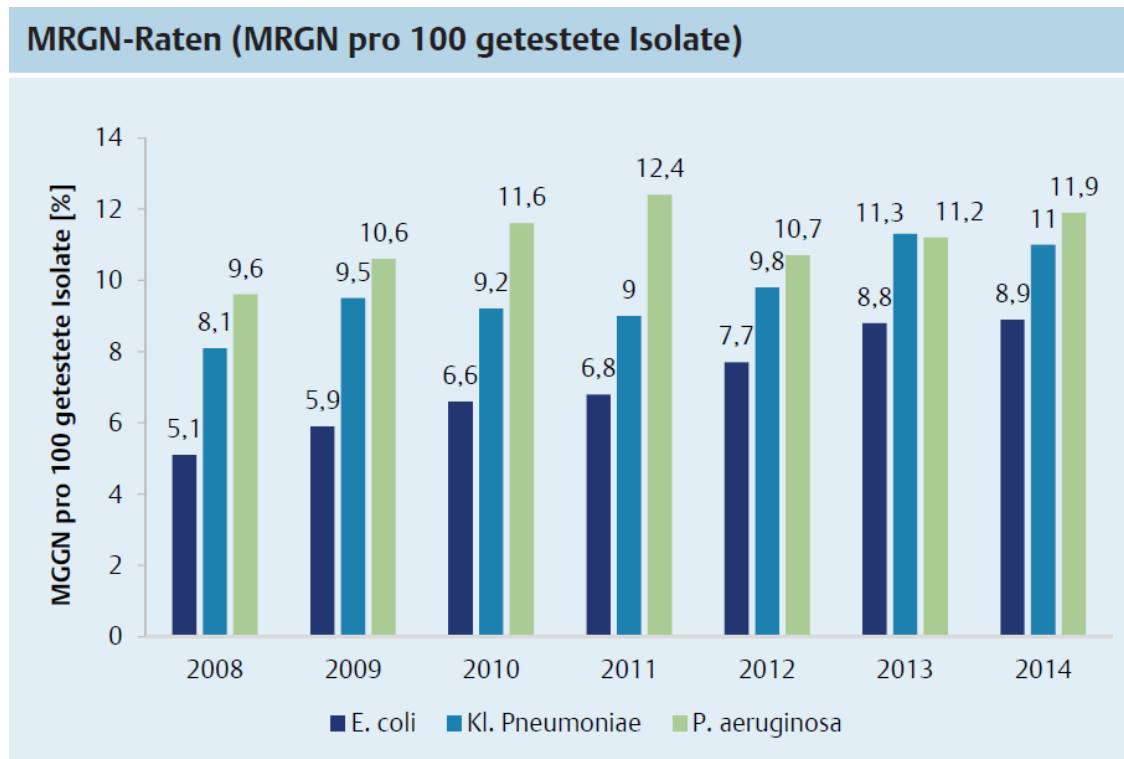
110.000 Messergebnisse, ca. 30.000 Probenahmen, 20.000 Zapfstellen und 4.600 Gebäude



- Kistemann T., Schreiber C., Völker S. (2010): „Vorkommen mikrobieller Trinkwasserkontaminationen in Hausinstallationen“. In: Flemming H.-C. (Hrsg.), Vermeidung und Sanierung von Trinkwasser-Kontaminationen durch hygienisch relevante Mikroorganismen aus Biofilmen der Hausinstallation, IWW-Schriftenreihe, S. 31–100. BMBF-Förderkennzeichen 02WT0832.

# MULTI-RESISTANT PATHOGENS

## Epidemiology, surveillance and significance



[Geffers C et al., AINS 2016; 51: 104]

# Resistenzen



Kinder infizieren  
sich mit  
Carbapenem  
resistenten  
*Pseudomonas*  
*aeruginosa*  
(2021)

Case report | [Open access](#) | [Published: 28 April 2021](#)

**Carriage of two carbapenem-resistance genes in *Pseudomonas aeruginosa* isolated from hospital-acquired infections in children from Costa Rica: the importance of local epidemiology**

[Cristian Pérez-Corrales](#) , [Valeria Peralta-Barquero](#) & [Christopher Mairena-Acuña](#)

[Antimicrobial Resistance & Infection Control](#) **10**, Article number: 71 (2021) | [Cite this article](#)

**1648** Accesses | **2** Citations | **1** Altmetric | [Metrics](#)

# Resistant *Pseudomonas aeruginosa* in the EU

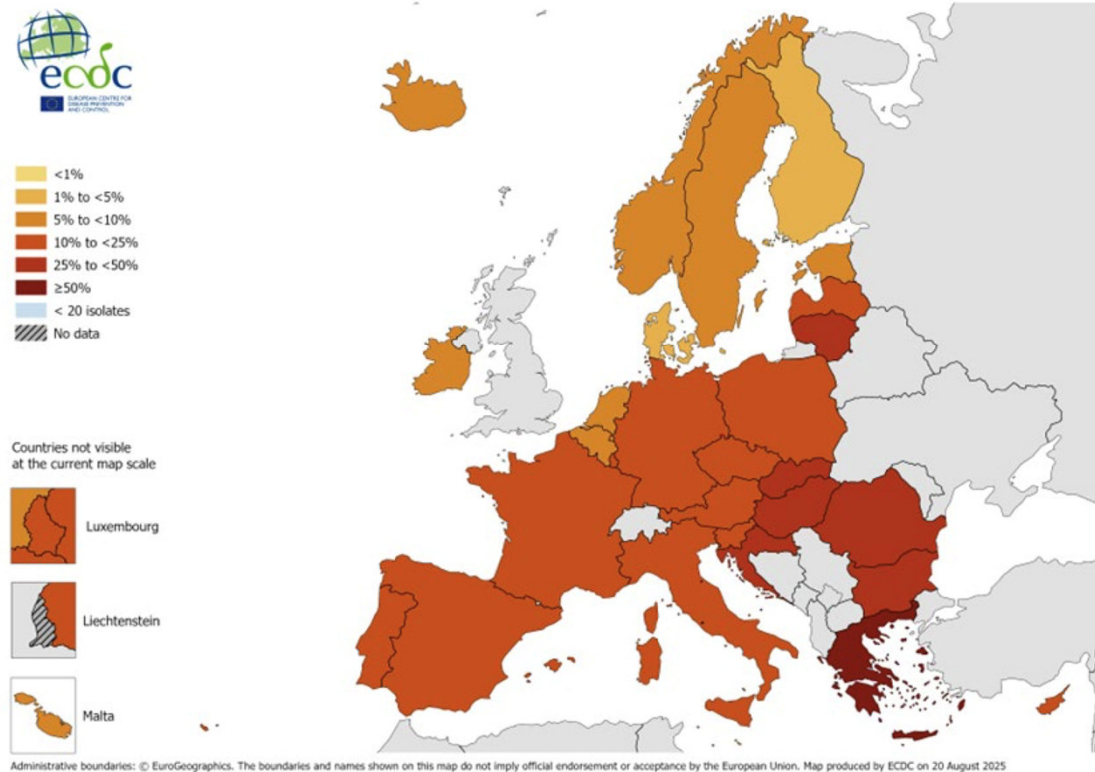


SURVEILLANCE REPORT

## Antimicrobial resistance in the EU/EEA (EARS-Net)

Annual Epidemiological Report for 2024

**Figure 6. *Pseudomonas aeruginosa*. Percentage of invasive isolates with resistance to carbapenems (imipenem/meropenem), by country, EU/EEA, 2024**



<https://www.ecdc.europa.eu/sites/default/files/documents/antimicrobial-resistance-eu-annual-epidemiological-report-2024.pdf>

