

# Older Adults and Burns

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*Burn injury among older adults will result in significant morbidity and mortality despite the many advances in burn treatment. Many adult burn units in North America admit and treat a significant number of older adults so understanding the issues and problems specific to this age group is important. Older adults experience specific problems with wound care, and if the injury is large, they will require critical care interventions during the course of treatment. Despite the advances in wound care and critical care that have occurred, the mortality rates of older adults with burn injuries remain quite high. This article reviews the literature on specific issues for older adults that need to be considered when treating older adults with burn injury.*

*Key words: burn injury, burn depth, older adults, geriatric, mortality*

## Introduction

Older adults are at high risk for thermal injury<sup>1-6</sup> and experience significant burn-related morbidity and mortality.<sup>7-9</sup> Burns and other fire-related injuries are currently the second-leading cause of death from home accidents among older adults.<sup>10</sup> While advances in resuscitation and burn care strategies have improved the survivability of thermal injuries in all age groups,<sup>9,11</sup> older adults have generally experienced a less marked decline in mortality over time relative to younger adults.<sup>5,7,12-15</sup> More recently, modifications in burn care have had a more significant impact on survival in this population and have raised new concerns regarding rehabilitation and quality of life among older survivors of burn injury.<sup>16</sup> With the steady growth of the older adult population in Western countries, issues surrounding burn prevention and treatment among older individuals have become of paramount importance.<sup>8,12,17-20</sup>

## Epidemiology

The epidemiology of burn injury among

older adults has been well studied in several countries. Of note, the definition of older adult has been loosely interpreted in the burn literature, describing ages ranging from 45 to 75 years.<sup>9,21</sup> Most survival data for trauma patients (including burns) starts to decline as early as ages 60-65. A 10-year analysis (1995-2005) of the National Burn Repository of the American Burn Association revealed that individuals over the age of 65 comprise 9.9% of all burn unit admissions, and have a mean age of  $76.4 \pm 6.6$  years.<sup>22</sup> Women tend to be more highly represented among older burn victims than in younger populations<sup>8,15,23</sup>; in many series, older women in fact outnumber older men.<sup>13-15,17,24,25</sup> While this finding is not consistent across all studies,<sup>2,9,12,20,26,27</sup> the greater preponderance of older women may reflect the decrease in workplace-related injuries among the geriatric burn population.<sup>26</sup> In fact, the vast majority of burn injuries among older adults occur in a domestic setting (61.5%),<sup>22</sup> specifically in the kitchen (cooking)<sup>3,5,9,10,26,27</sup> and bathroom.<sup>5,9,21,27</sup> Flame (32.2%) and scald injuries (15.7%)

are the most common cause of major burns among older persons.<sup>22</sup> Direct contact with hot surfaces (i.e., stoves) (1.2-2.9%), electrical (0-2.9%) and chemical (0-2%) burns are less frequently reported in this population.<sup>2,6,8,12,19,21,24,28,29</sup> Although less information is available for older individuals treated on an outpatient basis, there appears to be a higher proportion of scald and contact injuries among these minor burns.<sup>3</sup> There is also some evidence that etiology of burns among older adults may differ according to gender, with women sustaining a higher proportion of scald and contact injuries.<sup>2,17</sup> Finally, burn etiology has also been linked to outcome, whereby flame injuries appear to have the highest risk of mortality in the older adult population.<sup>30</sup> Flame burns almost always result in full-thickness loss of the skin and deeper tissues, and likely account for the higher mortality.

