

OPTIMIZING BURN TREATMENT IN DEVELOPING LOW- AND MIDDLE-INCOME COUNTRIES WITH LIMITED HEALTH CARE RESOURCES (part 1)

Atiyeh B.,¹ Masellis A.,² Conte C.³

¹ General Secretary, Mediterranean Council for Burns and Fire Disasters – MBC, Plastic and Reconstructive Surgery, American University of Beirut Medical Center, Beirut, Lebanon

² Burnet Project Manager, Plastic Surgery and Burns Therapy, Palermo Civic Hospital, Palermo, Italy

³ Director, Plastic Surgery and Burns Therapy, Palermo Civic Hospital, Palermo, Italy

SUMMARY. In developing countries burn injuries are much more common than in the USA and Europe or other affluent developed countries, due to poverty, overcrowding, and illiteracy, and are associated with higher mortality rates. The high incidence makes burns an endemic health hazard in these countries. Over 90% of burn-related fatalities occur in developing or low- and middle-income countries (LMICs), with south-east Asia alone accounting for over half of fire-related deaths. Management of burns and their sequelae even in the well-equipped, modern burn units of advanced affluent societies remains demanding despite advances in surgical techniques and development of tissue-engineered biomaterials available to these burn centres. Undoubtedly, in a developing country with limited resources and inaccessibility to sophisticated skills and technologies, management of burns constitutes a major challenge. The present review of the literature analyses the challenges facing burn management in LMICs and explores probable modalities to optimize burn management in these countries. The review will be published in three parts. Part I will present the epidemiology of burn injuries and challenges for management in LMICs. Part II will be about management of burn injuries in LMICs and Part III will discuss strategies for proper prevention and burn care in LMICs.

Introduction

Burns and their sequelae are responsible for significant mortality and morbidity worldwide¹ including developing countries² and are among the most devastating of all injuries, with outcomes spanning the spectrum from physical impairments and disabilities to emotional and mental consequences.³ Burn injuries represent a diverse and varied challenge to medical and paramedical staff.¹ In developing countries burn injuries are much more common than in the USA and Europe⁴ or other affluent developed countries due to poverty, overcrowding, and illiteracy.^{1,5} The exact number of burns in developing or low- and middle-income countries (LMICs) is difficult to determine. Judicious extrapolation suggests that India for example, with a population of over 1 billion, has 700,000-800,000 burn admissions annually.⁵ The high incidence makes burns an endemic health hazard in these countries.⁵ Unfortunately, higher fire-related mortality rates are reported in developing countries by the “Injury Chart Book 2002” of the WHO Department of Injuries and Violence Prevention of the Non-communicable Diseases and Mental Health Cluster (Figs. 1, 2).⁶ Globally, fire-related burns are responsible for about 265,000 deaths annually.³ Over 90% of these fatalities occur in developing or LMICs with south-east Asia alone accounting for over half of fire-related deaths.^{3,7} Moreover,

the fire-related burn burden reported as days lost is also higher in LMICs, particularly in the south-east Asia region.⁶

The management of burns and their sequelae, even in well-equipped, modern burn units of advanced affluent societies, remains demanding despite advances in surgical techniques and development of tissue-engineered biomaterials available to these burn centres. Undoubtedly, in a developing country with limited resources and inaccessibility to sophisticated skills and technologies, management of burns constitutes a major challenge.⁸ Difficulties experienced in burn management are amplified many times in LMICs¹ and lack of government initiative and low literacy rates preclude effective prevention programmes.⁵ Furthermore, many uneducated households are fraught with superstition, taboos, weird religious rituals, and faith in alternative systems of “medicine”, which complicates management.⁵

Epidemiology of burns in developing LMICs

The causes of burn injuries in the developing countries are many¹ but most of them are largely preventable.⁸⁻¹⁰ Like other injury mechanisms, the prevention of burns requires adequate knowledge of the epidemiological characteristics and associated risk factors, and it is hence im-