# Case studies

## Common RAPD pattern of *Pseudomonas aeruginosa* from patients and tap water in a medical intensive care unit

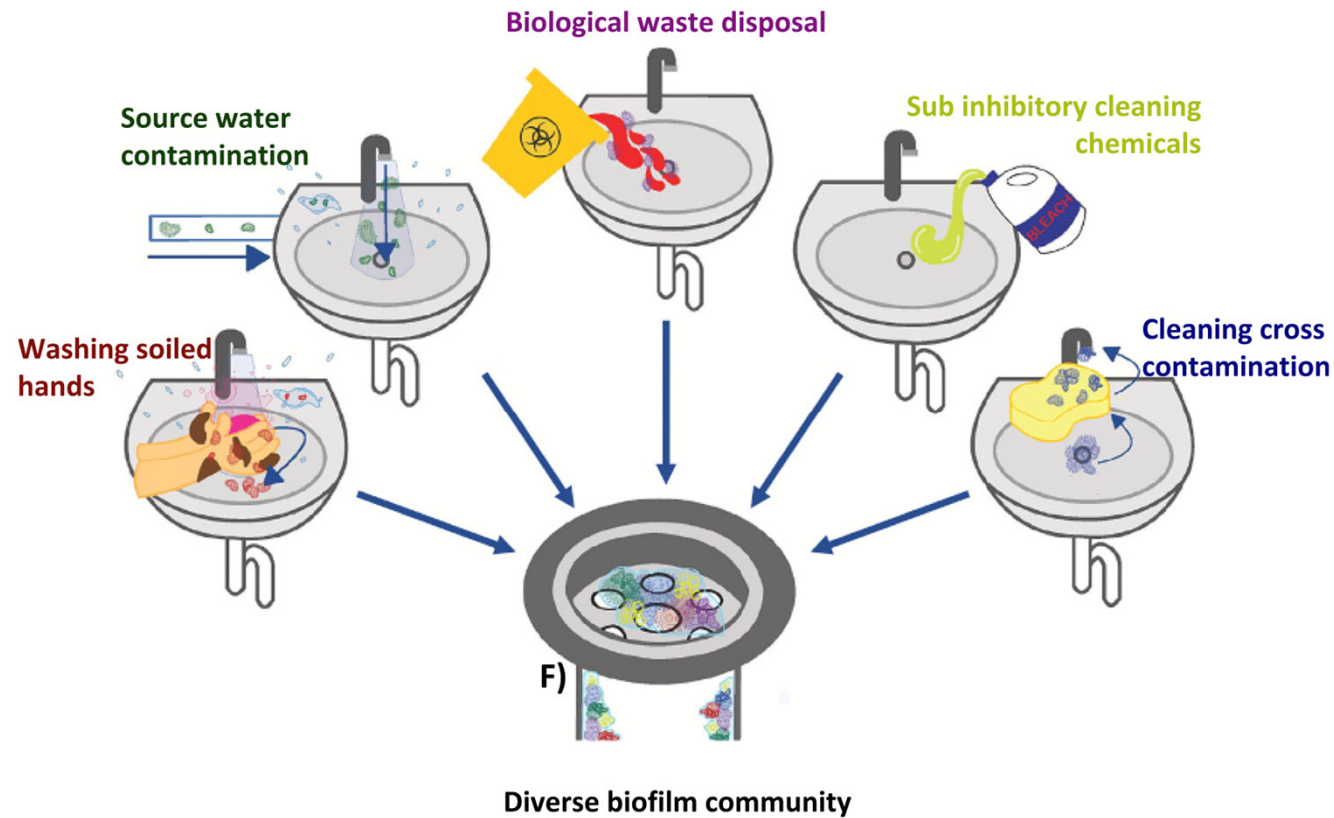
Matthias Trautmann<sup>a</sup>, Cindy Bauer<sup>a</sup>, Christian Schumann<sup>b</sup>, Philipp Hahn<sup>c</sup>,  
Martin Höher<sup>b</sup>, Mathias Haller<sup>d</sup>, Philipp M. Lepper<sup>b,e,\*</sup>

The epidemiology of *Pseudomonas aeruginosa* infections and colonizations was studied prospectively on a 12-bed medical intensive care unit. Patients were monitored for *P. aeruginosa* colonization by performing throat swabs or tracheal aspirates on admission and weekly thereafter over a period of 6 months. Cultures of possibly infected sites were taken as clinically indicated. Water samples from all patient care-related tap water outlets were collected in 2-weekly intervals and examined for the presence of *P. aeruginosa*. Strains isolated from patients and water samples were analysed by serotyping and random amplified polymorphic DNA polymerase chain reaction (RAPD-PCR) typing. During the 6-month period, 60 of 143 (42%) water samples contained *P. aeruginosa* at various levels ranging from 1 to >100 colony-forming units per 100 ml sample. Genotypically, water samples contained 8 different clonotypes. Nine patients had infections due to *P. aeruginosa* and 7 patients were colonized. Isolates from patients showed a similar distribution of genotypes as did tap water isolates, and strains of identical genotype as patient strains had been isolated previously from tap water outlets in 8 out of 16 (50%) infection or colonization episodes. However, patients also harboured strains not previously isolated from tap water. Thus, in addition to tap water, other environmental or unknown reservoirs appeared to play a role for the epidemiology of *P. aeruginosa* infections on this ward. However, because tap water played a significant role for strain transmissions, we conclude that intensified water site care is justified.

DNA typing:

8 von 16 (50%)  
Infektionen/Kolonisationen  
vom Wasserhahn

# Kontaminationsquellen von Siphons und Wasserhähnen



Aus „Handwashing basins and healthcare associated infections: Bacterial diversity in biofilms on faucet and drains“ Hyward et al Science of the Total Environment 949 (2024)

### Droplet- Rather than Aerosol-Mediated Dispersion Is the Primary Mechanism of Bacterial Transmission from Contaminated Hand-Washing Sink Traps

Shireen M. Kotay<sup>a</sup>, Rodney M. Donlan<sup>b</sup>, Christine Ganim<sup>b</sup>, Katie Barry<sup>a</sup>, Bryan E. Christensen<sup>b</sup>, Amy J. Mathers<sup>id a,c</sup>



Scherkräfte des Wassers aus dem Wasserhahn, das direkt auf den Abfluss des Waschbeckens und/oder die Oberfläche der Schüssel fließt, führen zu einer Dispersion der Bakterien.

### Antimicrobial Resistance & Infection Control

Home About [Articles](#) Submission Guidelines [Submit manuscript](#)

Research | [Open access](#) | Published: 16 February 2017

### The sink as a potential source of transmission of carbapenemase-producing *Enterobacteriaceae* in the intensive care unit

[Deborah De Geyter](#) , [Lieve Blommaert](#), [Nicole Verbraeken](#), [Mark Sevenois](#), [Luc Huyghens](#), [Helena Martini](#), [Lieve Covens](#), [Denis Piérard](#) & [Ingrid Wybo](#)

*Antimicrobial Resistance & Infection Control* 6, Article number: 24 (2017) | [Cite this article](#)

12k Accesses | 54 Altmetric | [Metrics](#)



Die von Patienten und dem Syphon in dem betroffenen Zimmer isolierten Stämme waren hochgradig verwandt und wiesen auf eine Übertragung von Waschbecken zu Patienten hin. 7 von 8 Waschbecken in den Isolierzimmern der Intensivstation als CPE-kontaminiert befunden.

## Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis

Antimicrobial Resistance Collaborators\*

www.thelancet.com Vol 399 February 12, 2022



9.324 Sources  
204 Countries  
174 Authors

- 5 M Deaths caused in relation to resistant germs in 2019 (1,27 M direct)
- Estimation until 2050: 10 M Deaths worldwide (Number 1 ahead of Cancer)
- 4,000 active ingredients in development to fight cancer (Nature)
- 40 active ingredients being researched as possible new antibiotics
- CDC: 55 Billion US\$ yearly cost (\$20 Billion direct treatment, \$35 Billion loss of productivity)
- 70% of the infections are caused by only 6 Pathogens, *Pseudomonas aeruginosa* is part of
- Number of deaths caused by resistant *Ps. aer.* are comparable with Deaths caused by Legionella
- 60% increase of use of antibiotics between 2000 and 2015

# MULTI-BARRIER SYSTEM



Wissen und Training

Hände Hygiene mit modernen Monitoring Systemen

Flächendesinfektion

Monitoring von Gram-negativen Bakterien

**Endständige Filtration?**

## CASE STUDIES

*Infectious Disorders • Brief Report*

### **Resolution of a *Pseudomonas aeruginosa* outbreak in a hematology unit with the use of disposable sterile water filters**

#### **Infection control by point-of-use water filtration in an intensive care unit – a Hungarian case study**

Zsófia Barna, Katalin Antmann, Judit Pászti, Renáta Bánfi, Mihály Kádár, Anita Szax, Melinda Németh, Eszter Szegő and Márta Vargha

ORIGINAL ARTICLE

EPIDEMIOLOGY

### **Removal of waterborne pathogens from liver transplant unit water taps in prevention of healthcare-associated infections: a proposal for a cost-effective, proactive infection control strategy**

Z. Y. Zhou<sup>1</sup>, B. J. Hu<sup>2</sup>, L. Qin<sup>3</sup>, Y. E. Lin<sup>4</sup>, H. Watanabe<sup>3</sup>, Q. Zhou<sup>2</sup> and X. D. Gao<sup>2</sup>

1) Microbiology Laboratory, Zhongshan Hospital of Fudan University, 2) Department of Infection Control, Zhongshan Hospital of Fudan University, Shanghai, China, 3) Division of Infectious Diseases, Department of Infectious Medicine, Kurume University School of Medicine, Kurume, Fukuoka, Japan and

4) National Kaohsiung Normal University, Kaohsiung, Taiwan



2002: 61 Blood  
Culture positive

2003: 7  
Blood Culture  
positive

2008: 2.7 Cases *Ps.*  
*aer* 100 Patient days

2008: 0.0  
Cases *Ps. aer*  
100 Patient  
days

3.2 Cases per  
1,000 Patient days

1.7 Cases  
per 1,000  
Patient Days

# Case studies

## Point-of-use water filtration reduces endemic *Pseudomonas aeruginosa* infections on a surgical intensive care unit

Matthias Trautmann, MD,<sup>a,b</sup> Simone Halder, MD,<sup>a,b</sup> Josef Hoegel, PhD,<sup>c</sup> Hilde Royer, RN,<sup>d</sup> and Mathias Haller, MD<sup>e</sup>  
Stuttgart, Ulm, and Kempten, Germany

**Background:** Endemic infections because of *Pseudomonas aeruginosa* were observed on a surgical intensive care unit (ICU) for a period of >24 months. Tap water probing revealed persistent colonization of all ICU water taps with a single *P. aeruginosa* clonotype.

**Results:** (1) The mean monthly rate ( $\pm$ SD) of *P. aeruginosa* infection/colonization episodes was  $3.9 \pm 2.4$  in the prefilter and  $0.8 \pm 0.8$  in the postfilter period. *P. aeruginosa* colonizations were reduced by 85% ( $P < .0001$ ) and invasive infections by 56% ( $P < .0003$ ) in the postfilter period. (2) Microbiologic examinations of tap water revealed growth of *P. aeruginosa* in 113

**Conclusion:** Taking into account various patient-related and general ward variables, point-of-use water filtration was associated with a significant reduction of chronically endemic *P. aeruginosa* colonizations/infections on a surgical ICU. (Am J Infect Control 2008;36:421-9.)

Studie ICU > 24 Monate

85% weniger Kolonisierungen  
56% weniger Infektionen

# Case studies

## Contribution of tap water to patient colonisation with *Pseudomonas aeruginosa* in a medical intensive care unit

A.-M. Rogues<sup>a,b,\*</sup>, H. Boulestreau<sup>a,b</sup>, A. Lashéras<sup>b</sup>, A. Boyer<sup>c</sup>, D. Gruson<sup>c</sup>, C. Merle<sup>b</sup>, Y. Castaing<sup>c</sup>, C.M. Bébear<sup>d</sup>, J.-P. Gachie<sup>a,b</sup>

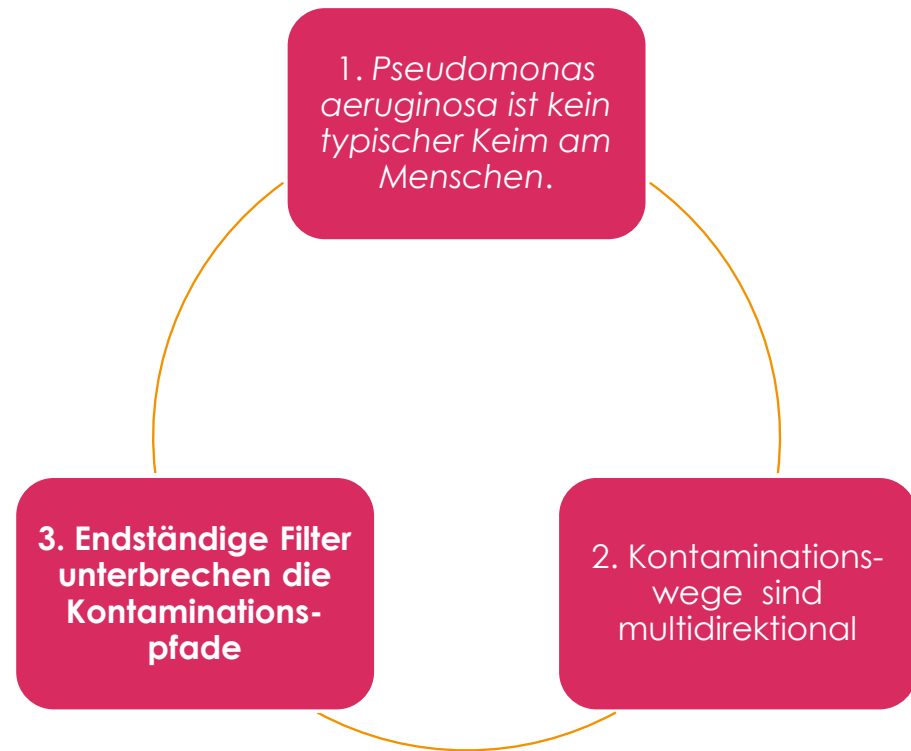
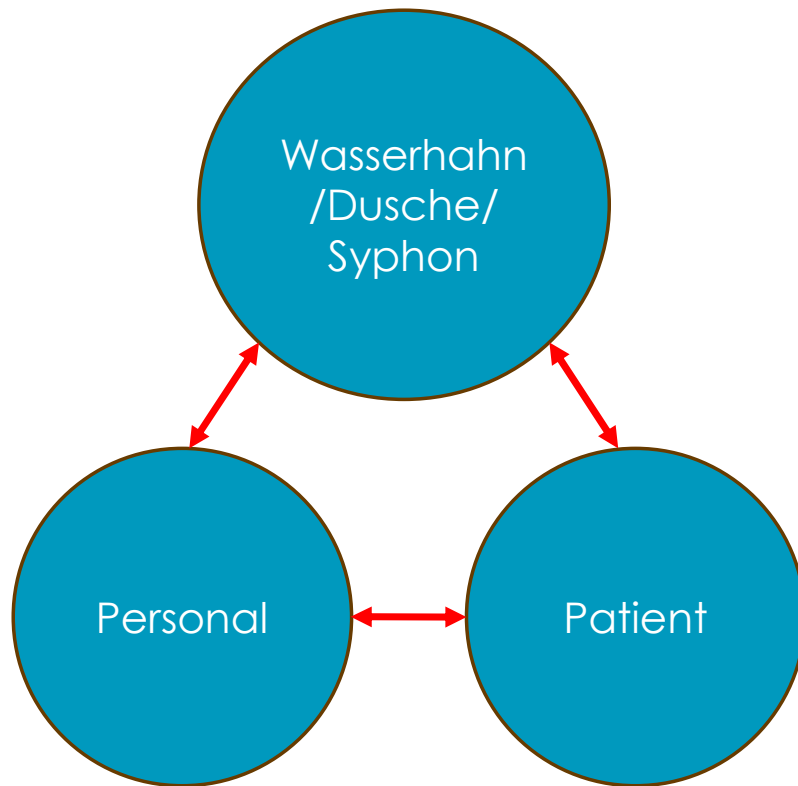
**Summary** This study examined tap water as a source of *Pseudomonas aeruginosa* in a medical intensive care setting. We prospectively screened specimens of patients, tap water and hands of healthcare workers (HCWs) over a six-month period in a 16-bed medical intensive care unit. Molecular relatedness of *P. aeruginosa* strains was investigated by pulsed-field gel electrophoresis. A total of 657 tap water samples were collected from 39 faucets and 127 hands of HCWs were sampled. *P. aeruginosa* was found in 11.4% of 484 tap water samples taken from patients' rooms and in 5.3% of 189 other tap water samples ( $P < 0.01$ ). *P. aeruginosa* was isolated from 38 patients. Typing of 73 non-replicate isolates (water samples, hands of HCWs and patients) revealed 32 major DNA patterns. Eleven (52.4%) of the 21 faucets were contaminated with a patient strain, found before isolation from tap water in the corresponding room in nine cases, or from the neighbouring room in two cases. Among seven *P. aeruginosa* strains isolated from HCW hands, the genotype obtained was the same as that from the last patient they had touched in six cases, and in the seventh with the last tap water sample used. More than half of *P. aeruginosa* carriage in patients was acquired via tap water or cross-transmission. Carriage of

