

## EMERGENCY TREATMENT OF MINOR BURNS AT CHILDREN

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### Summary

*The burns are one of the most common causes of pediatric accidents and are extremely serious medical, surgical, psychological and social circumstances, with a vital and potentially invalid risk. [1] This trauma is a serious aggression of teguments, and depending on their depth and extension can produce scarring and permanent sequelae and even death. They can affect all age groups with different mechanisms and effects.*

*Adult responsibility is major in preventing these accidents because children, having age-specific curiosity they do not understand the danger at which they are exposed to, and they are among the most affected by these traumas. The burns with hot liquids are the most common types of burning encountered in young children. Annually, at the Grigore Alexandrescu Children's Emergency Clinical Hospital in Bucharest, there are almost 1,500 children with burns, 70% of which are minor. The moderate and especially severe burns, however, have a reserved vital and functional prognosis, causing death or impairing the children quality of life throughout their entire life. Prevention of burns and knowledge of first aid measures followed by specialist treatment in a plastic surgery service are the most important ways to improve vital prognosis, as well as aesthetic and functional outcomes.*

**Key words:** burn, children, emergency primary care.

Received: 12.07.2018

Accepted: 20.08.2018

### Introduction

The human skin is the largest organ and the most important organ of the immune system, [1] it fulfills essential functions for survival: protection against external aggressions (physical, chemical, infectious agents), thermoregulation, evaporation (functioning as a semi-permeable barrier).

Physical aggressions with the most common physical agents are thermal burns produced by contact with flames, objects or hot liquids, exposure to the sun. Electrical burns can combine

the effects of varying body currents with flame heat burns. Other mechanisms describe chemical burns - when the skin comes in contact with strong acids or bases - and irradiation.

Burns are relatively frequent, encountered in all age groups and have an impact and a high incidence especially in economically and culturally marginalized countries. Annually, emergency services in the United States treat 500,000 patients with burns. Of these, 46% are caused by flames and causes about 3,500 deaths. [12].

From the experience of our country we can see that the factor of education is more important

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than the economic factor in preventing serious child injuries, the overwhelming majority of the child's burns do not occur in families with higher education, the latter lacking a much better economic standard a more correct and more attentive attitude towards the rights and needs of the children they have in their care.

Depending on the depth of the burn injury, we distinguish:

- **Superficial burns** (epidermal, gr. I) - sunburn, short-term exposure to liquids below 50°C, only damage to the epidermis, red and slightly edged skin, nausea and local warmth, spontaneous healing 2-3 days has no definitive consequences. [1]

- **Superficial partial burns** (dermal surface, gr. II A) - it cleanses the epidermis in its entirety and in part dermis and skin annexes, produces: phlebitis, perilesional edema, pink appearance, intense pain, local inflammation and abundant exudate, spontaneous healing in 7-14 days, without definitive scarring consequences. [1]

- **Partial deep burns** (Gr.II B) - they damage the skin and dermis completely, blister and white or red wine eschar, perilesional major edema, moderate exudate, local inflammation, intense pain, hypoallergenic areas, thirst, oliguria, possible spontaneous healing in more than 14 days with scar zones. [1]

- **Burns in all dermal thickness** (total, sub-dermal, gr.III). It is the complete necrosis of the skin, affecting in some cases the underlying structures. All the epithelial elements in the structure of the skin are destroyed. Spontaneous re-epithelium from the deep layers is not possible. Clinical appearance: broken fingers, white eschar, important perilesional edema, reduced exudate volume, marked impairment of the general condition (even on small surfaces in the child) very long or impossible spontaneous healing, with significant definitive scarring. [1]

## Evaluation

For the initial assessment of burns, several factors are taken into account: the manufacturing mechanism, the depth (thickness of the affected skin), location, associated lesions, and especially the affected area, but also the time between the accident and the priming measures specialized help.

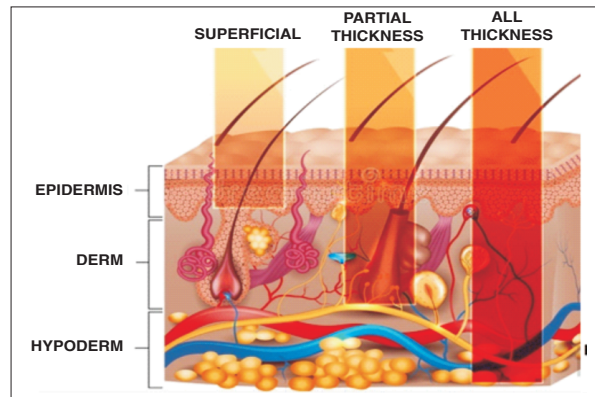


Fig. 1. Classification of burns - [3.]