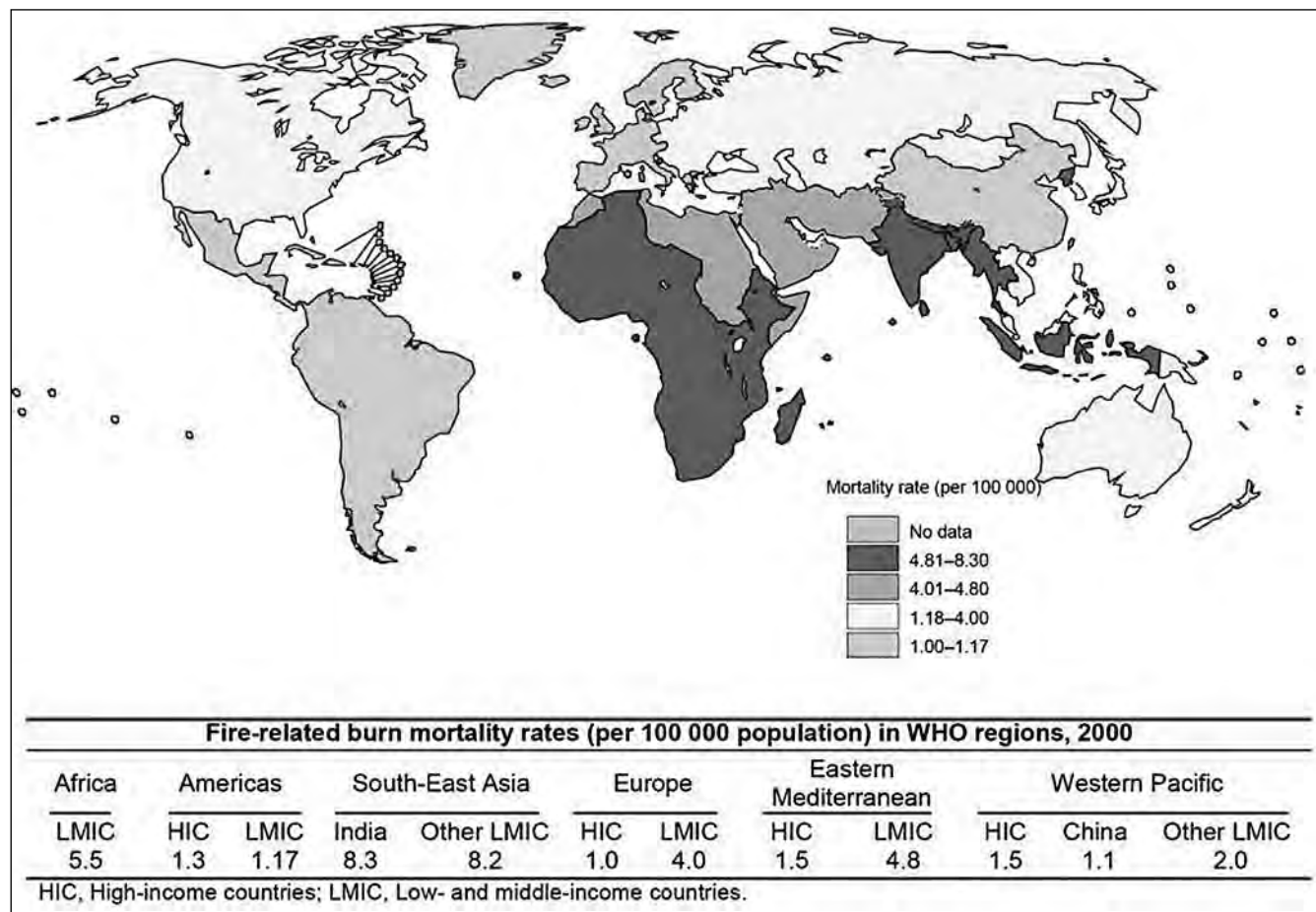


Fig. 1 - Global fire-related burn mortality (Reproduced from “The Injury Chart Book – 2002. A Graphical Overview of the Global Burden of Injuries. Department of Injuries and Violence Prevention + Noncommunicable Diseases and Mental Health Cluster, World Health Organization, Geneva, Switzerland).

portant to define clearly the social, cultural, and economic factors contributing to burn causation.⁹ Unfortunately, despite the fact that management of burn injuries remains a formidable public health problem,¹ there is a palpable lack in most LMICs of comprehensive data documenting the extent of the burn injuries problem to guide policy makers and medical personnel.¹⁸ Existing data are grossly under-reported.¹

The epidemiology of burn injuries in developing countries is said to be different from that in the developed world.⁵ It has been reported that the preponderance of burns seen during childhood and among the elderly in high-income countries (HICs) is rarely seen in LMICs.³ Children and elderly people may be at relatively less risk because many households still exist as joint families, and the system safeguards these age groups to some extent.⁵ More recently, however, studies in LMICs have demonstrated a high number of burns in persons older than 60 yr.^{3,11} Previously reported low incidence was probably due to lack of data on

the elderly.³ Moreover, children, especially those under 5 yr, have been shown to constitute the highest risk group of burn victims, followed by those aged 20-29 yr.^{1,12} Of the studies that reported data on childhood burns, infants and toddlers from birth through 4 years of age were shown to have a disproportionately higher number of burns³ comprising nearly one-third of the total number of burn cases, all age groups considered.^{3,13} In many settings like Brazil, Côte d’Ivoire, and India, this age group accounts for nearly half of all childhood burns.³

