


NURSING HOME

Published Quarterly
Volume 11, No. 4

 December 2000

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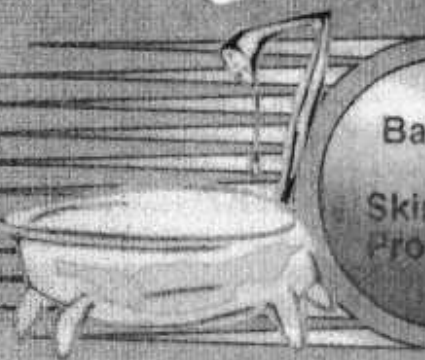
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Infection Control

*Hydrotherapy tubs have the potential to act as reservoirs for the spread of nosocomial infection. Of primary concern is *Pseudomonas aeruginosa*, the fourth leading cause of nosocomial infections. In order to ensure resident security, guidelines have been recommended that address the cleaning and disinfecting needs of the hydrotherapy tub.*

By Bernice Thompson, R.N., B.N., E.T. and Scott Budgell, B.Sc., CPHI(C)

Hydrotherapy tub usage

(Infection risks - cleaning and disinfecting)

Recently, the David Thompson Health Region, centred in the Red Deer area of Alberta, struggled with the complex issue of hydrotherapy tub usage, including the cleaning and disinfecting processes that would optimize infection control efforts associated with safe tub usage.

Unacceptable levels

In 1998, a cluster of *Pseudomonas aeruginosa* infections in residents and staff in a 100-bed LTC facility in central Alberta led to an investigation into the exact cause. Hydrotherapy tubs within the facility were sampled and found to have unacceptable levels of *Pseudomonas aeruginosa*, heterotrophic plate counts* and both fecal and total coliforms. This

led to a hydrotherapy tub cleaning project that, to this day, remains ongoing and viable.

This project saw the introduction of a number of policy recommendations and procedures necessary to ensure that bathing water quality is maintained in hydrotherapy tubs used in regional long-term care facilities. Issues related to the recommended cleaning and disinfecting processes - the chemicals required, the effectiveness of the cleaning process, the cost - as well as the risk factors of infection, will be dealt with in this presentation.

Nosocomial infections

Of primary consideration is that these bathing devices have the potential to act as reservoirs and sources for the spread of nosocomial *Pseudomonas aeruginosa* infection. *Pseudomonas aeruginosa*, a gram-negative bacteria, is the fourth leading cause of noso-

comial infections. *Pseudomonas* is able to thrive in moist environments, grow with minimal nutritional requirements, tolerate a variety of temperatures, and is innately resistant to antibiotics (APIC, 1996), as well as being somewhat impervious to certain chemical disinfectants.

Bacterial biofilm

Pseudomonas are able to thrive within and around hydrotherapy tubs due to the protection they have from the chemical disinfectants. Alginate slime forms the matrix (or the substance within which) the *Pseudomonas* biofilm anchors its cells. This biofilm, within which the *Pseudomonas* bacteria is shielded, is capable of retarding access of disinfectants to the bacterial cells within. This biofilm is able to produce degradative enzymes capable of neutralizing certain chemical disinfectants. Also, genetic exchange between biofilm

* The heterotrophic plate count is a procedure for estimating the number of live aerobic and facultatively anaerobic bacteria in water.

bacteria cells can also reduce the effectiveness of disinfectants and may increase resistance to the disinfectants. For example, according to McDonnell, et al. (1999), "the adaptation of *Pseudomonas aeruginosa* to quaternary ammonium compounds is well known."

Known reservoirs for *Pseudomonas aeruginosa* in LTC/health care facilities, besides hydrotherapy tubs/whirlpool baths, also include sinks and mops, respiratory equipment, cleaning solutions, medicines, disinfectants, and food mixers. All these devices or items tend toward a moist environment. Hydrotherapy tubs, as we shall see, can present with their own unique problems.

The pseudomonades are able to attach to the piping and other internal plumbing structures of the hydrotherapy tub in a slimy matrix that extends considerable protection to the bacteria from chemical eradication. Thus, if the disinfection process employed is incomplete or not done in a scrupulous manner, biofilm fragments remain and will reattach. Once established, pseudomonades can be checked, but probably never obliterated (Mak, Zazulak, Hanna, 1995).