## Classification of Burn Depth

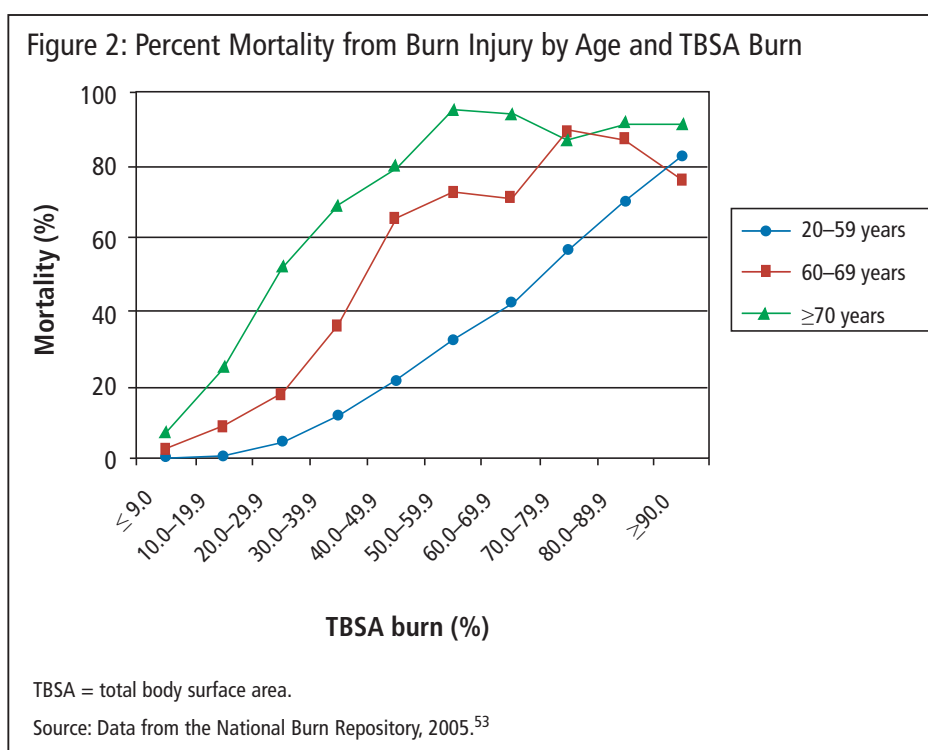
Burn injury is classified according to the depth of the injury to the skin. In the past, burns were classified as first, second, or third degree. The classification was purely clinical based on the appearance of the skin after injury. First degree burns were those that would heal with dressing alone and cause little concern. Second degree burns were subclassified as either superficial or deep. The superficial injury was also purported to heal without the need for surgery, while the deeper second degree burns would likely require surgical intervention. All third degree burns by definition involved the entire thickness of the skin (epidermis and dermis) and therefore surgery was the only option. This four-part classification has been replaced by a new system that classifies burns as either superficial, partial-thickness or full-thickness burn injury. This classification is important for patients once they are in a burn centre and less important when they are in the emergency rooms because the clinical appearance of the wounds changes over the first 3-5 days post injury. Clinical classification of burn depth in the hands of experienced burn clinicians has a poor

predictive value and is only 70% accurate at best. The reason for adopting a new classification of superficial, partial, and full-thickness injury is that the percentage of full-thickness burn (those that definitely require surgery) is one of the major determinants of survival following burn injury. Older adults have very thin epidermis and dermis, with reduced sensation and sometimes reduced blood supply, rendering the skin more susceptible to full-thickness injury, hence the requirements for surgery (Figure 1).

### Risk Factors

Total body surface area (TBSA) burned, percent full-thickness burn, and smoke inhalation injury are the most important and independent predictors of burn mortality.<sup>8,9,12,19,20,27,29</sup> Risk factors for burn injury in older adults are multifactorial. Comorbid conditions<sup>3,14,24,25,27,31</sup> such as dementia,<sup>10,17,32</sup> cardiorespiratory disease,<sup>17,25</sup> smoking,<sup>8,10,21,32</sup> and alcoholism<sup>8,10,17,21,23,32</sup> are well-known contributors to the incidence and severity of burns among older adults. Even in otherwise healthy individuals, age-related declines in reaction time, mobility, mentation, hearing, smell, and visual acuity may impair risk assessment and lead to delays in escaping harm and accessing medical care.<sup>1,5,9,19,21,24,26,33</sup> Skin changes experienced by older adults, including dermal atrophy, loss of dermal appendages, and thinning of the subcutaneous fat, provide little protection against thermal insults and increase the likelihood of full thickness injury.<sup>4,6,19,34–37</sup> Social factors such as living alone<sup>6,24,34,38</sup> have also been linked to burn injury among older adults, perhaps reflecting a lack of supervision and domestic support. Of concern also is a small but significant number of older individuals who have burn injuries while living in long-term care (LTC) facilities.<sup>38,39</sup>