The mechanism of production may suggest the existence of associated lesions, causing complications in the absence of hospitalization, with adequate supervision and treatment. It is the case of electrocution, chemical burns, burns associated with other traumas (falls, road accidents, etc.)

The depth of the burn is directly related to the production mechanism and the duration of contact between the skin and the source. Chemical burns continue to work while the lesion agent is not neutralized but, unlike the neutralization of chemicals outside the body, in the case of burns, the application of an alkaline substance to acids or a base for acids triggers an exothermic reaction that will worsen the initial lesion.

Localization of burns is important because certain areas such as face, palms, soles, perineum etc. often suffer from deep burns, which usually require hospitalization for a correct treatment that minimizes functional and aesthetic sequelae.

The burned surface (b.s.) - expressed as a percentage of the body surface area (s.a.) is a very important prognostic factor. The larger the burn, the greater the percentage of the body will be devoid of protective functions of the skin. Burned skin, by the destruction of superficial layers and increased permeability induced by the inflammation produced by the burn, is a source of fluid loss, electrolytes, proteins, coagulation factors or plasma, and figurative elements in the blood. If these losses are not compensated and if the inflammatory reaction of the body to the burn is not controlled (by surgical excision of the full burning skin followed by the skin defect), the patient may die.

In adults the surface area burnt from TBSA-total body surface area can be estimated using „Rule 9“. [4–6]. The following tables show the equivalent values: for adults, children and infants.

Infants and children are using different percentages, because in their head and neck they represent a higher percentage of the body surface than the lower limbs. In evaluating pediatric burns, because of the difference in body proportions, the Lund and Browder method is used, slightly modified for each child's Lund age [7].

Another simple method to calculate the burn rate is by using the child's hand as a unit of measure, representing 1% of the TBSA [4], [7].

The initial evaluation of a burn is important to determine if a burned patient can be treated in outpatient settings or should be referred to a specialist hospital.

The criteria for addressing a patient to a specialized plastic surgery service are as follows:

The American Burns Association has established a system of classification of minor, moderate or severe burns, as the patient can be treated in ambulatory, can be treated in a regular hospital that has a plastic surgery service or requires referral and hospitalization in a specialized center for the treatment of large (severe) burns.

Minor burns may be treated by the specialist in ambulatory conditions, provided that they:

- be isolated,

- not be located in aesthetic or functional areas (see above)
- not to be circumferential (when they may become constrictive, and edema may cause distal ischemia)
- not touch the joints (when healing with vicious scars may affect the later function of the limb)
- not meet one of the hospital admission criteria (location, surface, depth, mechanism, illness or associated injuries, airway burns, etc.) [8].

The American Burns Association has developed the following recommendations regarding the severity of burns

EBA Guides (European Burns Association) propose the following transfer criteria to a Burning Center:

1. Patients with superficial burns greater than:
  - > 5% in children under 2 years of age
  - > 10% in children between 3-10 years
  - > 15% in children aged 10-15 years
  - > 20% in adults
  - > 10% in the elderly over 65 years
2. Other patients:
  - Patients requiring resuscitation of burns shock
  - Patients with burns of the face, hands, genitals, large joints
  - Burns of partial thickness or all thickness at any age and on any surface
  - Burns with suspicion of inhalation injury

**Table 1. Surface of anatomical structures in adult - after TBSA [4.]**

Anatomical structure	The area represented at adult
Head - anterior	4,5%
Head - posterior	4,5%
Trunk - anterior	18%
Trunk - posterior	18%
Every superior limb - anterior	4,5%
Every superior limb - posterior	4,5%
Every inferior limb - anterior	9%
Every limb inferior - posterior	9%
Genitals / perineum	1%

**Table 2. Surface of anatomical structures at children - after TBSA [4]**

Anatomical structure	The area represented at children
Head - anterior	8,5%
Head - posterior	8,5%
Trunk - anterior	18%
Trunk - posterior	18%
Every superior limb - anterior	4,5%
Every superior limb - posterior	4,5%
Every inferior limb - anterior	6,5%
Every limb inferior - posterior	6,5%
Genitals / perineum	1%

