Prevention of Nosocomial Infections with KLEANIK™
Self - Disinfecting Drain Trap
The Drain Trap as a Source of Transmission of Pathogens

- Content of living micro-organisms in sealing liquid of common drain traps: $10^6 - 10^{10}$ colony forming units per ml.
- Drain traps contain about 200 ml of sealing liquid.
- Total amount of living bacteria per drain trap $10^8 - 10^{12}$ colony forming units.
- Due to the excellent growth conditions, drain traps can be an important source for the cultivation of antibiotic resistant pathogens outside the human body.
The drain trap as a Source of Transmission of Pathogens

- In patient rooms, sink drains are the **major reservoirs of living microorganisms** outside the human body and in the direct environment of the patient.
- Common drain traps are always “**open**” reservoirs.
Drain traps offer excellent conditions for growth of micro-organisms

- High nutrient content and sufficient nutrient flow.
- Moderate room temperatures are sufficient for fast multiplication.
- Oxygen containing substrates
- **Figure 1**: Multiplication of bacteria in a drain trap
Biofilm – The Ally of Bacteria

- **Biofilm** is the main tool for microorganisms to survive and multiply in waste water environments (e.g. drain traps).
- Within this biofilm a lot of excellent conditions necessary for growth of microbes in waste water tubes can be found.
- Because the biofilm acts as protective barrier against anti-microbial substances it can be a possibility for expression of resistance against antibiotics.
The Known Problem: Transmisson of Bacteria from drain trap to Patient

- Drain traps are permanent “open” reservoirs of pathogenic and non-pathogenic microorganisms, bacteria, yeast and fungi, respectively.
- This means there is a uncovered surface between the upper surface of the contaminated sealing liquid and the room air. When the sink is used this surface is moved, an aerosol is formed and so an exchange of microorganisms between liquid and air occurs.
- If the concentration of living bacteria in sealing liquid is \( > 10^5 \) CFU/ml, transmission of bacteria from sealing fluid to hands of hospital personnel takes place.
- Bacteria (e.g. Pseudomonas aeruginosa) can survive up to 70 minutes on hands of hospital personnel and therefore transmission to the patient is possible.

( DÖRING et al. 1989 ).
The Approach

- Prevention of adherence of microorganisms and particles on the inner wall of the drain trap (biofilm formation) by **vibration**
- Prevention of bacterial growth and multiplication by **heat disinfection**
The Technical Solution

- Vibration
  Ultrasound

- Heat - Disinfection
  $T > 70^\circ C$
Lab- Results: 
Kinetics of Heat Killing of Bacteria (Ps.aerug.) in the Self-disinfecting drain trap

![Graph showing the kinetics of heat killing of Bactericidal Pseudomonas aeruginosa]
Lab- Results:
Kinetics of Heat Killing of Bacteria (Ps.aerug.) in the Self-disinfecting drain trap

Explanation of figure 2:

- Using the self-regulating heating-system the temperature of sealing liquid increases within 20 minutes from 18°C up to 75°C.
- After about 2 hours the survival rate of Pseudomonas aeruginosa is less than 0.001%.
- After about 60 minutes the concentration of survived bacteria is less than the critical transmission level.
The aim of functional test in hospital (Intensive Care Unit Hospital of University of Tübingen) was to corroborate the action of vibration, and heating under actual operating conditions. Results of this phase of testing are documented in doctoral theses E. Cinar, Tübingen, 2000.
Functional Test in Hospital ( ICU )
(Tübingen 1999, Prof. Döring, Diss. E.Cinar, 2000)

After complete replacement of all common drain traps by our self – disinfecting drain traps at an intensive care unit the number of living cells within the sealing liquid was near zero. This means: Using the self-disinfecting drain trap there is no risk of transmission of living bacteria from the drain traps to patients.
Functional Test in Hospital (ICU)
(Tübingen 1999, Prof. Döring, Diss. E.Cinar, 2000)

![Graph depicting bacterial count over time](graph.png)
After two weeks of regular functioning one of the drain traps has been switched out. It is shown that the growth of bacteria starts immediately after vibration and heating was out of function.

