# Hot Water Safety
POSITION STATEMENT

Alberta Centre for INJURY Control & Research

## Hot Water Safety: Preventing Tap Water Scald Injuries

### Background

Although burns from fire and flames are often emphasized when thermal injury is discussed, children are more likely to be hospitalized because of burns from hot liquids (54). Hot tap water accounts for nearly one-fourth of all scald burns among children in the US and is associated with more deaths and hospitalizations than other hot liquid burns (37). In Alberta in 1998, 61 children under the age of 9 were seen in the emergency department for hot tap water burn, and 11 were admitted to hospital. In 1999, 62 children were seen and 16 were admitted (Alberta Health Surveillance, June 2002). "Infant skin is thinner and more fragile than adult skin so it can burn at temperatures that may feel comfortable to an adult," says Dr. Collin Goto (45). As with other burns, the treatment of choice for tap water scalds is prevention. Such burns may be especially amenable to prevention because the risk of tap water scald injury is virtually eliminated when hot water is supplied at a safe temperature (17, 28, 30, 57). Prevention may be accomplished by reducing the temperature of hot water supplied to 49°C by either lowering the temperature setting of the hot water heater or installing thermostatically controlled mixing devices (23, 54). Either a master thermostatic mixing device installed in the water line near the water heater or thermostatic mixing devices installed at each point of use can control the temperature of water delivered for use. Measured at the faucet, a maximum hot water temperature of between 48.9°C and 54.4°C would allow time for most people to escape before receiving a severe burn (30). Why, then, are most home water heaters set between 60°C and 70°C (23)? Part of this answer lies in the association with *Legionella pneumophila* (Legionnaires' disease) and water temperatures lower than 60°C. When deciding whether to lower the thermometer settings on domestic hot water heaters, one must weigh the risk of contracting Legionnaires' disease against the risk of acquiring a serious scald burn.

### Scald Prevention

The best method to stop scalds from occurring is to modify the environment using passive injury control methods, such as legislation of the maximum temperature of hot water supplied (6-8, 10, 18, 23, 32, 33, 36, 37, 40, 47, 50, 51, 56). Most proponents of scald prevention recognize 49°C as the optimal temperature of hot tap water delivery (2-5, 7-9, 11, 13, 14, 16, 18, 19, 22-25, 28-30, 32-35, 37-39, 42, 44, 46, 49, 52-54, 57). At this temperature, a full thickness burn will take between 5 to 10 minutes (16, 19, 24, 25, 41, 42, 49), versus 2 to 6 seconds at 60°C (4, 5, 13, 14, 19, 23-25, 28-30, 36, 37, 41, 47, 49, 51, 53, 54, 56). In 1983 in Washington State, USA, legislation was introduced requiring the pre-setting of new hot water cylinder thermostats to 49°C. The law also required water

heaters in rented homes to be set at 49°C when a new tenant moved in, and warning labels to be provided on the water heaters. These measures led to a 50% decrease in tap water scalds treated in the hospital (47). Reports from other countries, particularly Scandinavia and Holland, have reported a low incidence of bath scalds through  **statutory water** temperature control (52). What, then, are the barriers to the lowering of hot water temperature to 49°C in Canadian residences?

**Legionella pneumophila**

One of the greatest concerns with lowering the temperature of water heaters to 49°C, is a large body of evidence stating that water must be stored at 60°C to eliminate the growth of the pneumonia-causing bacteria *Legionella pneumophila* (15, 36, 50, 51, 56). Many studies, however, state a significant drop in numbers of the bacteria at around 50°C (20, 21, 40,43,59). Still other studies have found *Legionella* in water with temperatures as high as 66°C (40, 43, 60). So which is the correct temperature to keep hot water at to avoid the risk of contamination with *L. pneumophila*? Perhaps a more pertinent question to our topic is: what is the risk of contracting disease from *L. pneumophila* at lower water temperatures? Alary and Joly showed that bacteria of the family *Legionellaceae* are common in domestic water distribution systems and noted that nearly one-third of all domestic water heaters were contaminated by these bacteria (1). It is widely accepted that the organism is not a large concern in immunocompetent people, and that lowering the temperature of domestic hot water heaters will not cause a *Legionella* epidemic (1, 26, 47, 50, 60). Huyer *et al.* reported that studies have concluded that, although contamination of residential water heaters with *Legionella* was not infrequent, it did not appear to be an important source of infection in children and immunocompetent people (23). In 1993, Waller *et al.* stated that education is still needed to dispel commonly held myths about household hot water, such as the threat of infection by *Legionella* bacteria (54). Though it is recognized that setting heater thermostats at 49°C may allow for growth of *Legionella*, higher temperatures are not safe, as the opportunity for scalding is too great (21, 26, 40, 47, 50, 54).