Opportunistic pathogens

Pseudomonades are opportunistic; they are relatively resistant to antibiotics and, although they rarely cause disease in healthy individuals, are capable of placing at risk susceptible populations such as people on antibiotics, people with open sores, those with indwelling catheters, and those who are immunocompromised; i.e., the frail elderly.

Respiratory infections, UTIs, wound infections, as well as endocarditis, bacteremias, central nervous system infections, ear and eye infections, bone and joint infections and gastrointestinal infections can be caused by pseudomonades (Todar, 1997).

The discharge from an infection

caused by a pseudomonas usually has a greenish or blue hue and a sweet, grape-like odour. It often presents as a slimy, mucous appearance to urine and respiratory secretions. Human colonization is frequently at moist sites like the ear, axilla, and perineum.

Unregulated tub usage

A *Communicable Disease Report* from 1995 discusses pseudomonas isolated in wounds of 4 of 24 nursing home residents who had used a whirlpool bath from which *Pseudomonas aeruginosa* was also isolated. The recommendation following the incident was that the use of the whirlpool bath should be restricted to continent residents with intact skin and that the bath should be cleaned with a degreasing agent and disinfected with hypochlorite (chlorine bleach) between use by the individual residents. Their conclusion was: "The prevalence of known infection with *Pseudomonas aeruginosa* was low in the residents of the nursing home, but the unguarded and unregulated use of whirlpool baths may present an infection hazard to residents using the bath and to hospitals that admit residents from such nursing homes" (Hollyoak, et al., 1995).

In the United States, between 1989 and 1996, a number of water-borne-disease outbreaks were investigated. Study results of these outbreaks consistently showed that the most frequently reported hot tub or whirlpool-associated illness was pseudomonas dermatitis. (Herwaldt, et al., 1991; Kramer, et al., 1996; Moore, et al., 1993)

In a study from Germany (Bethe and Krusche, 1995), a high count of pseudomonas was found in a hydrotherapy tub. Use of the tub was prohibited because of the risk of infections. The reason for the high pseudomonas count was identified as being due to the design of the pumps and different procedures (established for other types of tubs) for cleaning and disinfection.

In a letter to the British medical

journal, *The Lancet*, the author suggests that microbiologic advice be sought before such a bath is purchased. The writer (Fallon, 1995) states that tub use should be restricted to patients with intact skin. He also said that elderly and debilitated patients could still be at risk - even with intact skin.

For example, *Pseudomonas aeruginosa* has also been implicated in urinary tract infections in healthy individuals using whirlpool/hydrotherapy baths. Salmen, et al. (1983) reported on three such cases where two adolescent females and a 25-year-old man suffered from urinary tract infections traced to contaminated whirlpool baths. The authors point out that infections such as dermatitis and UTIs are probably under reported, either because the cause is not identified or a skin rash may be self-limiting. The authors further theorize that water jets in hydrotherapy tubs or whirlpool baths may propel water-laden bacteria into the urethra, or colonization may occur predisposing the person to a urinary tract infection.

Chapped hands/open pores

In an anecdotal reference from another study, it was reported that a nursing home staff member developed a cellulitis in her thumb. Extensive treatment with antibiotics was required before the inflammation subsided. It was concluded in a Workers' Compensation Board report that, although the exact aetiology of the bacteria was not clear, it would be reasonable to suspect a pseudomonas bacterial infection. Its conclusion was that the infection started at the site of the pre-existing hairline cut (related to chapped hands), and that the most likely source of the bacteria would be the nursing home setting.

Even with the absence of open sores, pseudomonades can gain entry through the skin. Dilated skin pores, moisturizing and softening of the skin can facilitate their entry (Mak, et al.,

1995). Further, there is the possibility of increased risk with the propulsion of warm water through agitator jets.

Even a low level of pseudomonas in a hydrotherapy tub presents a risk to a susceptible population. Host factors, it appears, rather than the number of *Pseudomonas aeruginosa* organisms isolated, may be a factor in determining clinical outcome (Mak, et al., 1995).