DNA typing

52,4% Ps.aer. Von den Patienten zum Wasserhahn

7 Strains an Händen des Personals von Patienten

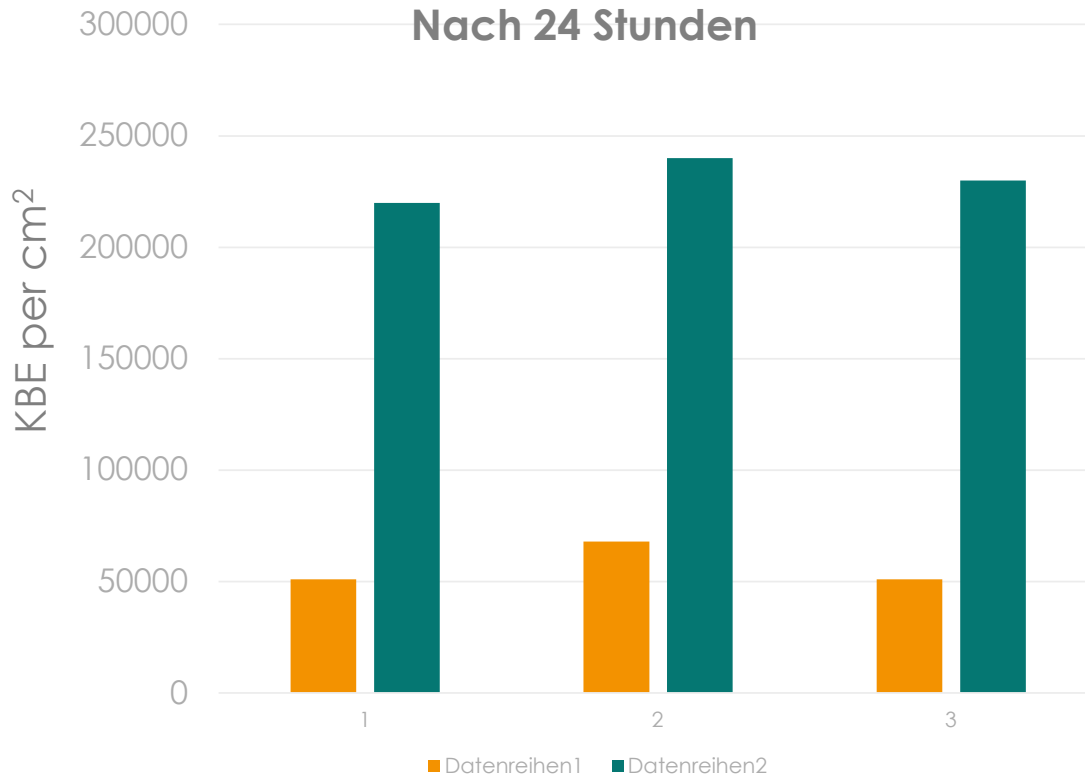
# CONTAMINATION PATHWAYS



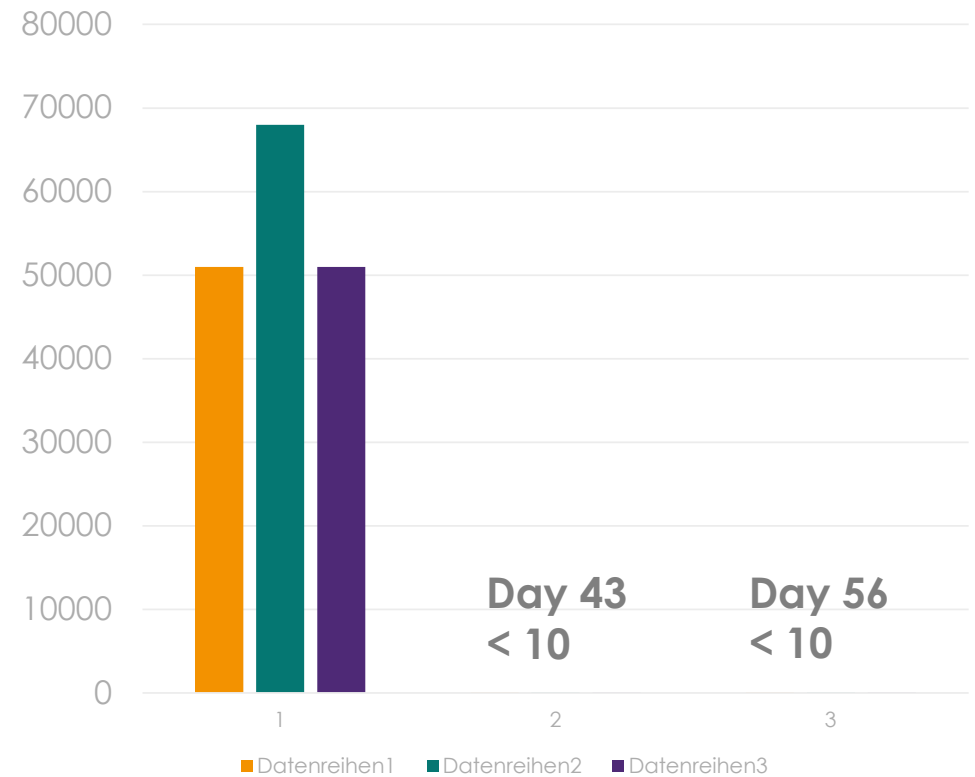
# ISO 22196 ANTIBAKTERIELLE EIGENSCHAFTEN



