

Reducing the incidence of tap-water scalds: strategies for physicians

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Abstract

BURNS ARE A SIGNIFICANT CAUSE of severe injury and death. Scalds, including those from hot tap water, are one of the most common causes of burns, especially in vulnerable populations (children, elderly people and people with physical and cognitive disabilities). Although people generally recognize the danger associated with hot tap water, many are unaware of the short exposure periods that can result in serious burns. Tap-water scalds are preventable. Both active and passive prevention measures are beneficial in reducing this serious health hazard. Physicians are in a unique position to disseminate information on the danger of hot tap water and on ways to eliminate the risk to vulnerable populations. Not only do physicians have contact with these populations, they also have credibility as a source of health information for the public.

Résumé

LES BRÛLURES SONT UNE IMPORTANTE CAUSE de blessures graves et de décès. Les agents bouillants, y compris l'eau chaude du robinet, sont une des causes les plus fréquentes de brûlures, surtout chez les populations vulnérables (enfants, personnes âgées et personnes qui ont des incapacités physiques et cognitives). Même si l'on reconnaît en général le danger que représente l'eau bouillante du robinet, beaucoup de gens ne savent pas que de brèves expositions peuvent causer de graves brûlures. Les brûlures causées par l'eau du robinet sont évitables. Des mesures de prévention actives et passives aident à réduire ce danger grave pour la santé. Les médecins sont dans une position unique de pouvoir diffuser de l'information sur le danger posé par l'eau chaude du robinet et sur des façons d'éliminer le risque pour les population vulnérables. Les médecins sont en contact avec ces populations et le public leur fait aussi confiance comme source d'information sur la santé.

Scalds (direct contact with hot liquids) are one of the most common types of burns, especially in children. Scalds caused by hot tap water account for between 2500 and 4500 hospital admissions each year in the US.¹⁻⁴ At least 459 deaths from tap-water scalds occurred across the US from 1979 to 1986, an average of 57 deaths per year.⁵ From 1990 to 1994, 203 scalds due to hot tap water (an average of 50 per year) were reported to the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP); scalds accounted for 0.06% (203/337 583) of all injuries reported during this period (Dr. Susan Mackenzie, Senior Epidemiologist and Acting Chief, and Margaret Herbert, Senior Analyst, Child Injury Division, Health Protection Branch, Health Canada: unpublished data, 1994). Of the total scald injuries reported to CHIRPP, 56.9% occurred in males and 76.0% in children less than 5 years of age; 30.0% of injuries resulted in hospital admission and 51.7% were treated on an outpatient basis. Scalds caused by hot tap water accounted for 14.0% of injuries in children admitted to the Hamilton Burn Unit, Hamilton, Ont., between 1986 and 1990.⁶ Scalds represented 5.6% of all injury-related admissions to the Hospital for Sick Children, Toronto, in the 1995-96 fiscal year (Trauma Registry, Hospital for Sick Children: unpublished data, 1995-96), and this proportion has remained relatively constant over the years.



Education

Éducation

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Although scalds caused by hot tap water are not uncommon,⁷ many people are not aware that ordinary household tap water can be a source of injury.⁸ They may recognize the danger⁹ but may not be aware of the short exposure periods that can result in serious burns.

Most home water heaters are set at between 60°C (140°F) and 70°C (158°F). Setting water heaters at a lower temperature (49°C [120°F]) would significantly reduce the number and severity of scalds from tap water.