Data from the National Burn Repository (1995–2005) indicates that older burn patients have a mean percent TBSA burn of  $7.4 \pm 14.5\%$  and a mean full-thickness burn area of  $4.0 \pm 11.8\%$ <sup>22</sup>; these burns most commonly involve the

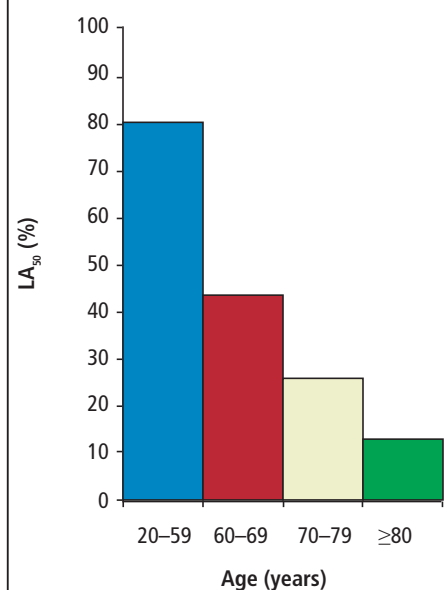


extremities, followed by the trunk, the head, and neck.<sup>6,17,19,29</sup> Smoke inhalation injury is also clinically diagnosed in 10.4% of older individuals with burns.<sup>22</sup> Other major predictors of mortality among older adults include severity and number of comorbid illnesses,<sup>9,12,15,19,26,29</sup> pre-existing malnutrition,<sup>40</sup> postburn complications,<sup>15,20,26</sup> and increasing age.<sup>9,12,20,26</sup> In-hospital mortality of older persons with burns in North America averaged 18.5% over the past 10 years.<sup>22</sup> While this mortality rate has declined from earlier decades, it still exceeds that of younger adults. Figure 2 illustrates the effect of age on survival from burn injury according to TBSA burn. Furthermore, the TBSA burn associated with 50% mortality ( $LA_{50}$ ) surpasses 80% among young adults,<sup>40</sup> but decreases to 35–43.1% among adults age 60–69 years<sup>12,40</sup> and to 13.1% among those 80 years or over.<sup>12</sup> The significant effect of age on  $LA_{50}$  is illustrated in Figure 3. In many series, older individuals with burns exceeding 50% TBSA have a near-100% mortality rate.<sup>8,14,28,33,34,38</sup>

Mortality early in burn injury results from intractable shock, whereas late mortality is attributable to multi-organ system failure.<sup>41</sup> While this is true for all age