Ohne Bakterizides Additiv  
Nach 24 Stunden



Mit Bakterizidem Additiv





# DATEN ENDSTÄNDIGER FILTER

| Filterstudie Ergebnisse Kaltwasser-Paramter KBE 22°C |                     |             |         |     |           |       |       |        |        | Ab 28  |        | Wischdesinfektion |  |                 |  |
|------------------------------------------------------|---------------------|-------------|---------|-----|-----------|-------|-------|--------|--------|--------|--------|-------------------|--|-----------------|--|
| Nr.                                                  | Raumbezeichnung     | Entnahmeort | Armatur | Art | Filtertyp | Tag 0 | Tag 7 | Tag 21 | Tag 28 | Tag 50 | Tag 56 |                   |  |                 |  |
| 1                                                    | Patienten-Nasszelle | WB          | EMB     | KW  | i3        | 0     | 0     | 0      | 0      | 0      | 0      |                   |  |                 |  |
| 1                                                    | Patienten-Nasszelle | Dusche      | TMB     | KW  | i3        | 0     | 0     | 0      | 0      | 0      | 0      |                   |  |                 |  |
| 2                                                    | Patienten-Nasszelle | WB          | EMB     | KW  | i3        | 0     | 1     | 0      | 0      | 0      | 0      |                   |  |                 |  |
| 2                                                    | Patienten-Nasszelle | Dusche      | TMB     | KW  | i3        | 0     | 0     | 0      | 0      | 0      | 14     |                   |  |                 |  |
| 3                                                    | Patienten-Nasszelle | WB          | EMB     | KW  | i3        | 0     | 0     | 0      | 0      | 0      | 0      |                   |  |                 |  |
| 3                                                    | Patienten-Nasszelle | Dusche      | TMB     | KW  | i3        | 0     | 0     | 0      | 0      | 0      | 0      |                   |  |                 |  |
| 4                                                    | Patienten-Nasszelle | WB          | EMB     | KW  | i3        | 0     | 1     | >100   | 17     | 0      | 90     | Retrograd         |  | Biofilm Armatur |  |
| 4                                                    | Patienten-Nasszelle | Dusche      | TMB     | KW  | i3        | 0     | 0     | 0      | 0      | 0      | 0      |                   |  |                 |  |
| 5                                                    | Patienten-Nasszelle | WB          | EMB     | KW  | i3        | 0     | 0     | 0      | 0      | 0      | 0      |                   |  |                 |  |
| 5                                                    | Patienten-Nasszelle | Dusche      | TMB     | KW  | i3        | 0     | 0     | 0      | 0      | 0      | 0      |                   |  |                 |  |

## CFU 22° (Water Bacteria)

- 60 Samples
- 4 Cont. > 1 (7%)
- 1 Cont. > 100 (2%)

| Filterstudie Ergebnisse Kaltwasser-Paramter KBE 36°C |                     |             |         |     |           |       |       |        |        | Ab 28  |        | Wischdesinfektion |  |  |  |
|------------------------------------------------------|---------------------|-------------|---------|-----|-----------|-------|-------|--------|--------|--------|--------|-------------------|--|--|--|
| Nr.                                                  | Raumbezeichnung     | Entnahmeort | Armatur | Art | Filtertyp | Tag 0 | Tag 7 | Tag 21 | Tag 28 | Tag 50 | Tag 56 |                   |  |  |  |
| 1                                                    | Patienten-Nasszelle | WB          | EMB     | KW  | i3        | 0     | 0     | 0      | 0      | 25     | 0      |                   |  |  |  |
| 1                                                    | Patienten-Nasszelle | Dusche      | TMB     | KW  | i3        | 0     | 48    | >100   | 2      | 0      | 0      |                   |  |  |  |
| 2                                                    | Patienten-Nasszelle | WB          | EMB     | KW  | i3        | 1     | 2     | >100   | >100   | 23     | >100   |                   |  |  |  |
| 2                                                    | Patienten-Nasszelle | Dusche      | TMB     | KW  | i3        | 0     | 0     | 0      | 0      | 27     | 40     |                   |  |  |  |
| 3                                                    | Patienten-Nasszelle | WB          | EMB     | KW  | i3        | 0     | 0     | 0      | 0      | 0      | 0      |                   |  |  |  |
| 3                                                    | Patienten-Nasszelle | Dusche      | TMB     | KW  | i3        | 0     | 0     | 22     | >100   | 7      | >100   |                   |  |  |  |
| 4                                                    | Patienten-Nasszelle | WB          | EMB     | KW  | i3        | 1     | 5     | >100   | 26     | 0      | >100   |                   |  |  |  |
| 4                                                    | Patienten-Nasszelle | Dusche      | TMB     | KW  | i3        | 1     | 0     | 0      | 0      | 0      | 0      |                   |  |  |  |
| 5                                                    | Patienten-Nasszelle | WB          | EMB     | KW  | i3        | 0     | 0     | 0      | 56     | >100   | 4      |                   |  |  |  |
| 5                                                    | Patienten-Nasszelle | Dusche      | TMB     | KW  | i3        | 0     | 0     | 0      | 46     | >100   | >100   |                   |  |  |  |

## CFU 36° (Patients Bacteria)

- 60 Samples
- 23 Cont. > 1 (38%)
- 11 Cont. > 100 (18%)

# DATEN ENDSTÄNDIGER FILTER



| Filterstudie Ergebnisse Kaltwasser-Paramter E.coli |                     |             |         |     |           |       |       |       |        |        |        |        |
|----------------------------------------------------|---------------------|-------------|---------|-----|-----------|-------|-------|-------|--------|--------|--------|--------|
| Nr.                                                | Raumbezeichnung     | Entnahmeort | Armatur | Art | Filtertyp | Tag 0 | Tag 7 | 1. NK | Tag 21 | Tag 28 | Tag 50 | Tag 56 |
| 1                                                  | Patienten-Nasszelle | WB          | EMB     | KW  | i3        | 0     | 0     |       | 0      | 0      | 0      | 0      |
| 1                                                  | Patienten-Nasszelle | Dusche      | TMB     | KW  | i3        | 0     | 0     |       | 0      | 0      | 0      | 0      |
| 2                                                  | Patienten-Nasszelle | WB          | EMB     | KW  | i3        | 0     | >80   | 0*    | 0      | 0      | 0      | 0      |
| 2                                                  | Patienten-Nasszelle | Dusche      | TMB     | KW  | i3        | 0     | 0     |       | 0      | 0      | 0      | 0      |
| 3                                                  | Patienten-Nasszelle | WB          | EMB     | KW  | i3        | 0     | 0     |       | 0      | 0      | 0      | 0      |
| 3                                                  | Patienten-Nasszelle | Dusche      | TMB     | KW  | i3        | 0     | 0     |       | 0      | 0      | 0      | 0      |
| 4                                                  | Patienten-Nasszelle | WB          | EMB     | KW  | i3        | 0     | 0     |       | 0      | 0      | 0      | 0      |
| 4                                                  | Patienten-Nasszelle | Dusche      | TMB     | KW  | i3        | 0     | 0     |       | 0      | 0      | 0      | 0      |
| 5                                                  | Patienten-Nasszelle | WB          | EMB     | KW  | i3        | 0     | 0     |       | 0      | 0      | 0      | 0      |
| 5                                                  | Patienten-Nasszelle | Dusche      | TMB     | KW  | i3        | 0     | 0     |       | 0      | 0      | 0      | 0      |
| *chemische Desinfektion des Filters                |                     |             |         |     |           |       |       |       |        |        |        |        |

## E-Coli

- 60 Samples
- 1 Cont. > 1 (2%)