Of special note is the continued use of copper pipes in hot water plumbing. Copper pipes have been associated with the retarded growth of *Legionella pneumophila* (43, 60), so should be used in all new hot water systems to offset any increase in growth due to lowered temperatures. Additionally, hot water heaters, both gas and electric, should be manufactured with heating elements at the bottom of the tank. This has been correlated with a decrease in contamination with *L. pneumophila*, as deposits at the bottom of hot-water tanks have been associated with bacterial growth if not heated properly (1, 27).

In the case where residents are at increased risk of contracting Legionnaire's disease, the temperature of the hot water heater can be kept higher and plumbing devices installed to safeguard the temperature of the water delivered for use.

**Dishwasher/Laundry Detergent**
A second argument to have hot water stored at 60°C is that, in the past, detergents used to wash dishes and laundry were designed to operate optimally at that temperature. Recent research papers, however, suggest that lower temperatures can be achieved and detergents will still operate effectively. Baptiste remarks that it has been shown that four of six major dishwashing detergents tested performed with good to excellent cleaning results and met public health germ kill standards at operating temperatures as low as 38°C (7). Several others point out the effectiveness of detergents at temperatures lower than 55°C (16, 23, 28, 41, 49). The argument that hot water must be at 60°C in order for cleaning detergents to work properly is unfounded, and should not be used to prevent lowering hot water temperatures.

**Hot Water Supply**
Many people feel that water heaters in the home should be kept at 60°C to provide ample hot water for all household needs. Several studies reject this argument, stating that hot water heaters set at 49°C provide ample hot water for most household needs (7, 14, 23, 28, 49, 50).

**Energy Savings**
An added benefit of reducing hot water temperature from 60°C to 49°C is the energy saved by doing so (7, 14, 21, 22, 28, 50, 52). As much as 10% can be saved on the water-heating portion of heating bills by turning heaters down to 49°C (16, 41, 49).

**Conclusions**
Scald burns, especially amongst the youngest and eldest of our population, remains a problem in our healthcare system. Hot water is currently delivered from the taps of Canadian homes at a temperature of 60°C, which can cause a third-degree burn in less than 6 seconds. By requiring building codes to state that all hot water be delivered at 49°C from the tap, governments can significantly reduce the burden of scalds on our society. At 49°C, a 10-minute window of time remains for people to be removed from the source of a tap water scald without receiving serious injuries. The risk of Legionnaires' disease is not greatly increased at this lowered temperature, since individuals who are immunocompetent can be advised to use point of delivery temperature control devices. Dishwasher and laundry detergents can still function at 49°C. Lowering the temperature at hot water heaters will have the added benefit of saving energy.

**ACICR recommendation**
Given the above discussion, it is reasonable to call for changes to the provincial building code requiring that the maximum temperature of water at the faucet not exceed 49°C*, ensuring the safety of residents of new dwellings. Educating the public on the risks associated with hot tap water should be a goal of injury control stakeholders in Alberta. Additionally, the ACICR recommends informing owners of existing homes that safe tap

water temperatures can be accomplished simply by reducing the temperature of their hot water heater to 49°C. This, of course, is not be the case for larger buildings and hospitals, where the increased complexity of plumbing systems and water stagnation increases the risk of *Legionella* infection beyond what is reasonable (26, 36, 40, 47, 50, 59, 60). Hospital-acquired *Legionella* infection is currently a recognized problem in hospitals, and water temperature should be regulated at points of exit from hot water system, using thermostatic mixing valves or some other anti-scald technology (7, 8, 12, 23, 32, 33, 36, 37, 47, 50, 51). *Note that 54°C has been advocated as a safe temperature, but studies have shown that many hot water heater thermostats are inaccurate by as much as 5°C (14, 54, 55), so 49°C is a safer set point.