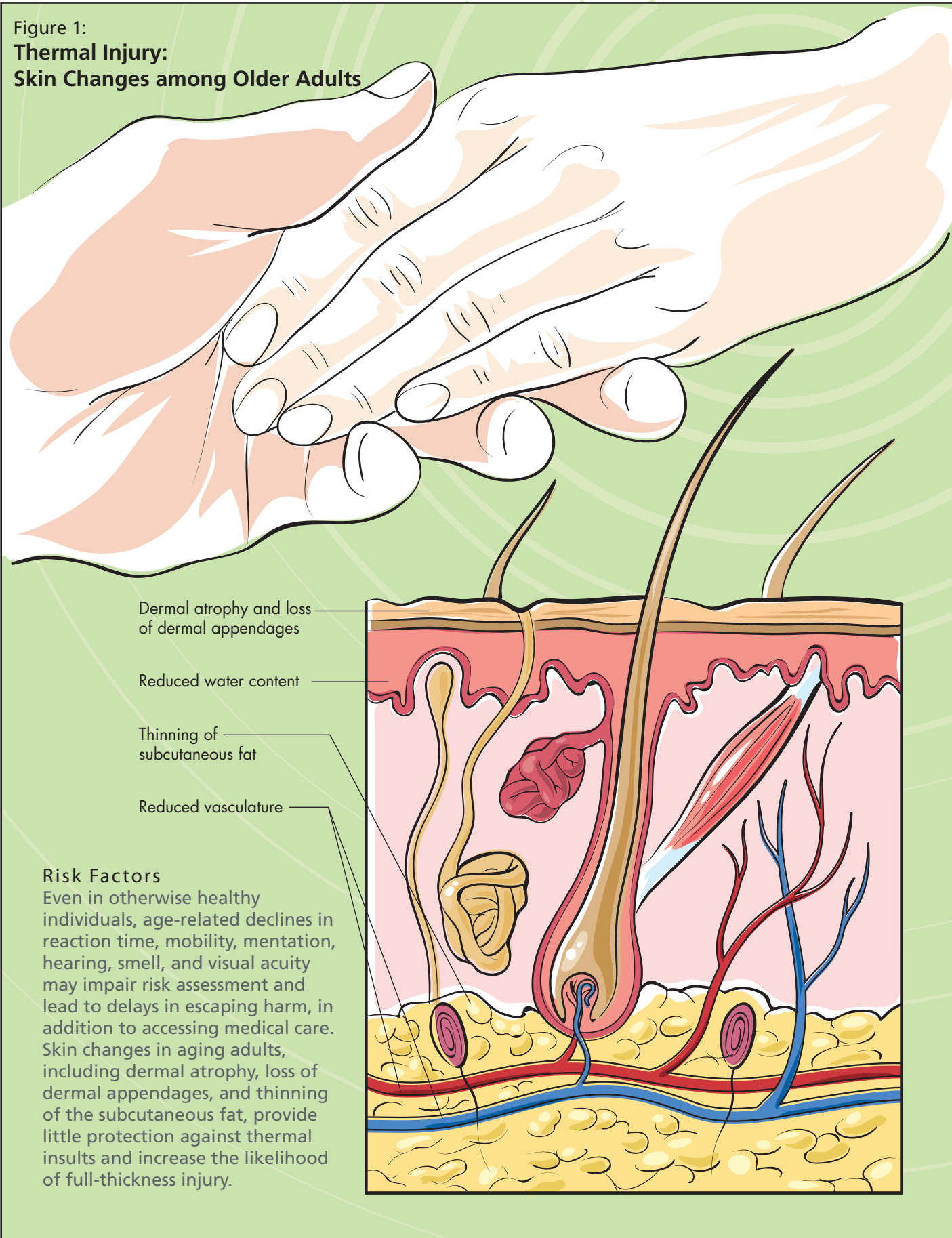
groups, the diminished physiologic reserve of older individuals limits their ability to respond to the substantial stress of thermal injury.<sup>4,9,28</sup> As a result, older adults with burns tend to be sicker and more difficult to treat than younger

Figure 3: TBSA burn associated with 50% Mortality ( $LA_{50}$ ) by Age Group



Source: Wibbenmeyer LA, et al., 2001<sup>12</sup> and Demling RH, 2005.<sup>40</sup>

Figure 1:  
**Thermal Injury:  
Skin Changes among Older Adults**



**Risk Factors**

Even in otherwise healthy individuals, age-related declines in reaction time, mobility, mentation, hearing, smell, and visual acuity may impair risk assessment and lead to delays in escaping harm, in addition to accessing medical care. Skin changes in aging adults, including dermal atrophy, loss of dermal appendages, and thinning of the subcutaneous fat, provide little protection against thermal insults and increase the likelihood of full-thickness injury.

adults. They demonstrate more medical and infectious complications than other age groups due to their underlying comorbidities and generally weakened immune systems.<sup>26</sup> Additionally, a sizeable proportion of older adults may have some degree of protein-energy malnutrition on admission, leading to increased mortality, length of hospitalization, and rehabilitation requirements.<sup>40</sup> Demling<sup>40</sup> further revealed that older adults with moderate to severe malnutrition exhibit higher infection rates and delayed wound healing compared with age-matched controls.

### Anabolic Steroids

Based on the study by Demling, *et al.*, anabolic steroids have been investigated in the management of burns among older adults. In a prospective randomized trial of 50 older adults with 10–30% TBSA burn, Demling and DeSanti found the addition of oxandrolone to a good nutritional program to improve several outcome measures, including weight and nitrogen loss, wound healing, and length of stay.<sup>42</sup> While more research is needed in this area, anabolic steroids may be useful in reducing burn-related morbidity among older adults.