# Studie Ergebnisse Warmwasser-Parameter Legionellen

|                  |                     |             |         |     | Zweck B   | Zweck c |       |        |        |        |        |
|------------------|---------------------|-------------|---------|-----|-----------|---------|-------|--------|--------|--------|--------|
|                  | Raumbezeichnung     | Entnahmeort | Armatur | Art | Filtertyp | Tag 0   | Tag 7 | Tag 21 | Tag 28 | Tag 50 | Tag 56 |
| 1                | Patienten-Nasszelle | WB          | EMR     | KW  | i3        | 200     |       |        |        |        |        |
| 1                | Patienten-Nasszelle |             |         | WW  | i3        | 0       | 0     | 0      | 0      | 0      | 0      |
| 1                | Patienten-Nasszelle |             |         |     | i3        | 1000    |       |        |        |        |        |
| 1                | Patienten-Nasszelle |             |         |     | i3        | 400     | 0     | 0      | 0      | 0      | 0      |
| 2                | Patienten-Nasszelle |             |         |     |           | 100     |       |        |        |        |        |
| 2                | Patienten-Nasszelle |             |         |     |           | 0       | 0     | 0      | 0      | 0      | 0      |
| 2                | Patienten-Nasszelle |             |         |     |           | 2       |       |        |        |        |        |
| 2                | Patienten-Nasszelle |             |         |     |           | 100     | 0     | 0      | 0      | 0      | 0      |
| 3                | Patienten-Nasszelle |             |         |     |           | 300     |       |        |        |        |        |
| 3                | Patienten-Nasszelle |             |         |     |           | 6       | 0     | 0      | 0      | 0      | 0      |
| 3                | Patienten-Nasszelle |             |         |     |           | 900     |       |        |        |        |        |
| 3                | Patienten-Nasszelle |             |         |     |           | 600     | 0     | 0      | 0      | 0      | 0      |
| 4                | Patienten-Nasszelle |             |         |     |           | 200     |       |        |        |        |        |
| 4                | Patienten-Nasszelle |             |         |     |           | 100     | 0     | 0      | 0      | 14     |        |
| 4                | Patienten-Nasszelle |             |         |     |           | 100     |       |        |        |        |        |
| 4                | Patienten-Nasszelle |             |         |     |           | 100     | 0     | 0      | 0      | 0      | 0      |
| 5                | Patienten-Nasszelle |             |         |     | i3        | 4       |       |        |        |        |        |
| 5                | Patienten-Nasszelle |             |         |     | i3        | 6       | 0     | 0      | 0      | 0      | 0      |
| 5                | Patienten-Nasszelle |             |         | KW  | i3        | 400     |       |        |        |        |        |
| 5                | Patienten-Nasszelle | Dusche      |         | WW  | i3        | 300     | 0     | 0      | 0      | 0      | 0      |
| nicht auswertbar |                     |             |         |     |           |         |       |        |        |        |        |

# Legionella

- 70% positive > 100/100ml Rohwasser
- 1 Kontamination < 100 (2%)

## Legionella

- 70% positive > 100/100ml Rohwasser
- 1 Kontamination < 100 (2%)



# Risiken bei der Verwendung von Filtern bei langer Anwendung?

## Failure of a hollow-fibre shower filter device to prevent exposure of patients to *Pseudomonas aeruginosa*

Ö. Yetiş<sup>a,\*</sup>, S. Ali<sup>b</sup>, K. Karia<sup>b</sup>, P. Wilson<sup>b</sup>

<sup>a</sup> Division of Infection and Immunity, University College London, London, UK

<sup>b</sup> University College London Hospitals NHS Foundation Trust, London, UK

**Table 1**  
Presence of *Pseudomonas aeruginosa* in the effluent of hospital shower water fitted with a point-of-use (POU) filter unit at various durations of use

| POU shower filter details |           |                                 |                                            |                                          | Effluent water quality (presence of <i>P. aeruginosa</i> ) <sup>b</sup> |                                       |
|---------------------------|-----------|---------------------------------|--------------------------------------------|------------------------------------------|-------------------------------------------------------------------------|---------------------------------------|
| Shower ref. number        | Ward ref. | Ward specialty                  | Location of corresponding shower (bay/SIR) | Age of filter (days in use) <sup>a</sup> | Without POU filter (cfu/100 mL)                                         | With POU filter in place (cfu/100 mL) |
| 1                         | Ward E    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | >300                                  |
| 2                         | Ward E    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 3                         | Ward E    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 4                         | Ward E    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 5                         | Ward E    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 6                         | Ward E    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 7                         | Ward E    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 8                         | Ward E    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 9                         | Ward F    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 10                        | Ward F    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 11                        | Ward F    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 12                        | Ward F    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 13                        | Ward F    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 14                        | Ward F    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 15                        | Ward F    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 16                        | Ward F    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 17                        | Ward F    | Haematology                     | SIR                                        | 15                                       | >300                                                                    | 0                                     |
| 18                        | Ward B    | Elderly care                    | Bay                                        | 45                                       | >300                                                                    | >300                                  |
| 19                        | Ward C    | Adolescent haematology/oncology | Bay                                        | 45                                       | >300                                                                    | >300                                  |
| 20                        | Ward C    | Adolescent haematology/oncology | Bay                                        | 47                                       | >300                                                                    | 0                                     |
| 21                        | Ward D    | Oncology (adult)                | Bay                                        | 47                                       | >300                                                                    | 0                                     |
| 22                        | Ward A    | Infectious diseases             | Bay                                        | 47                                       | >300                                                                    | 0                                     |
| 23                        | Ward F    | Haematology                     | SIR                                        | 52                                       | >300                                                                    | >300                                  |
| 24                        | Ward C    | Adolescent haematology/oncology | Bay                                        | 150                                      | >300                                                                    | >300                                  |
| 25                        | Ward C    | Adolescent haematology/oncology | SIR                                        | 150                                      | >300                                                                    | >300                                  |

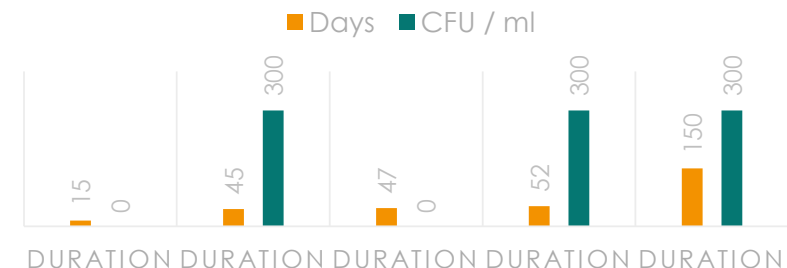
SIR, single isolation room; cfu, colony-forming units.

<sup>a</sup> Expiry date of POU filter units is 92 days from date of installation (manufacturer specifications). Numbers of *P. aeruginosa* present in shower water with and without a POU filter unit were determined by membrane concentration assay.

26 % (6/23) der Filtereinheiten vor dem Verfallsdatum kolonisiert wurden.

Man sollte sich nicht auf die Verwendung von Hohlfaserfiltern verlassen, um Patienten vor einer Exposition gegenüber *P. aeruginosa* zu schützen.

## PSEUDOMONAS AERUGINOSA



Sind 92 bis 120 Tage sinnvoll für den klinischen Einsatz?



# ZWECKBESTIMMUNGEN VON ENDSTÄNDIGEN FILTERN



## Allgemeine Bevölkerung

- Rückhalt von Legionella
- Kein Medizinprodukt
- Flexible Anwendungsdauer
- TWIN 12 (KTW, W270)

## Infektionsprävention von Patienten

- Medizinprodukt
- Rückverfolgbarkeit
- Bakterienrückhalt gemäß ASTM F838
- DIN EN ISO 13485
- Eindeutige Anwendungsdauer
- Klinische Evidenz
- Biokompatibilität DIN ISO 10993

# WASSERFILTER FÜR DIE ALLGEMEINE BEVÖLKERUNG



Stand: Version vom 7. März 2022 unter Berücksichtigung der 3. Änderung  
Rev01

## BEWERTUNGSGRUNDLAGE

### Bewertungsgrundlage für Kunststoffe und andere organische Materialien im Kontakt mit Trinkwasser<sup>1,2</sup> (KTW-BWGL) Allgemeiner Teil

#### 5.6 Anforderungen hinsichtlich der Förderung der mikrobiellen Vermehrung

##### 5.6.3 Anforderungen bei der Prüfung nach dem volumetrischen Verfahren (Verfahren 2)

Folgende Anforderungen sind einzuhalten:

- a) Die Oberfläche der Produkte darf keine biozide Wirkung auf das Trinkwasser haben. Deshalb erfüllen Produkte ohne eine Oberflächenbesiedlung (Vergleich der Kontaktkultur/des Abstrichs des Prüfkörpers mit der/dem der Negativkontrolle) nicht diese Anforderung.