**Bibliography**

1) Alary M, Joly JR. Risk factors for contamination of domestic hot water systems by Legionellae. *Applied and Environmental Microbiology* 1991; **57(8):** 2360-7.

2) American Academy of Family Physicians. *Burns: Preventing Burns in Your Home*. Retrieved June 2002 from http://www.familydoctor.org/handouts/649.html.

3) American Academy of Pediatrics. *The Injury Prevention Program Age-Related Safety Sheets*. Retrieved June 2002 from http://www.aap.org/family/tippmain.htm.

4) Dr. Andrew J. and Henrietta Panettieri Burn Center at Bridgeport Hospital, Yale Hospital Services. Retrieved June 2002 from http://www.bridgeporthospital.org/services/burn.html.

5) Arizona Burn Center. *Hot Water*. Retrieved June 2002 from http://www.azburncenter.com/Burn_Tips/Hot_Water/hot_water.html.

6) Baker SP. Determinants of injury and opportunities for intervention. *American Journal of Epidemiology* 1975; **101(2):** 98-102.

7) Baptiste MS, Feck G. Preventing tap water burns. *American Journal of Public Health* 1980; **70(7):** 727-9.

8) Connect for Kids – Athey JL, Kavanagh L (1999). *Childhood Burns: The Preventable Epidemic*. Retrieved June 2002 from http://www.connectforkids.org/content1554/content_show.htm?attrib_id=326&doc_id=8223.

9) Czech Republic Business Guide & Quick Reference Slovakia – Sasser SM. *Kid's Safety*. Retrieved June 2002 from http://www.neweuropepromotions.com/czech/child2.html.

10) Dershewitz RA, Williamson JW. Prevention of childhood household injuries: A controlled clinical trial. *American Journal of Public Health* 1977; **67(12):** 1148-53.

11) Developmental-Behavioral Pediatrics Online Community. *Selected Conditions of Young Children with Disabilities*. Retrieved June 2002 from http://www.dbpeds.org/conditions/conditions.cfm?Abbrev=burns.

12) Eadie PA, Williams R, Dickson WA. Thirty-five years of paediatric scalds: Are lessons being learned? *British Journal of Plastic Surgery* 1995; **48:** 103-5.

13) East Tennessee Children's Hospital. *Safety Articles*. Retrieved June 2002 from http://www.etch.com/safburn.cfm.

13a) East Tennessee Children's Hospital Associate Director for Public Relations – Janya Marshall – Jmarshall@etch.com - June 2002.

14) Erdmann TC, Feldman KW, Rivara FP, Heimbach DM, Wall HA. Tap water burn prevention: The effect of legislation. *Pediatrics* 1991; **88(3):** 572-7.

15) Farrell ID, Barker JE, Miles EP, Hutchison JGP. A field study of the survival of *Legionella pneumophila* in a hospital hot-water system. *Epidemiology and Infection* 1990; **104:** 381-7.

16) Feldman KW, Schaller RT, Feldman JA, McMillon M. Tap water scald burns in children. *Pediatrics* 1978; **62(1):** 1-7.

17) Furjuoh SN. The mechanisms, intensity of treatment, and outcomes of hospitalized burns: Issues for prevention. *Journal of Burn Care & Rehabilitation* 1998; **19:** 456-60.

18) Gallagher SS, Hunter P, Guyer B. A home injury prevention program for children. *Pediatric Clinics of North America* 1985; **32(1):** 95-112.

19) Georgia Firefighter Burn Foundation. *Hot Water Facts*. Retrieved June 2002 from http://www.gfbf.org/hotwaterfacts/index.shtml.