### Intubation

The older adult burn population poses several treatment-related challenges. Early fluid resuscitation is critical for any individual with a major burn and is uniquely challenging for older adults, owing to the precarious balance between under-resuscitation (leading to intravascular collapse and organ failure) and fluid overload (leading to pulmonary edema and congestive heart failure).<sup>9,11,25,34,35</sup> Optimizing pain control can also be exceptionally difficult due to poor tolerance of narcotics among older adults, and their susceptibility for delirium and oversedation.<sup>43</sup> On occasion, providing appropriate pain relief may necessitate mechanical ventilation. Our centre uses fentanyl as the metabolites are less and it spares the cardiovascular system.

Underlying respiratory disease is

### Key Points

Older adults with burn injury are at increased risk for deep full-thickness burns from a variety of causes, many of which are preventable.

Clinicians treating older adults with burns must carefully consider early institution of anabolic steroids.

Surgical considerations in terms of the timing of surgery and the methods used can vary substantially between institutions and are fraught with complications related to poor wound healing.

Outcomes of burn injury in older adults result in significant disability.

The advent of artificial skin substitutes has had a dramatic effect on wound care in younger adults that has not yet been realized in older adults.

common among older adults and may also lead to prolonged intubation, particularly if superimposed on inhalation injury, acute respiratory distress syndrome, and/or sepsis.<sup>43</sup> Every effort is made to limit the period of intubation, however, since pulmonary infections (resulting in sepsis and multi-organ failure) are the leading cause of death among older adults with burns.<sup>8,24,27,41</sup>

### Wound Care and Surgical Debate on the Timing of Surgery

An important goal of burn management is to achieve closure of the burn wound, both to reduce the risk of burn wound infection and to limit the physiologic stress response to thermal injury.<sup>4,6,35,44,45</sup> Early excision and grafting of burn wounds is the standard of care for children and younger adult with burns, but use of this approach for older adults is considerably debated.<sup>44</sup> Certain studies have reported decreased infectious complications,<sup>44,46</sup> mortality,<sup>14,44</sup> and/or length of hospitalization<sup>44–46</sup> among older adults undergoing surgical wound closure within 3–7 days of burn injury. Other reports have not corroborated these findings, and have found no benefit to survival or length of stay with early operative intervention.<sup>11,12,17,19,24,29</sup> Still other studies have demonstrated increased complications, hospitalization, or reoperation rates using this approach for older adults.<sup>25,47</sup> As a result, whereas

certain authors believe that early excision of the burn wound is warranted before medical and/or burn-related complications arise (aggressive surgical approach),<sup>14,44,45</sup> others advocate waiting until the wounds are fully demarcated and the patient is medically stabilized prior to excision (conservative approach).<sup>6,31,47</sup> Indeed, a certain percentage of older patients will declare their outcome during the early resuscitation phase. Since there is no good evidence to suggest that mortality differs between early and late surgical approaches, the rationale for conservative management is that needless operations may be avoided for patients destined for a poor outcome.<sup>6,31,47,48</sup> Our practice is to look at each older patient on a case-by-case basis and consider their physiological health, their response to resuscitation, and their personal preferences with respect to advance directives in order to formulate the most appropriate treatment plan.

### Surgical Excision

Whether early or delayed, surgical closure of burn wounds is performed for 62.1% of older burn patients.<sup>22</sup> The thin skin and high proportion of third degree burns among older adults means that a fascial approach to burn wound excision is often required. This approach entails complete removal of the dermis and subcutaneous fat, and is associated with a higher incidence of joint contracture when compared to more superficial (tangential)



excisions.<sup>43</sup> While harvesting a patient's own skin (autografting) is the ideal choice for burn wound coverage,<sup>49</sup> split-thickness skin grafting can be technically challenging among older adults and a new full-thickness wound can be unintentionally created at the donor site.<sup>36</sup> The poor microvasculature, impaired wound healing, and high susceptibility to infection of older burn patients may also negatively affect skin graft take and donor site healing.<sup>5,6,9,15,21,26,37,50</sup> To circumvent the considerable morbidity associated with donor sites among older adults, primary closure of the burn wound or donor site (dermolipectomy) may be attempted, and is facilitated by the skin laxity of older age.<sup>41,49</sup> Alternative strategies include the use of acellular Allograft dermis,<sup>36</sup> cultured epithelial autografts,<sup>44</sup> and synthetic skin substitutes (Integra<sup>®</sup>, Biobrane<sup>®</sup>),<sup>51</sup> but further evidence is required to support their clinical effectiveness among older adults.