Filter müssen  
kurzfristig einen  
Biofilm  
aufweisen damit  
sie die KTW  
Bedingungen  
erfüllen

- Sinn dieser  
Vorschrift ist  
die  
Vermeidung  
von Chemie  
im Wassernetz



# WASSERFILTER IM KLINISCHEN UMFELD

27.6.2012

DE

Amtsblatt der Europäischen Union

L 167/1

I

(Gesetzgebungsakte)

## VERORDNUNGEN

VERORDNUNG (EU) Nr. 528/2012 DES EUROPÄISCHEN PARLAMENTS UND DES RATES

vom 22. Mai 2012

über die Bereitstellung auf dem Markt und die Verwendung von Biozidprodukten

(Text von Bedeutung für den EWR)

(2) Sofern in dieser Verordnung oder in anderen Unionsvorschriften nicht ausdrücklich anders geregelt, gilt diese Verordnung nicht für Biozidprodukte oder behandelte Waren, die in den Geltungsbereich der folgenden Rechtsakte fallen:

- a) Richtlinie 90/167/EWG des Rates vom 26. März 1990 zur Festlegung der Bedingungen für die Herstellung, das Inverkehrbringen und die Verwendung von Fütterungsarzneimitteln in der Gemeinschaft <sup>(1)</sup>;
- b) Richtlinie 90/385/EWG, Richtlinie 93/42/EWG und Richtlinie 98/79/EG;

Medizinprodukte  
dürfen biozide  
Eigenschaften  
aufweisen

# WASSERFILTER IM KLINISCHEN UMFELD



## Biokompatibilität 10993

Für die Biokompatibilität gibt es die Normenreihe EN ISO 10993-XX

Ausgehend von der EN ISO 10993-1 wird auf die anderen Normen verwiesen

**Wer als Medizinprodukt im Markt ist, muss eine Biokompatibilitätsprüfung nach ISO 10993 machen!**

Ausgehend von einer Evaluation durch einen Experten, werden die weiteren Prüfungen, Tests und Bewertungen bestimmt

### **7 Interpretation of biological evaluation data and overall biological risk assessment**

Expert assessors who have the necessary knowledge and experience shall determine and document:

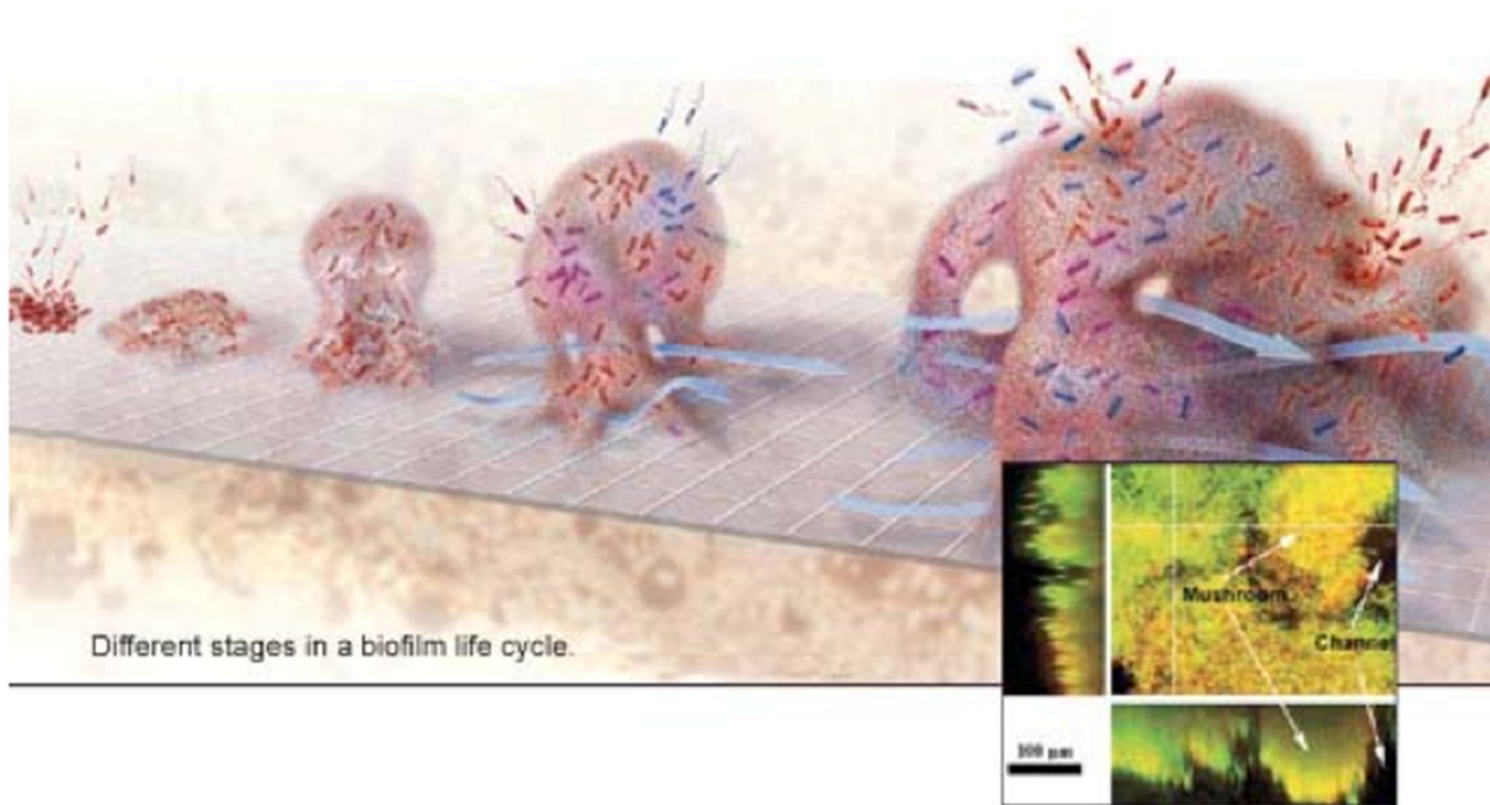
- a) the strategy and planned content for the biological evaluation of the medical device;
- b) the criteria for determining the acceptability of the material for the intended purpose, in line with the risk management plan;
- c) the adequacy of the material characterization;
- d) the rationale for selection and/or waiving of tests;
- e) the interpretation of existing data and results of testing;
- f) the need for any additional data to complete the biological evaluation;

# BIOFILM



From "Health Significance, Prevention and Control of Water-Associated *Pseudomonas aeruginosa* Infections" - Recommendation of the DE Society for Hospital Hygiene 2016

# BIOFILM



# RESISTANCE OF BIOFILM



[J Bacteriol.](#) 2003 Mar; 185(5): 1485–1491.

doi: [10.1128/JB.185.5.1485-1491.2003](#)

PMCID: PMC148055

PMID: [12591863](#)

## Diffusion in Biofilms

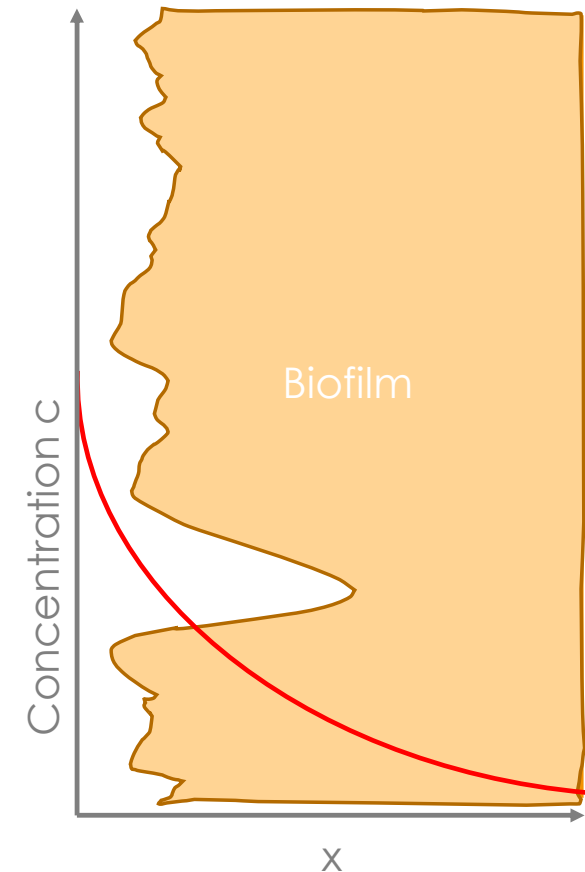
[Philip S. Stewart](#)\*

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This article has been [cited by](#) other articles in PMC.