The critical level for transmission (CLT) (conc. of living bacteria higher than $10^5$ CFU/ml) was reached again after two weeks.
Functional test in Hospital (ICU)
(Tübingen 1999, Prof. Döring, Diss.E.Cinar, 2000)

ITS Tübingen, Zi. 313, 1999

Live Bacterial Count (CFU/ml)

Period of Investigation (Weeks)

- Installed
- Disabled

Total Number of Microorganisms
Pseud.aerug.
Critical Level
Results of the Functional Test in Hospital (ICU)

- The concentration of living bacteria in the self-disinfecting drain trap does not depend on any circumstances outside.
- The concentration of living micro-organisms is always $10^1$ to $10^3$ CFU / ml
- This is 0.01 to 1% of the critical concentration of living bacteria for transmission (CLT = $10^5$ CFU / ml)
- Within 2 years no formation of biofilm has been observed.
Results of the functional test in a hospital
Colonization and Infection

- Colonization is the basis of infection.
- There is no infection without any colonization.
- **Therefore:** The incidence rate of colonization (IRC) is a very sensitive and useful indicator for the expected incidence rate of nosocomial infections (IRNI).
Colonization as an Indicator for Infection

- **3.3%** of patients without colonization of the trachea bronchial system came down with pneumonia.
- **48%** of patients with colonization of the trachea bronchial system came down with pneumonia.
- **30%** of all people are colonized by facultative pathogens.
Colonization as an Indicator for Infection

- The impact of an infection control device can be determined by its influence on the incidence rate of nosocomial infections as well as on the incidence rate of colonization (IRC).
Bacteriological and Epidemiological Tests in Hospital (ICU)
(Bautzen-Bischofswerda 2002/2003, B. Sissoko)

Detection of Pathogens: Overall Bacterial Counts

Period of Investigation 2002 - 2003
Bacteriological and Epidemiological Tests in Hospital (ICU)
(Bautzen-Bischofswerda 2002/2003, B. Sissoko)

Antibody Detection: Germs Typical Water

Period of Investigation 2002 - 2003
Bacteriological and Epidemiological Tests in Hospital (ICU)
(Bautzen-Bischofswerda 2002/2003, B. Sissoko)

Antibody Detection: Overall Bacterial Counts - Water Germs

Period of Investigation 2002 - 2003
Bacteriological and Epidemiological Tests in Hospital (ICU) (Bautzen-Bischofswerda 2002/2003, B. Sissoko)

Antibody Detection: Pseudomonas Spec

Period of Investigation 2002 - 2003
Bacteriological and Epidemiological Tests in Hospital (ICU)
(Bautzen-Bischofswerda 2002/2003, B. Sissoko)

Antibody detection: Klebsiella Pneumonia

Period of Investigation 2002 - 2003
Bacteriological and Epidemiological Tests in Hospital (ICU)

(Bautzen-Bischofswerda 2002/2003, B. Sissoko)

Antibody Detection: of Acinetobacter Spec.

Bacteriological and Epidemiological Tests in Hospital (ICU)
(Bautzen-Bischofswerda 2002/2003, B. Sissoko)

Period of Investigation (Jan 2002 bis März 2003)

Number (N)

NI (ges.) - NI (Ps.,K.)
Bacteriological and Epidemiological Tests in Hospital (ICU)

(Bautzen-Bischofswerda 2002/2003, B. Sissoko)

- The results show that the self-disinfecting drain trap significantly reduces the rate of colonization of patients.
- Therefore it is to be expected that a significant decrease of incidence rate of nosocomial infections will be found if the number of patients investigated is high enough.
Kinetics of Nosocomial Infections – I

Kinetics of Nosocomial Infections Caused by Water Borne Pathogens

Rate of Incidence (%)

Jan | Feb | Mrz | Apr | Mai | Jun | Jul | Aug

Time

Standard drain trap
KLEANIK™
Kinetics of Nosocomial Infections – II

Kinetics of Nosocomial Infections Caused by Non-Water Borne Pathogens

- Standard drain trap
- KLEANIK™

Rate of Incidence (%)

Time

Jan Feb Mrz Apr Mai Jun Jul Aug
Rates of Incidence (abs.)

Nosocomial Infections

Incidence Rate (%)

Standard
KLEANIK™

Incidence Rate (abs.)

w bp  nw bp  both
Rates of Incidence (rel.)

Nosocomial Infections

Relative Rate of Incidence (%)

- w bp
- nw bp
- both

Standard
KLEANIK™
Conclusions

- These results indicate a **significant reduction of nosocomial infections** in the ICU.
- Infections caused by water-borne pathogens: **reduction of 75 % or more**.
- Infections caused by non – water-borne pathogens: **reduction of 50 %**.
- All nosocomial infections caused by water-borne and non-water-borne pathogens: **reduction of 60 %**.
Kleanik™ – The Convenient & Preventive Solution

- Continuous Disinfection
- Fully Automatic
- Self-Regulating
- Compact Unit – Easy Installation
- Built-in Safety Features
- Proven Technology
- Enhanced Patient Safety
- Reduced Hospital Costs