### Cost and Outcome

Overall, the greater number of medical, surgical, and wound healing complications among older adult burn survivors results in a prolonged course of hospitalization (mean 12.8 ± 17.9 days), which is associated with significant costs to the health care system (mean \$60,501.90).<sup>22</sup> Older patients also exhibit a slower recovery and require more in-hospital rehabilitation to achieve the same functional improvement as younger adults. Additionally, a greater proportion of older patients may require transfer to a rehabilitation centre or LTC facility at hospital discharge. Only 35.6% of older patients in the National Burn Repository (1995–2005) were discharged directly to their homes. Manktelow, *et al.*, similarly reported that 47% of older adults with burns experience a drop in their level of independence at hospital discharge.<sup>33</sup> In contrast, other studies have found that most older burn survivors are able to return to independent living, with or without family assistance.<sup>4,8,12,14,24</sup> However, the high proportion of older adults returning to independent living in these small retrospective studies likely reflects

an element of survivor bias, whereby those older individuals who survived long enough to be followed were the healthiest, highest functioning, and least injured of the older burn population.

Few studies have looked at the long-term functional and psychological outcomes of older adult survivors of burn injury. The study by Larson, *et al.*, gives a positive outlook, with most patients returning to their pre-injury level of functioning at 1 year post-burn.<sup>50</sup> However, other studies have found that functional impairment among older adults may persist beyond 6 months to 1 year.<sup>23,33</sup> In a self-report study of older adult burn survivors, 30% reported that they continued to be more dependent on others at 1–5 years post-discharge.<sup>5</sup> Furthermore, Wibbenmeyer, *et al.*, obtained follow-up (median 104 days) in 171 of 215 older adult burn survivors, and found that 22.8% of patients had suffered burn-related sequelae, including contractures (8.1%) and amputations (4.6%).<sup>12</sup> This suggests that functional outcome among older adult burn survivors may be further limited by burn complications occurring after discharge.

### Prevention

Considering the significant morbidity of burns among older adults, the most important goal of health care workers is to prevent these injuries from occurring in the first place.<sup>5,9,21</sup> In support of this viewpoint, epidemiologic studies have revealed that the majority of burn injuries among older adults are in fact preventable.<sup>5,28</sup> Primary prevention strategies at the policy level, such as regulating home water temperatures, and at the individual level, such as ensuring functional smoke detectors in the home, are necessary to minimize thermal injury in this population.<sup>10,26,32</sup> Older individuals lacking adequate supervision or displaying at-risk behaviours, such as leaving the stove on, should also be referred for home safety evaluations.<sup>10</sup> During home visitations, Murray, *et al.*, found that more than 50% of older adults had inadequate safety equipment in the bathroom and over 30% had tap water temperatures exceeding 60°C.<sup>52</sup> Secondary prevention strategies

are equally underutilized. In a study by Ehrlich, *et al.*, only 4% of older individuals presenting to the emergency department with minor burns were referred to a social worker for home safety evaluations.<sup>3</sup> Similarly, only 25% of older adult burn survivors reported that they had implemented changes to decrease the risk of a second burn injury.<sup>5</sup> Burn education campaigns via mass media, as well as individualized education by caregivers, primary care physicians, and within burn units are critical to reducing the morbidity and mortality burden of thermal injury in this population.<sup>5,10</sup>

### Conclusion

In summary, although recent advances in burn management have improved survival in older adults with burns, the older burn patient continues to present a major therapeutic challenge.<sup>19</sup> Well-designed, prospective studies are needed to establish definitive guidelines for optimal surgical and medical management of burns among older adults. Additionally, these patients have unique rehabilitation requirements that need to be addressed in order to maximize return to pre-injury level of functioning.<sup>37</sup> With the growing number of older burn survivors, it will be increasingly important to evaluate and improve the long-term function and quality of life outcomes of this population. Finally, strategies for burn prevention and education remain central to limiting the burden of burn injury among older adults.



No competing interests declared.

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