**Table 3. Surface of anatomical structures at children under 10 kg - after TBSA [4]**

Anatomical structure	The area represented at children under 10 kg
Head and neck	20%
Trunk - anterior	16%
Trunk - posterior	16%
Every superior limb - posterior	8%
Every inferior limb - anterior	16%
Genitals / perineum	1%

**Table 4. Criteria for referral to a specialized service - [12]**

Criterion
Burns with a partial thickness exceeding 10% body surface area (s.c.)
Burns of interest: face, neck, palms, soles, genitals or joints
Electrical and chemical burns
Burns with airways damage
Burns in patients with associated pathologies
Burns in patients with concomitant trauma
Burns in pregnant women and children, regardless of the surface burned

**Table 5. Appreciation of severity and attitude towards the patient with burns - [5]**

EVALUATION OF SEVERITY OF A BURN		
MINOR BURNS	MODERATE BURNS	SEVERE BURNS
< 10% TBSA in adult < 5% TBSA in children and elderly	10-20% TBSA in adult 5-10% in children 2-5% all thickness electrocuted Burning the airways Burn circumferential Collateral disorders	> 20% TBSA in adults > 10% TBSA in children and elderly > 5% of all thickness electrocuted The hot air burn Burning of the face, eyes, ears, hands, feet, genital area and joints Burns with associated lesions: fractures, major trauma
EMERGENCY ATTITUDE		
Ambulatory treatment	Hospital admission (plastic surgery section)	Transfer to a Burning Center

- Any burns if there is any doubt about the treatment
- Circumferential burns at any age
- Burns associated with trauma or illness, regardless of the surface
- Patients requiring special support: social, emotional or long-term rehabilitation
- Major electrical burns
- Major chemical burns
- Burns associated with burns, such as: toxic epidermal necrolysis, necrotizing fasciitis, staphylococcal skin syndrome, if the affected area is 10% for children and the elderly or 15% for the treatment, or if there are doubts about the treatment

**Material and method:**

Inside the „Grigore Alexandrescu“ Children’s Hospital, between January 2015 and August 2017, about 1500 children aged between 0 months and 16 years were treated for burns.

Of these, most were minor burns (about 70%). Moderate and severe burns, requiring hospitalization, were about 30%.

Chart gender distribution and severity of burns

Burns were found more frequently in male children.

Depending on the age group, the mechanisms and severity of burns are different. Age groups: I. 0-2 years, II. 3-8 years, III. 9-12 years, IV.13-16 years.

I. During the first 6 months of life, when the child cannot move alone, burns are often due to parental mistakes: too hot water in the bathroom, when doing the toilet, spilling the pot with the hot water, etc. A serious associated injury, unfortunately insufficiently suspected and treated, which can lead to compromising the child’s airways, is the suction of hot water [14]. Between 7 and 12 months, the baby begins to move but is not stable enough to venture alone. Access to other rooms is generally reduced (if the

doors are closed or the play area is carefully restrained). Accidents occur either by dropping or pulling the face of the table or the hot liquid vessels left too close to the edge of the table or stove. After one year and 2-3 years, the child begins to explore the world surrounding it without had the most basic notions of danger and the possibility of injury. The child must be permanently supervised, coordination of movements is not completed and falls are frequent. At this age, children have no discernment. There are a lot of new objects and spaces around them, and the electric wires, switches, sockets are attractive to them, making electrodes frequent. Likewise, stoves, fireplaces, cookers, ovens, but especially fire, are a real fascination for them, especially if they are forbidden [9]). Some of them can repeat the same mistakes several times without learning that certain things are dangerous. Therefore, the only ways to prevent these accidents is to restrict access by using a pedestrian, secured child-less than 3 years of age, a specially designed and organized room for a larger child, playgrounds well-groomed and protected from accidents, careful supervision and security of sources of fire, explosion, electric current. [1]

**II.** Between 3 and 8 years old, the child begins to learn about permissible and prohibited things, learns that certain things are dangerous and associates hot objects with pain and injuries. But supervision and protection continue to be necessary - and mandatory to avoid injury. Lack of attention and coordination, as well as the overwhelming energy they have at this age, predispose children to multiple casualties by falling in or near the fire, scorching with hot liquids (the pot left on the chill), playing unattended in the presence of high lines voltage or flammable and explosive substances, contact with hot surfaces, etc. The fascination for fire and its production probably has ancestral roots, but the inadequate manuscript and the impossibility of rational thinking that identifies dangerous situations make the child wanting to experience an almost safe victim.