Cleaning and disinfecting

The challenge for any facility, just as it continues to be for the facilities in the David Thompson Health Region in Alberta, is to develop consistent and effective cleaning and disinfecting processes that are safe, practical, fast and easy for staff to use. (See side-bar on "Cleaning and disinfecting procedures").

Guidelines drafted for hydrotherapy tub cleaning and disinfecting usually recommend 10-15 minutes tub disinfection, with a quaternary ammonium compound (QAC), or other appropriate disinfectant, before bathing residents, between baths and after baths are completed. The lines must also be purged at this time (at the conclusion of the last bath of the day) in order to prevent build-up of bio-film, and to thoroughly clean the tub's plumbing (Policy Statement, Regional Public Health - Department of Health Protection and Prevention, David Thompson Health Region, 1999).

Cleaning is always essential prior to disinfection. An item that has not been properly cleaned, cannot be properly disinfected. Therefore, it is necessary to clean, rinse and disinfect all components of the hydrotherapy tub including tub basin or foot well, the internal plumbing systems, lift chair and any other components that may be employed with the tub.

Usually, low level disinfection is adequate to kill pseudomonas on surfaces. However, for disinfecting hydrotherapy tubs used by residents whose skin is not intact, the recom-

Cleaning/disinfecting procedures

1. Drain all water from the tub and rinse the inside surface of the tub with clean water from the shower hose.
2. Close the drain and fill the tub with cool water until the intake valve is covered.
3. In the tub basin, prepare at least an intermediate level disinfectant solution according to Health Canada's Infection Control Guidelines: Hand Washing, Cleaning, Disinfection and Sterilization in Health Care and/or Long Term Care Facilities (Health Canada, 1998).
4. Scrub the interior of the tub using the prepared disinfectant solution from the bottom of the tub/foot well. Scrub chair, footpads and any other components.
5. Circulate the disinfectant cleanser for the prescribed time (according to manufacturer's instructions). This is necessary in order to ensure adequate contact time between the disinfectant and all internal surfaces.
6. Open the drain, direct water from the shower spray into all inlets until the water discharging from the outlets is clear. Rinse the tub, chair, footpads, etc. with clean water. At this point, the tub is ready for use.
7. At the end of each day, after cleaning and disinfecting, drain the tub but do not rinse it. Allow the disinfecting solution to remain in the lines overnight.
8. The following morning, sanitize before the first use.

Important considerations

- If infections are occurring or increasing, the tub should be closely monitored in co-operation with an infection control practitioner or public health inspector.
- Always wash hair and shave residents at the end of the bath. Water should not be circulated either during or after these procedures.
- If resident is incontinent of feces, shut jets off, drain tub and rinse thoroughly.
- Always rinse tub thoroughly prior to use.
- Hang brush to dry - away from the tub area.
- Ensure that the shower hose is stored outside the tub during tub use.
- Do not use bath oils. Use only skin care products approved by tub manufacturer.
- Check tub condition regularly for presence of chips or cracks in the tub surface.
- Residents (and staff) who exhibit open sores or skin infections should not engage in bathing activities in recirculating hydrotherapy tubs unless the infection site is covered with waterproof dressing.
- The presence of low levels of *Pseudomonas aeruginosa* in tub water samples may not be a concern if corresponding infection rates are low.
- When a standard and consistent method of tub cleaning has been established, it should be clearly posted for all staff.

mendation is for cleaning followed by an intermediate level disinfectant.

Factors that affect the level of disinfection to be employed (low, intermediate or high) include the presence of organic material (i.e., feces, urine, wound drainage), water temperature, the concentration of active ingredients of the disinfectant, contact time, the hardness of the water, and interfering residues that remain after cleaning (Health Canada, *Communica-*

ble Disease Report, 1998).

In order to accurately determine the quantity of disinfectant required, the volume of water needed to cover the intake valve must first be determined. Following the manufacturer's direction on use, the appropriate amount of chemical is added to the tub to a final concentration as noted in the tables. Methods confirming the strength of the disinfectant should be provided by the supplier. (Cont'd., Pg. 9)

Sampling

All provinces have regulations that require regular water sampling of all aquatic facilities such as whirlpools, hydrotherapy tubs and special purpose pools. These regulations usually involve taking at least one sample of water at specified intervals.