The vast majority of childhood burns is reported to occur in the home, while adult burns are reported to occur in the home, outdoors, and at work places in approximately equal proportions.^{3,14} For all age groups, the kitchen is the most common scene of burns, followed by the backyard, house yard, or veranda for younger children, and the living room and the home vicinity for older children. Among the elderly population, the bathroom is also reported as a common scene of burns.^{3,14} Most domestic burns

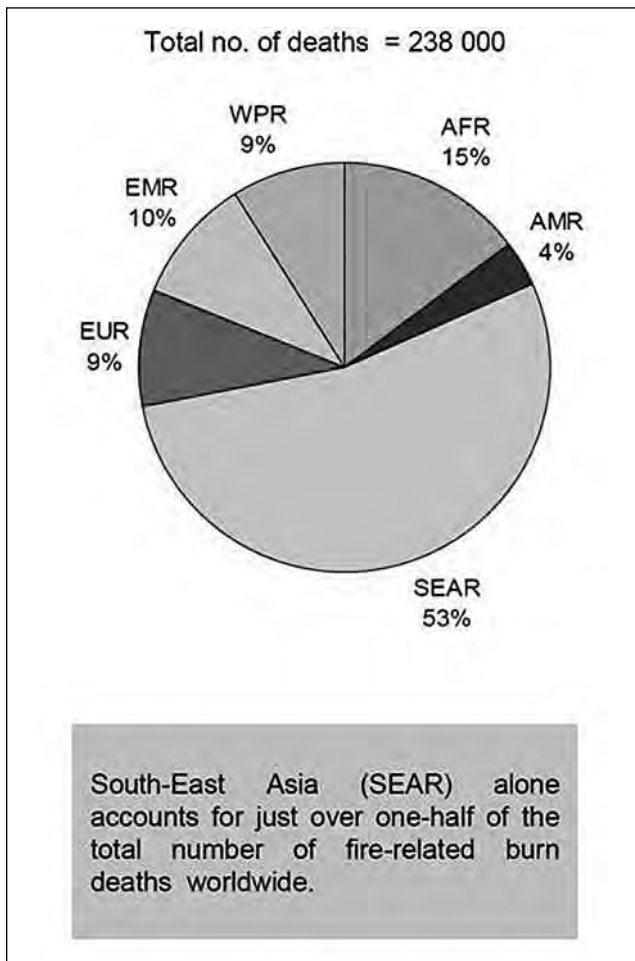


Fig. 2 - Fire-related burn mortality rates (per 100,000 population) in WHO regions (Reproduced from "The Injury Chart Book – 2002. A Graphical Overview of the Global Burden of Injuries. Department of Injuries and Violence Prevention + Noncommunicable Diseases and Mental Health Cluster, World Health Organization, Geneva, Switzerland).

are sustained by women aged 16-35 yr, due to the traditional practice of cooking at floor level or over an open fire, compounded by the wearing of loose-fitting clothing made from non-flame-retardant fabric.^{1,5,6,15,16}

The commonest mode of burn injury is a flame burn. Most such incidents are related to malfunctioning kerosene pressure stoves^{5,8} and homemade kerosene lamps used for lighting¹ or from domestic appliances using flammable fuel.¹⁷ In South Africa it was estimated that from 2002 to 2004 over 46,000 dwellings were destroyed each year. Of the burned households 11-13% were structures defined as "shacks". These structures are made of highly combustible, toxic materials such as treated or painted wood and plastics, assembled close to one another on irregular ground. The incidence of mortality due to smoke and toxic fumes

in such fires is maximal for any age group.¹⁷ Unsupervised and careless handling of firecrackers during festivals also leads to an increased incidence of injuries during festival periods. Fire is also a common injurious agent in homicide and suicide.⁵ Unfortunately, self-inflicted burns tend to be more extensive and have a 14-times higher mortality rate than accidental burns owing to the use of accelerants.¹⁻¹⁸

The resulting figures of a study about survival following burns in Iran are terrifying and dreadful compared with those of developed countries.⁴ In Turkey, deaths of patients with extensive burns usually occur in the first five days following injury, due to acute renal failure and hypovolaemic shock, while deaths from moderate and minor burns usually occur after seven days, as a result of wound infection and sepsis.² In many LMICs mortality increases and reaches a plateau of 100% at 60% TBSA burned. With few exceptions the overall mortality rate from burns is 27%.¹⁻¹⁹ Mortality also increases with inhalation burn injury and smoke and fumes inhalation. The additional mortality attributable to these associated injuries, however, is not very easy to estimate.¹⁷