Much of what makes life in a microbial biofilm different from life in a free aqueous suspension can be explained by invoking the phenomenon of diffusion. This article discusses the profound influence of the physics of the diffusion process on the chemistry and biology of the biofilm mode of growth. I have framed the discussion in the form of answers to five important questions.

can easily represent an increase in the diffusion distance, compared to a single cell, of 2 orders of magnitude. As is explained in the next section, diffusive equilibration time scales as the square of the diffusion distance. In other words, a biofilm that is 10 cells thick will exhibit a diffusion time 100 times longer than that of a lone cell.



# RESISTANCE OF BIOFILM

## Biofilms: Survival Mechanisms of Clinically Relevant Microorganisms

Rodney M. Donlan<sup>1\*</sup> and J. William Costerton<sup>2</sup>

*Centers for Disease Control and Prevention, Atlanta, Georgia 30333,<sup>1</sup> and Center for Biofilm Engineering, Montana State University, Bozeman, Montana 59717<sup>2</sup>*

TABLE 4. Susceptibility of planktonic and biofilm bacteria to selected antibiotics

| Reference | Organism                                 | Antibiotic  | MIC or MBC of planktonic phenotype (µg/ml) | Concn effective against biofilm phenotype (µg/ml) |
|-----------|------------------------------------------|-------------|--------------------------------------------|---------------------------------------------------|
| 215       | <i>S. aureus</i> NCTC 8325-4             | Vancomycin  | 2 (MBC)                                    | 20 <sup>a</sup>                                   |
| 26        | <i>Pseudomonas aeruginosa</i> ATCC 27853 | Imipenem    | 1 (MIC)                                    | >1,024 <sup>b</sup>                               |
| 26        | <i>E. coli</i> ATCC 25922                | Ampicillin  | 2 (MIC)                                    | 512 <sup>b</sup>                                  |
| 208       | <i>P. pseudomallei</i>                   | Ceftazidime | 8 (MBC)                                    | 800 <sup>c</sup>                                  |
| 114       | <i>Streptococcus sanguis</i> 804         | Doxycycline | 0.063 (MIC)                                | 3.15 <sup>d</sup>                                 |

<sup>a</sup> Concentration required for 99% reduction.

<sup>b</sup> Minimal biofilm eradication concentration.

<sup>c</sup> Concentration required for ~99% reduction.

<sup>d</sup> Concentration required for >99.9% reduction.

# MULTI-BARRIER SYSTEM



Wissen und Training

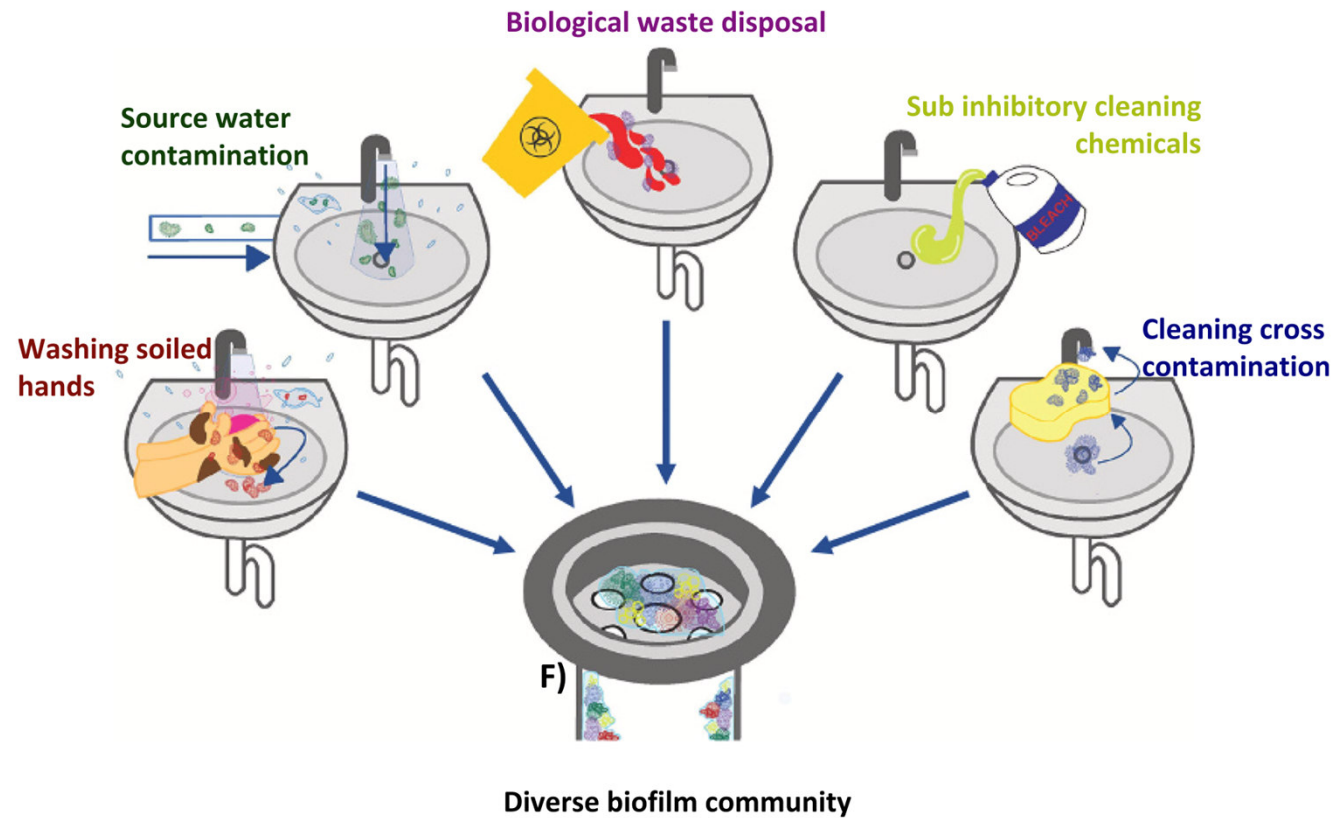
Hände Hygiene mit modernen Monitoring Systemen

Flächendesinfektion

Monitoring von Gram-negativen Bakterien

**Eigenschaften Endständiger Sterilfilter**

# Kontaminationsquellen von Siphons und Wasserhähnen



Aus „Handwashing basins and healthcare associated infections: Bacterial diversity in biofilms on faucet and drains“ Hyward et al Science of the Total Environment 949 (2024)

# STERILFILTER ALS TEIL DES BARRIERE-SYSTEMS



## Effektiver klinischer Einsatz von endständigen Sterilfiltern

Bei einem klinischen Einsatz > 4 Tage für die Infektionsprävention braucht es biozide Eigenschaften

Ein direkter Kontakt des Wasserstrahls mit dem Siphon führt zu Kontaminationen

Anwendungsdauern von mehreren Monaten sind kritisch zu betrachten

Biozide Eigenschaften sollten mindestens 3 Log-Stufen/cm<sup>2</sup> in 24h betragen

Eine KTW Zulassung ist damit nicht möglich

Klinische Untersuchungen sollten ein Standard sein

Biokompatibilität gemäß ISO 10993 muss nachgewiesen werden, wenn das Produkt ein Medizinprodukt ist.

# MEDICAL CERTIFICATION / VERIFICATIONS



Medical Product 510k class II



Quality Management System acc. to **ISO 13485:2016**



Biocompatibility test acc. to **DIN EN ISO 10993**



Measurement of antibacterial activity on plastic surfaces acc. to **ISO 22196**

**ASTM F838-20** ⓘ

Determining Bacterial Retention of Membrane Filters acc. to **ASTM F838-20**



Suitability of non-metallic materials and products for use in contact with water intended for human consumption with regard to their effect on the quality of the water according to **BS6920**



**Vielen Dank für Ihre Aufmerksamkeit.**