Reduction of tap-water scalds is best achieved through the involvement of a variety of professionals, including physicians. Physicians play an important role in injury prevention. Not only do they have frequent contact with the identified vulnerable populations, but also, because of their status as a credible source of information, the information they provide is likely to contribute to behavioural change.^{10,11}

At-risk populations

Three populations are particularly at risk for tap-water scalds: children less than 5 years of age, elderly people and people with disabilities (Dr. Susan Mackenzie, Senior Epidemiologist and Acting Chief, and Margaret Herbert, Senior Analyst, Child Injury Division, Health Protection Branch, Health Canada: unpublished data, 1994).^{1-5,12} Young children may not be able to respond quickly to a situation involving contact with hot water because their physical condition is underdeveloped, and elderly people may not be able to respond because of a physical impairment. The resulting increased time of contact with hot water increases the risk of significant injury. Risk is further increased in young, active, curious children because they cannot comprehend the dangers of hot water. There is a similarly increased risk for children and adults with cognitive impairments. Sensory disorders may limit recognition of dangerous temperatures,^{1,3} and other physical disabilities may prevent a quick escape from the situation.^{1,12} In older children with developmental disabilities, parents and caregivers may expect age-appropriate rather than developmentally appropriate reactions. Intentional scalding in an abusive situation is also a risk for children. Studies have found that 5% to 28% of scalds among children were the result of abuse (Dr. Susan Mackenzie and Margaret Herbert, Health Canada: unpublished data, 1994).^{8,13}

A time-temperature relation has been established in regard to scalds of adult skin (Table 1).¹⁴ This research showed that the exposure time required to produce a deep second-degree burn injury depends directly on the water temperature. The time is cut approximately in half for each rise in temperature of 1°C. According to one report, at temperatures higher than 54°C (130°F), children's skin can burn in about one quarter of the time it takes to burn

adults' skin.¹⁵ Most tap-water scalds (90%) occur in the home, and most of these (65%) occur in the bathroom (Dr. Susan Mackenzie and Margaret Herbert, Health Canada: unpublished data, 1994). Scalds result from water that is at a temperature higher than required for typical activities of daily living (Table 2).^{16,17}

Reducing the incidence of scalds

Tap-water scalds are preventable. Intervention is either passive, involving altering the injurious agent (i.e., the water temperature), or active, involving changing the behaviour of individuals. Active measures to prevent tap-water scalds include educating people about the danger of hot water, constantly supervising young children and people with cognitive underdevelopment or impairments, testing bath-water temperature before allowing others to get into a bathtub, forbidding children from using a bathtub as a play area, filling the tub with cold water first and then adding hot water, and facing children away from the tap handles in a bathtub.

Effective passive prevention methods to limit the temperature of tap water include reducing the temperature set on the thermostat for home water heaters or installing antiscald devices that regulate the maximum water temperature at the faucet. In several US states, legislation has been passed requiring home-water-heater thermostats to be set at a safe level, and these measures have had positive outcomes.^{2,18,19} Antiscald devices can be used in residences where dangerous higher temperatures are required or in multi-unit dwellings where the hot-water system does not permit setting the thermostat at a safe level.^{1,3,4,8,18,20} Various devices are available through plumbing-supply stores. De-

Table 1: Exposure time at given temperatures that causes deep second-degree burn injury in adults

Temperature, °C (°F)	Exposure time
44 (111)	6 h
49 (120)	9 min
51 (124)	2-6 min
52 (125)	2 min
55 (131)	20-30 s
60* (140)	5-6 s
66 (151)	2 s
70 (151)	1 s

*Usual temperature of home water heaters.

Table 2: Typical hot water temperatures in daily living

Temperature range, °C (°F)	Activity
32-41 (90-105)	Infant's and toddler's bath
34-45 (93-113)	Adult's bath
39-41 (101-105)	Adult's shower
41-42 (105-108)	Hot tub
42-45 (108-113)	Too hot for activities; threshold for sensation of pain in adults



pending on the device and the skill level of the purchaser, the assistance of a plumber may be required to install it.

Strategies for physicians

During patient visits, physicians can discuss the danger of hot tap water while identifying steps that can be taken to reduce the risk of injury in vulnerable populations. Physicians can recommend that patients determine the water temperature in their home to ensure that it does not exceed 49°C. Because exact temperatures are poorly marked on the thermostats of hot-water heaters, measurement of the water temperature is best done at the tap with a meat or candy thermometer.³ Liquid-crystal display thermometers have also been used for this purpose.² Although some authors recommend that people adjust the thermostats on their own hot-water heaters,^{2,7} this adjustment is best made by a representative from the company responsible for the tank function (the hydroelectric or natural-gas company).