Burn management challenges in LMICs

Risks of burn injuries

Developing countries have a much higher incidence of burn injuries than developed countries, creating a formidable public health problem.^{4,5} High population density, illiteracy, and poverty are the main demographic factors associated with a high risk of burn injury.⁵ Additional factors include perennial fuel scarcity, erratic power supply necessitating the use of kerosene stoves and lamps, and local traditional practices such as hot water baths for mothers immediately after childbirth and the treatment of convulsions in children with fire.²⁰ Lapses in child supervision, use of clothing with manmade fabrics, parental illiteracy, housing location in slums and congested areas, presence of a pre-existing impairment in a child, prior history of a sibling burn, and low socioeconomic status were reported as significant risk factors for childhood burns in Bangladesh and Pakistan.^{3,20,21} A study in Peru reported lack of water supply, low income, and overcrowding as risk factors for childhood burns.^{3,22} Furthermore, social, economic, and cultural factors interact to complicate the management, reporting, and prevention of burns.⁵

Health care facilities and structures

The cost of managing burn injuries is invariably high.¹⁰ It is a fact that countries with sound economies as depicted by the gross national product per capita tend to have a better health status. Related to the economy is health expenditure, which is also likely to have an impact on health status.^{23,24} Poor facilities and health structures are a com-



Fig. 3 - Ward for burn patients in a public hospital in south-east Asia.

mon denominator in most parts of the developing countries (Fig. 3).¹⁰ Most existing burn centres are situated in large cities and are insufficient for the high incidence of injuries.⁵ Although management in these centres is based primarily on standard principles, hospitals are ill equipped with staff and support facilities.²⁵ Regardless of inadequate physical structures, these centres are invariably plagued with lack of resources, lack of operating time, and shortage of blood. Often there are no dedicated burn surgeons and it is mostly general surgeons without formal training

who are involved in burn care.⁵ Burn nursing is also not a recognized concept.⁵ Resuscitation is often delayed as patients have to travel long distances and transport facilities are poor.^{5,25} Ambulance and pre-hospital services are non-existent.²⁵ Despite the reported annual increase in expenditure for burn care in a large number of LMICs and improving conditions of existing burn centres, burn management remains particularly inadequate in rural areas.¹ Moreover, there is generally no coordination between district hospitals and tertiary burn centres.⁵

RÉSUMÉ. Dans les pays en voie de développement les lésions causées par les brûlures sont beaucoup plus fréquentes que dans les Etats-Unis et l'Europe ou les autres pays développés riches, en raison de la pauvreté, du surpeuplement et de l'analphabétisme, et elles sont liées à des taux de mortalité plus élevés. L'incidence élevée des brûlures constitue un risque sanitaire endémique dans ces pays. Plus de 90% des décès causés par les brûlures surviennent dans les pays à revenu faible ou intermédiaire (PRFI) - le sud-est de l'Asie produit plus de la moitié des décès liés au feu. La gestion des brûlures et leurs séquelles, même dans les centres des brûlés bien équipés et modernes dans les nations avancées et riches, continue à être difficile malgré les progrès réalisés dans les techniques chirurgicales et le développement des biomatériaux créés grâce à l'ingénierie tissulaire qui sont maintenant disponibles dans ces centres. Sans aucun doute, dans un pays en voie de développement qui possède des ressources limitées et sans accès aux compétences et aux technologies les plus sophistiquées, la gestion des brûlures constitue un défi important. Cette revue de la littérature que nous présentons analyse les problèmes majeurs que les PRFI doivent affronter dans la gestion des brûlures et explore les modalités possibles pour optimiser la gestion des brûlures dans ces pays. La revue sera publiée en trois parties. Dans la première partie nous présenterons l'épidémiologie des brûlures et les défis que les PRFI doivent affronter dans leur gestion. La deuxième partie s'occupera de la gestion des brûlures dans les PRFI et la troisième considérera les stratégies les plus appropriées pour la prévention et pour les soins des patients brûlés dans les PRFI.