20) Groothuis DG, Veenendaal HR. Heat treatment as an aid for the isolation of Legionella pneumophila from clinical and environmental samples. *Zentralblatt für Bakteriologie, Mikrobiologie und Hygiene. 1. Abt. Originale A, Medizinische Mikrobiologie, Infektionskrankheiten und Parasitologie* 1983; **255:** 39-43.

21) Groothuis DG, Veenendaal HR, Dijkstra HL. Influence of temperature on the number of *Legionella pneumophila* in hot water systems. *Journal of Applied Bacteriology* 1985; **59:** 529-36.

22) Herd AN, Widdowson P, Tanner NSB. Scalds in the very young: Prevention or cure? *Burns* 1986; **12:** 246-9.

23) Huyer DW, Corkum SH. Reducing the incidence of tap-water scalds: Strategies for physicians. *Canadian Medical Association Journal* 1997; **156(6):** 841-4.

24) Injury Prevention Web. *Injury Prevention Policy: Tap Water Scalds*. Retrieved June 2002 from http://www.safetypolicy.org/pm/scald.htm.

25) ISI Caring Center for Children and Parents. *Child Safety Part 1: So Your Children Will Not Be Victims*. Retrieved June 2002 from http://www.garfield.library.upenn.edu/essays/v6p396y1983.pdf.

26) Joly JR. *Legionella* and the environment. *Canadian Journal of Public Health* 1984; **75:** 57-60.

27) Joly JR. *Legionella* and domestic water heaters in the Quebec City area. *Canadian Medical Association Journal* 1985; **132:** 160.

28) Katcher ML. Scald burns from hot tap water. *JAMA: Journal of the American Medical Association* 1981; **246(11):** 1219-22.

29) Katcher ML. Prevention of tap water scald burns: Evaluation of a multi-media injury control program. *American Journal of Public Health* 1987; **77(9):** 1195-7.

30) Katcher ML, Landry GL, Shapiro MM. Liquid-crystal thermometer use in pediatric office counseling about tap water burn prevention. *Pediatrics* 1989; **83(5):** 766-71.

31) Kemp A, Sibert J. Childhood accidents: Epidemiology, trends, and prevention. Journal of Accidents & Emergency Medicine 1997; 14: 316-20.

32) Kidsafe Victoria, Australia. *Report on the Victorian Scalds Prevention Campaign*: *Hot Water Burns Like Fire*. Retrieved June 2002 from http://hna.ffh.vic.gov.au/phb/hdev/injprev/kdsfrep/kdsfrep.htm.

33) Loma Linda University Children's Hospital. *Scald Prevention*. Retrieved June 2002 from http://www.llu.edu/lluch/safekids/safek7.html.

34) Medical Center of Central Georgia. *Burns*. Retrieved June 2002 from http://www.mccg.org/childrenshealth/burns/prevent.asp.

35) McLoughlin E, McGuire A. The causes, cost, and prevention of childhood burn injuries. *American Journal of Diseases of Children* 1990; **144:** 677-83.

36) Murray JP. A study of the prevention of hot tapwater burns. *Burns* 1988; **14(3):** 185-93.

37) National Safe Kids Campaign, USA. *Injury Facts: Burn Injury*. Retrieved June 2002 from http://www.safekids.org/tier3_cd.cfm?folder_id=540&content_item_id=1011.8) Connect for Kids – Athey JL, Kavanagh L (1999). *Childhood Burns: The Preventable Epidemic*. Retrieved June 2002 from

http://www.connectforkids.org/content1554/content_show.htm?attrib_id=326&doc_id=8223.

38) Evaluation of a statewide campaign to prevent scalds in young children. *New South Wales Public Health Bulletin Online*. 1999; **10(10):** 126-9. Retrieved June 2002 from http://www.health.nsw.gov.au/public-health/phb/phboct99.pdf.

39) Oklahoma Injury Prevention Service. *Injury Update February 28, 2000*. Retrieved June 2002 from http://www.health.state.ok.us/program/injury/updates/scald.pdf.