In Alberta, at least one sample of water shall be taken at intervals of not more than seven days, and shall be submitted to the Provincial Laboratory of Public Health for examination. (Facilities can obtain information from their regional public health offices on the specific regulations as they apply to respective provinces).

These samples are to be collected first thing in the morning after the tub has been cleaned, disinfected, refilled, is operating, and shall be taken from a point near an outlet (jets). These samples must be refrigerated ($<4^{\circ}\text{C}$), packed with freezer packs and shipped as soon as possible for analysis.

This sampling protocol is necessary to ensure that water quality is maintained so that not more than two consecutive water samples and not more than 15% of the series of samples taken over a six month period shall:

- contain more than 200 bacteria per millilitre,
- show the presence of coliform organisms or,
- show the presence of pseudomonades.

Safety considerations

Most tub cleaning guidelines allude to staff safety and the risks involved

in handling chemicals. Choosing a disinfectant that will be relatively safe and acceptable is not easy. The Health Canada *Communicable Disease Report* (1998) refers to chemical disinfectants as a double-edged sword: "Although their use is necessary in many routine health care settings, the ability of these products to kill infectious agents also makes them potentially harmful to humans and the environment." (See "Safety procedures")

Choosing a disinfectant

Not all chemical disinfectants are equal. Some are more appropriate than others in such areas as efficacy in sanitization, staff preparation and ability to comply with process involved (ease of use), risk of corrosion, potential to inflict harm to user, and cost.

Quaternary ammonia compounds, appropriate for low level disinfecting, for antisepsis and cleaning, have been found to be expensive to use in effective dilutions, have been associated with respiratory irritation, and have a narrow microbial spectrum. Also, the ability of *Pseudomonas aeruginosa* to adapt to QAC's and develop a resistance is well known.

Chlorine bleach, although it has a broad spectrum of antimicrobial activity, is less expensive and fast acting; but it is also corrosive and is a respiratory, skin and eye irritant.

A number of facilities in the David Thompson Health Region, after weeks of trialing various products and mak-

ing comparisons with other chemical disinfectants, opted for the use of an accelerated hydrogen peroxide compound. This product has been found to have advantages over other chemical cleaners and disinfectants in a number of areas including disinfection capabilities, efficiency in cleaning and cost effectiveness. As well, this hydrogen peroxide technology is said to be superior to many other environmental surface disinfectants which may require three times as long to achieve the same results (Sattar, et al., 1998). These authors also found hydrogen peroxide safer for staff, and environmentally friendly.

Cost factors

A number of costs are associated with the identification of *Pseudomonas aeruginosa* and other pathogens in hydrotherapy tubs and in the strategies necessary to effectively disinfect. These costs relate to staff time (15 minutes before, between and after bathing each resident), the price of the chemical cleaner/disinfectant, the testing and trialing of products, and the treatment of pseudomonad infections possibly related to the tubs.

A rough estimate of the cost of disinfecting one hydrotherapy tub over one week of use is \$10 per 24 hours, or \$70 per week. An additional \$5 per week/tub would be spent on descaling or soap scum removing product.

Compare these costs to the approximate costs associated with the required treatment of a nosocomial infection: pneumonia - \$5,683; bacteremia - \$3,517; urinary tract infection - \$680.

Conclusion

The purpose of this article was to review some of the current information on the safe use of hydrotherapy tubs. The disinfection needs of a tub may vary from day-to-day unless a decision is made to bathe only continent people with intact skin. Organic

Safety procedures

- Wear personal protective gear when working with concentrated chemicals.
- Read and understand the Material Safety Data Sheet (MSDS) on all chemicals being used. If unfamiliar with MSDS, seek an explanation or training from an infection control practitioner or Occupational Health and Safety representative.
- Always use recommended dilutions when working with concentrated chemicals.
- All disinfectants and chemicals are to be stored in appropriately labelled containers. Incompatible chemicals should not be mixed or stored together.
- Avoid inhalation of chemicals.
- Chlorinated disinfectants (bleach) may corrode metal components of the hydrotherapy tub and odour problems may also arise with usage.

material, bacterial load, the hardness of the water, and water temperature can all affect the outcome of disinfection procedures.