BIBLIOGRAPHY

1. Lau Y.S.: An insight into burns in a developing country: A Sri Lankan experience. *Public Health*, 958-65, 2006.
2. Kalayi G.D.: Mortality from burns in Zaria: An experience in a developing economy. *East Afr. Med. J.*, 83: 461-4, 2006.
3. Forjuoh S.N.: Burns in low- and middle-income countries: A review of available literature on descriptive epidemiology, risk factors, treatment, and prevention. *Burns*, 32: 529-37, 2006.
4. Forjuoh S.N.: Injury control in developing nations: What can we learn from industrialized countries? *Inj. Prev.*, 2: 90-1, 1996.
5. Ahuja R.B., Bhattacharya S.: Burns in the developing world and burn disasters. *BMJ*, 329: 447-9, 2004.
6. World Health Organization: "The Injury Chart Book: A Graphical Overview of the Global Burden of Injuries", Dept of Injuries and Violence Prevention + Noncommunicable Diseases and Mental Health Cluster, Geneva, 2002.
7. Murray C.J.L., Lopez A.D. (eds): *The Global Burden of Disease: A Comprehensive Assessment of Mortality and Disability From Diseases, Injuries, and Risk Factors In 1990 and Projected To 2020*, vol. I, World Health Organization, 1996.
8. Dongo A.E., Irekpa E.E., Oseghale L.O., Ogbenor C.E., Iyamu C.E., Onuminya J.E. snr: A five-year review of burn injuries in Irrua. *BMC Health Serv. Res.*, 7: 171, 2007.
9. Diop-Ndoye M., Bodjona J.P., Diouf E., Beye M.D., Ngom G., Fall I., Ndoye M., Ka-Sall B.: Management of thermal severe burns in children in Le Dantec University Teaching Hospital. *Dakar Med.*, 50: 194-7, 2005.
10. Aldemir M., Kara I.H., Girgin S., Güloğlu C.: Factors affecting mortality and epidemiological data in patients hospitalised with burns in Diyarbakir, Turkey. *S. Afr. J. Surg.*, 43: 159-62, 2005.
11. Adamo C., Esposito G., Lissia M., Vonella M., Zagaria N., Scuderi N.: Epidemiological data on burn injuries in Angola: A retrospective study of 7230 patients. *Burns*, 21: 536-8, 1995.
12. Laloë V., Ganesan M.: Self-immolation: A common suicidal behaviour in eastern Sri Lanka. *Burns*, 28: 475-80, 2002.
13. Atiyeh B.S., Saba M.: Cost/benefit value of a burn unit at AUB-MC. *Ann. Burns and Fire Disasters*, 8: 164-8, 1995.
14. Ferrara M.M., Masellis M., Conte F.: The philosophy of a burns prevention campaign. In: "The Management of Mass Burns Casualties and Fire Disasters", 314-6, Kluwer Academic Publishers 1992.
15. Sawhney C.P.: Flame burns involving kerosene pressure stoves in India. *Burns*, 15: 362-4, 1989.
16. Gupta R.K., Srivastava A.K.: Study of fatal burns cases in Kanpur (India). *Forensic Sci. Int.*, 37: 81-9, 1988.
17. Paraffin Safety Association of Southern Africa, 2003 SABS Stove Test Report (www.pasasa.org), 2005.
18. Pelaez Mata D.J., Medina Villanueva A., Garcia Saavedra S., Prieto Espunes S., Concha Torre J.A., Menendez Cuervo S. et al.: Importance of initial management in severe pediatric trauma. *Cir. Pediatr.*, 18: 17-21, 2005.
19. Keswani M.H.: Burns in India 1974-1999. *Burns*, 26: 63-4, 2000.
20. Delgado J., Ramirez-Cardich E.M., Gilman R.H. et al.: Risk factors for burns in children: Crowding, poverty, and poor maternal education. *Inj. Prev.*, 8: 38-41, 2002.
21. Daisy S., Mostaque A.K., Bari T.S., Khan A.R., Karim S., Quamruzzaman Q.: Socioeconomic and cultural influence in the causation of burns in the urban children of Bangladesh. *J. Burn Care Rehab.*, 22: 269-73, 2001.
22. Mabrouk A., Maher A., Nasser S.: An epidemiology study of elderly burn patients in Ain Shams University Burn Unit, Cairo, Egypt. *Burns*, 29: 687-90, 2003.
23. Olaitan P.B., Olaitan J.O.: Burns and scalds - epidemiology and prevention in a developing country. *Niger. J. Med.*, 14: 9-16, 2005.
24. Buor D., Bream K.: An analysis of the determinants of maternal mortality in sub-Saharan Africa. *J. Women's Health*, 13: 926-38, 2004.
25. Opaluwa A.S., Orkar S.K.: Emphasize burns prevention in developing countries. *BMJ*, 329: 801, 2004.

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Address correspondence to: Prof. B. Atiyeh, American University of Beirut, Plastic and Reconstructive Surgery, Beirut, Lebanon.
Fax: (9613) 340032; e-mail: aata@terra.net.lb