Active prevention steps include educating parents that young children should always be supervised when they are in the bathroom or kitchen. Physicians can also display educational materials such as pamphlets and posters in waiting areas. The Hospital for Sick Children has developed scald-prevention materials, which are available free of charge for educational purposes (see the beginning of this article for contact information).

Physicians can also support initiatives by professional associations and bodies to have the temperature of all home water heaters adjusted to a safe level.²¹

Effect of reducing water temperature

Reduction of the hot-water temperature in all homes to 49°C (120°F) would likely eliminate most tap-water scalds, because at least 9 minutes' contact with water at this temperature is required to cause a serious burn.¹⁴ In Washington state, where legislation requires new home water heaters to be preset at 49°C (120°F), prelegislation concerns about insufficient temperature flexibility have not been borne out.¹⁵ In a survey conducted 5 years after the legislation was passed, 77% of homes surveyed had hot-water temperatures lower than 54°C (130°F), with a mean temperature of 50°C (122°F). Flexibility was maintained because adjustment of the temperature was possible; however, few respondents raised the temperature of their water heaters after installation. Heaters were reported to be functioning satisfactorily. A comparison of scald admission rates before and after the legislation was passed showed a 56% reduction.¹⁹ Reducing scalds results in considerable savings in health care expenditures as well as a significant decrease in the

emotional and physical trauma suffered by scald victims.

Concerns have been raised about lowering home water-heater temperatures. Among these concerns are the effect on the functioning of automatic dishwashers and the risk of colonization of heaters with *Legionella pneumophila*.

Dishwasher effectiveness

Dishwasher-soap manufacturers generally recommend use of water with a temperature of at least 60°C (140°F) for effective function. However, there is evidence that dishwashing detergents can fulfil their role in cleaning and disinfecting at temperatures as low as 38°C (100°F), although some spotting may occur.^{3,8,20,22} Alternatively, dishwashers with internal heating (booster) elements provide high-temperature hot water without risk of injury. If a hot-water heater is maintained at 60°C (140°F) only to ensure dishwasher effectiveness, reducing the temperature of the heater could lead to substantial reductions in the use of energy,^{8,18,20} which could offset the cost of purchasing a dishwasher with an internal element.

Incidence of legionnaires' disease

Another issue raised when considering lowering water temperature is the risk that water heaters will be colonized by *L. pneumophila*, the organism that causes legionnaires' disease. The risk of colonization increases at temperatures below 60°C (140°F). *L. pneumophila* is typically associated with hospital-acquired infection, although it has been estimated to cause a small proportion of community-acquired pneumonia. Immunocompetent people are rarely infected.

L. pneumophila is a ubiquitous organism that colonizes ponds and rivers, water-collection systems, water heaters and water-delivery systems (especially large systems such as those found in hospitals but also residential systems).²³⁻²⁷ Studies have concluded that, although contamination of residential water heaters was not infrequent, it did not appear to be an important source of infection in children and immunocompetent people.^{24,26,27} Concern remains about the risk of *L. pneumophila* infection in immunocompromised patients, especially transplant recipients and people with chronic obstructive pulmonary disease.²⁸

Conclusion

Prevention of scalds from hot tap water would eliminate an important cause of injury and death. Prevention may be accomplished in many ways, although the easiest and most effective method is reducing the temperature of hot water to 49°C (120°F). Although factory presetting of home water heaters at this temperature would provide



protection in homes with new water heaters, alternative methods must be developed to change the temperature of existing water heaters. Utility service personnel (from hydroelectricity suppliers or natural-gas and propane companies) could change thermostats when they visit residences. Multimedia education has been shown to increase public awareness of the hazards of scalds and the importance of water-temperature reduction. Considerable cost saving, both in energy use and health care, may be achieved through these preventive strategies. Physicians are ideally positioned to encourage reduction of home water temperature through both advocacy and direct patient education.

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