40) Patterson WJ, Hay J, Seal DV, McLuckie JC. Colonization of transplant unit water supplies with *Legionella* and protozoa: Precautions required to reduce the risk of legionellosis. *Journal of Hospital Infection* 1997; **37:** 7-17.

41) Pediatric Advisor, Boystown Pediatrics. Christophersen ER. *Burn Safety: Hot Water Temperature*. Retrieved June 2002 from http://www.boystownpediatrics.org/parents/advisor/content/hhg/hotwatr.htm.

42) Pediatric Emergency Medicine Reports (October 2000). Stewart C. *Emergency Care of Pediatric Burns*. Retrieved June 2002 from http://www.ahcpub.com/ahc_root_html/hot/archive/pdmr102000.html.

43) Rogers J, Dowsett AB, Dennis PJ, Lee JV, Keevil CW. *Applied and Environmental Microbiology* 1994; **60(5):** 1585-92.

44) Sándor GKB, Clarke HM, Thomson HG, Zuker RM. Pediatric burns: A decade later. Canadian Journal of Plastic Surgery 1997; **5(4):** 210-2.

45) Schulze-Röbbecke R, Buchholtz K. Heat susceptibility of aquatic mycobacteria. *Applied and Environmental Microbiology* 1992; **58(6):** 1869-73.

46) Southwestern University Medical Center. *February 1999 Health News Tips*. Retrieved June 2002 from http://www.swmed.edu/home_pages/news/febtip99.htm.

47) Skelton G (April 2002). *Scarred for life: Preventing bath water scalds in the home, discussion paper*. Child Accident Prevention Trust. Retrieved June 2002 from http://www.capt.org.uk/Projects/default.htm - **link**: Scalds Project, **link**: Bath Water Scald Prevention Discussion Paper.

48) Sørensen B. Prevention of burns and scalds in a developed country. *Journal of Trauma* 1976; **16(4):** 249-58.

49) Stanwick RS, Moffatt MEK, Loeser H, Zuker RM. Hot tap water scalds in Canadian children. *Canadian Medical Association Journal* 1981; **125:** 1250-3.

50) Stanwick RS. Balancing the risks: *Legionella pneumophila* pneumonia and tap water scalds in the home. *Canadian Medical Association Journal* 1986; **135:** 1251-2.

51) Stone M, Ahmed J, Evans J. The continuing risk of domestic hot water scalds to the elderly. *Burns* 2000; **26:** 347-50.

52) Tennant WG, Davison PM. Bath scalds in children in the south-east of Scotland. *Journal of the Royal College of Surgeons of Edinburgh* 1991; **36:** 319-22.

53) University of Missouri, Columbia Extension. *Hot Water Burns.* Retrieved June 2002 from http://www.cdc.gov/nasd/docs/d000701-d000800/d000702/d000702.html.

54) Waller AE, Clarke JA, Langley JD. An evaluation of a program to reduce home hot tap water temperatures. *Australian Journal of Public Health* 1993; **17:** 116-23.

55) Waller AE, Langley JD, Clarke JA. Tap water scalds in New Zealand. *American Journal of Public Health* 1994; **84(9):** 1524.

56) Weaver AM, Himel HN, Edlich RF. Immersion scald burns: Strategies for prevention. *Journal of Emergency Medicine* 1993; **11:** 397-402.

57) Webne S, Kaplan BJ, Shaw M. Pediatric burn prevention: An evaluation of the Efficacy of a strategy to reduce tap water temperature in a population at risk for scalds. *Journal of Developmental and Behavioral Pediatrics* 1989; **10(4):** 187-91.

58) Webne S, Kaplan B. Preventing tap water scalds: Do consumers change their preset thermostats? *American Journal of Public Health* 1993; **83(10):** 1469-70.

59) Yee RB, Wadowsky RM. Multiplication of *Legionella pneumophila* in unsterilized tap water. *Applied and Environmental Microbiology* 1982; **43(6):** 1330-4.

60) Zacheus OM, Martikainen PJ. Occurrence of legionellae in hot water distribution systems of Finnish apartment buildings. *Canadian Journal of Microbiology* 1994; **40:** 993-9.