The process of hydrotherapy tub cleaning and sanitizing involves residents, nursing staff, housekeeping, occupational health and safety personnel, facility management, community health and infection control practitioners, as well as the tub and chemical disinfectant manufacturers.

Hydrotherapy tub cleaning and disinfecting is an on-going process. It is promising to note that through consistent cleaning methods with a safe, effective product, a better quality of tub water can result. With commitment and support, care-givers are able to provide a safe and comfortable bathing environment for residents.

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- The adaptation of *Pseudomonas aeruginosa* to QAC's is a well-researched phenomenon.
- Chlorine disinfectants are corrosive, inactivated by organic matter and can be an irritant to mucous membranes and respiratory tract.
- Hydrogen peroxide products are not a respiratory irritant, it biodegrades into water and oxygen, leaves no residue, has short contact times (5 minutes).

Genetic exchange between biofilm bacteria cells also reduces the effectiveness of a disinfectant and may increase resistance.

Plan / Implementation

- Obtain weekly hydrotherapy tub water samples to determine the presence of *Pseudomonas*, coliforms and the HPC.
- Develop an effective tub cleaning process, which is clear, concise, convenient, cost effective, adaptable to different tub sizes and which is easy for staff.
- Trial the process on a nursing unit, evaluate the results and revise the process as necessary.
- Conduct information sessions for all available staff to demonstrate correct tub cleaning and water sampling methods.
- Provide instructions to be posted in each tub room with step by step direction for cleaning and sampling.
- Maintain weekly contact with the unit to identify problems with the product or process and offer support to staff in problem solving processes.
- Continuing ongoing review and evaluation of process and water sample results, change or modify the process as necessary.

Evaluation / Feedback

- *Pseudomonas aeruginosa* counts and heterotrophic plate counts have become stabilized and are approaching acceptable numbers.
- It took approximately six months to achieve consistent decreases in *Pseudomonas* and heterotrophic plate counts.
- Staff reported less respiratory irritation, less soap scum and a cleaner looking tub with the cleaning process.

- Tub stoppers with exposed copper have demonstrated corrosion and some rubber tub components have turned white.
- The evaluation and feedback process is ongoing.
- Decreasing the agitation time dealt with problems of excessive foaming and odor associated with the breakdown of organic material.

Conclusion

- This project began in January 1999 and is ongoing. In the course of the project different products were tried at various sites within the Region and the results compared. For our purposes the use of an accelerated stabilized hydrogen peroxide product gave us the results we wanted.
- Communication, education, continuous evaluation and problem solving are vital components of the Hydrotherapy Tub Project.
- We feel strongly that adherence to a prescribed protocol and regular water sampling is the most important factors in achieving satisfactory results in hydrotherapy tub cleaning. The choice of product used should be determined by the facility.

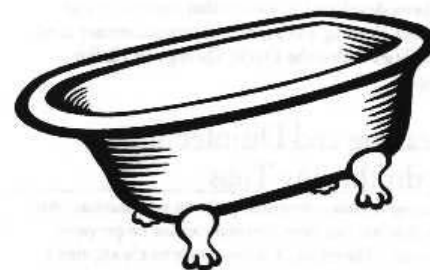
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Reference List is Available upon Request

Hydrotherapy Tub Cleaning Project



A Study into the Cleaning,
Disinfecting and Monitoring of
Hydrotherapy Tubs Within The
David Thompson Health Region

Health Protection & Prevention
Hospital Infection Control



Background

A cluster of (8-10) *Pseudomonas aeruginosa* infections in residents and staff at a 100 bed long term care facility lead to an investigation into the exact cause. Hydrotherapy tubs within the institute were sampled and found to have unacceptable levels of *Pseudomonas aeruginosa*, heterotrophic plate counts and both fecal and total coliforms. *Pseudomonas aeruginosa* is the fourth leading cause of nosocomial infection. It thrives in moist environments, grows with minimal nutritional requirements, tolerates a variety of temperatures and is innately resistant to antibiotics. Given the opportunity, *Pseudomonas* can form a semi-permanent biofilm, on the internal plumbing, which then provides a reservoir of bacteria to the system. Therefore, this document has been developed to ensure that consistent and effective cleaning and sanitizing procedures are used by facilities within the David Thompson Health Region.

