Preventing Waterborne Nosocomial Infections by Using Silver Ions to Reduce Bacterial Contamination in Hospital Showers

Brian Hopkins, BS, Andrew Streifel, MPH, REHS
University of Minnesota, Department of Environmental Health and Safety, Minneapolis, MN.

Abstract

Background/Objective: Nosocomial infections pose a serious threat to hospitalized patients. An estimated 100,000 people die each year from infections acquired while undergoing treatment, despite current prevention measures[1]. One area of concern has been waterborne pathogens in hospital showers[2]. Bacteria is generally maintained in low concentrations in the water supply. However, stagnant water may reside in shower hoses for hours or days between uses, acting as a reservoir for already present bacteria to reproduce. Without frequent flushing, protective biofilms can develop and potentially harbor opportunistic pathogens[3]. These biofilms are nearly impossible to remove without replacing the affected parts. To prevent bacterial buildup, silver impregnated shower hoses were placed into patient rooms. The hoses release silver ions, a natural antimicrobial, into the water when the shower is not in use[4].

Methods: Four patient rooms were selected for testing. Silver impregnated shower hoses were placed into two rooms. As a control, standard shower hoses replaced existing ones in two other rooms. In each shower, stagnant water was collected initially. The showers were then flushed for two minutes, and another sample was taken. Thirty-two samples were analyzed using serial dilutions and membrane filtration to determine bacterial concentration.

Results: Summarized data can been seen in the results section. A statistically significant difference between silver impregnated and standard shower hoses was not determined. Flushing of water was consistently effective in reducing bacterial levels.

Conclusions: Although the utilization of silver ions to decontaminate shower water showed varying success in the clinical setting, preliminary experiments performed in the lab do emphasize the potential benefits of using silver ions as a decontaminant. Additionally, the data highlight the importance of flushing stagnant water while enhancing the understanding of the hospital environment. As an added precaution, showerheads should be left in the dangling position to drain water after use. Due to its antimicrobial nature, silver impregnation should be further explored as an infection prevention technique.

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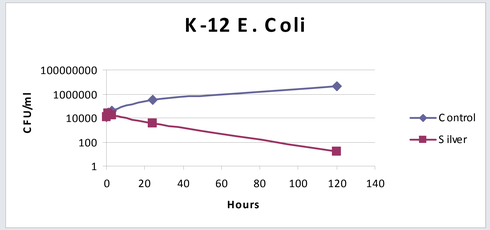
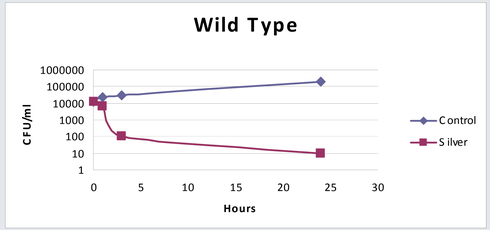
Laboratory Methods

Preliminary experiments were carried out to test the effect of silver impregnated shower hose on bacterial contamination. In the laboratory setting, a silver hose and standard hose were filled with deionized water contaminated with the K-12 strain of *E. coli*. Samples from each hose were analyzed for bacterial contamination after 0, 1, 3, and 24 hours. The experiment was then repeated with an unknown, wild-type bacteria that was previously acquired from the hospital water system.

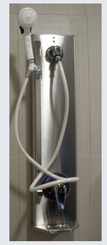
Results

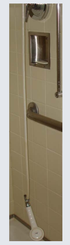




Clinical Methods

A total of thirty-two samples were collected in four showers in the Bone Marrow Transplant unit of the University of Minnesota Medical Center – Fairview. Silver impregnated shower hoses and standard shower hoses were each placed into two patient rooms.





Samples from each shower were collected before and after a two-minute flush and analyzed using serial dilutions and membrane filtration. Bacteria were grown on Plate Count Agar and colony forming units (CFUs) were counted.

Results

	Number of Samples	Mean (CFUs/ml)	Median (CFUs/ml)	Range (CFUs/ml)
Silver	8	59,223	13,950	110-196,000
Standard	8	33,306	38,000	1,950-88,000
Before Flush	16	49,471	25,050	110-196,000
After Flush	16	146	35	3-970

Independent samples t-tests were performed using SPSS.

Silver Hose vs. Standard Hose: $p > 0.05$
Before Flush vs. After Flush: $p < 0.05$

A p-value of less than 0.05 is considered statistically significant.

Conclusions

▪In the laboratory setting, silver ions released from silver impregnated shower hoses were shown to consistently and quickly reduce bacterial contamination in water.
▪In the clinical setting, the effectiveness of silver ions was not supported by the data.
▪Flushing shower water before use was shown to be a reliable method to remove bacterial contamination although the potential for biofilm buildup between use remains.

Reasons for Variability in Clinical Setting:
▪ The water sampled before flushing likely resided in the showerhead, which was not silver impregnated. Water in the shower hose may have had minimal contamination.
▪ In the clinical setting, the water could not have been mixed before use. The sample may not have been homogeneous or representative of the entire shower hose.
▪ The frequency and duration of shower use between sampling were not controlled in the clinical setting. More frequently used showers for a longer duration would be expected to contain less contamination.

Future Studies and Applications:
▪ Silver impregnation could be implemented into any piece of a water system to reduce contamination and prevent biofilm formation.
▪ Allowing the showerhead to dangle rather than attach in the upright position could be an effective measure to drain water, minimizing the reservoir for bacterial buildup.
▪ Automatic faucets and other low water outputs may not sufficiently flush bacteria during use. Further study may indicate whether the benefits of reducing water use is worth the potential costs to patients in the hospital.

References

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