Cleaning and Disinfecting Hydrotherapy Tubs

Cleaning is always essential prior to sanitization. An item that has not been cleaned cannot be properly sanitized. Therefore, it is necessary to **clean, rinse and sanitize** all components, including the tub basin, internal plumbing systems, lift chair and any other components.

- Drain all water from the tub and rinse the inside surface of the tub with clean water from the shower hose.
- Close the drain and fill the tub with cool water until the intake valve is covered.
- In the tub basin, prepare at least an intermediate level disinfectant solution according to Health Canada's Infection Control Guidelines: Hand Washing, Cleaning, Disinfection and Sterilization in Health Care and/or Long Term Care Facilities.
- Scrub the interior of the tub using the disinfectant solution from the bottom of the tub/foot well. Also, scrub the chair, footpads and any other components.

- Circulate the disinfectant cleanser for the prescribed time, to ensure adequate contact time between the disinfectant and all internal surfaces.
- Open the drain, direct water from the shower spray into all inlets until the water discharging from the outlets is clear. Rinse the tub, chair, pads etc with clean water.
- At this point, the tub is ready for re-use. At the end of each day, after cleaning and disinfecting, drain the tub but do not rinse it. Allow the solution to remain in the lines overnight.
- Be sure to sanitize before the first use the next day.
- Once a day clean with a soap scum remover and rinse well.

Important Points

Wash hair and shave patient at the end of the bath.

- Do not run jets following.
- If patient is incontinent of feces shut jets off, drain tub and rinse thoroughly.
- Always rinse tub thoroughly prior to use.
- Hang brush to dry.
- Do not use bath oil.

Variables

- Number of residents using the tub
- Presence of indwelling devices such as foley catheters
- Incontinence or non-intact skin
- Consistency of cleaning
- Tub water sampling and refrigeration of specimens
- Tub condition - presence of chips or cracks in the tub surface

SAMPLING

Presently, there are no specific regulations regarding bacteriological sampling of hydrotherapy tubs. However, provincial regulations do require weekly water sampling of all aquatic facilities such as whirlpools and special purpose pools. Therefore, as outlined in section 15(1) of the Public Health Act Swimming Pool Regulations, at least one sample of water shall be taken at intervals of not more than seven days, and shall be submitted to the Provincial Laboratory of Public Health for examination. These samples shall be collected first thing in the morning

after the tub has been cleaned, disinfected, re-filled, is operating and shall be taken from a point near an outlet (jets). Samples must be refrigerated (<4°C), packed with freezer packs and shipped as soon as possible for analysis. This sampling protocol is necessary to ensure that water quality is maintained so that not more than two consecutive water samples and not more than 15% of the series of samples taken over a 6 month period shall:

- contain more than 200 bacteria per millilitre,
- show the presence of coliform organisms or,
- show the presence of *Pseudomonas aeruginosa*.

For further information regarding water sampling, consult your local Public Health Inspector.

Interpreting results

Heterotrophic Plate Count (HPC)

Should be maintained less than 200 cfu/ml. HPC measures bacterial content of the water and therefore is a good indication of water quality and cleaning.

Coliforms

There should be zero coliforms in the tub water.

Pseudomonas count

The presence of low levels (<20/100 mls) of *Pseudomonas aeruginosa* in tub water samples may not be of concern if corresponding infection rates are low. If the counts are consistently 100/100 mls with high heterotrophic plate counts the results should be monitored closely and the cleaning process reviewed.

Infection Risks

- Increased risk with older age, chronic illness, decreased immunity, antibiotic usage, incontinence, open areas and internal devices.
- Dilated skin pores and moisturizing and softening of the skin may facilitate entry of *Pseudomonas*.
- Possible increased risk with propulsion of warm water through agitator jets.
- Host factors, rather than number of organisms isolated may be a factor determining clinical outcome.

Rationale for Disinfectant Use

- Quaternary Ammonium Compounds (QAC) require a 10-15 minute contact time.