**III.** At 9-13 years, the school-age child faces other challenges. With the first limitations of travel and social life, the child can also get basic concepts of fire protection and protection - which may be important, especially for those in isolated homes who have no other sources of education. However, there is also a competitive spirit, a desire for imitation, which together with a

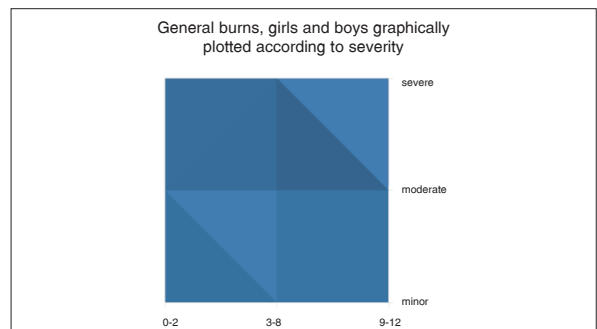
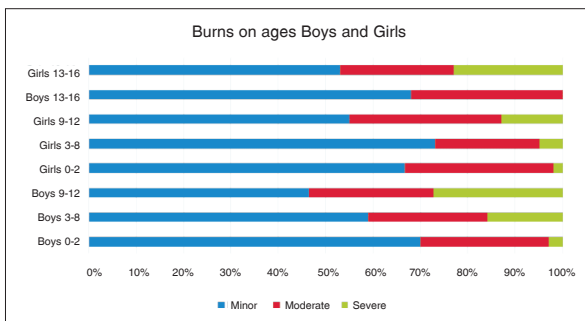
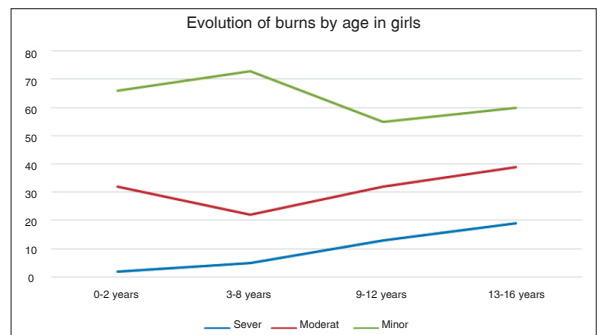
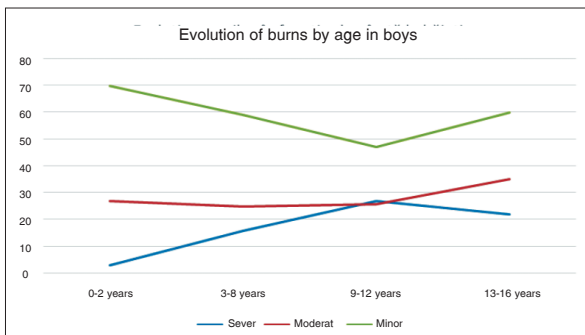


Chart gender distribution and severity of burns



slightly greater freedom - children who go and return to school themselves - can favor accidents. Children left alone can try to ignite fire, producing fires or explosions, or playing with fireworks and other combustible materials. The implementation of normative acts, including new ones in the country, prohibiting marketing to children and limiting their marketing on the market only at certain times of the year, has allowed some of these accidents to be reduced to a certain extent. Child supervision by an adult can also prevent serious injuries. [9]

IV. Older children (13-16 years) generally have a keen desire to become responsible, to take over from adult tasks. The adolescent crisis, with the intention of impressing and proving that they are almost adults, can lead to accidents.

### **Pre-hospital first aid measures**

Regardless of the severity or mode of burning, the treatment must begin at the place and time of the accident. Initial bases are critical for limiting depth, preventing serious complications and even saving the lives of the affected person, all the more so when it comes to a child. [1]

The gravity of a burn depends on the type and duration of the harmful agent, therefore the essential step in first aid is to stop the burning and cooling of the affected area. This can be done by washing with the water at the lower temperature of the region (cold tap water or sterile saline if available).

Rapid cooling of the affected area can reduce the deepening of the burn and decrease local pain. However, caution should be exercised in the case of large areas because a significant decrease in body temperature may cause hypothermia with cardiovascular damage (ventricular fibrillation and asistola) [14]. Ice applications or packs will never be used because it damages the skin (such as a burn) by contact and can induce hypothermia.

During first aid, the caregiver should be careful not to be physically involved in burning or chemical contamination. Particular attention must be paid during first aid to a person who has been electrocuted - the power supply must be stopped quickly and the wound will not be reached in the absence of current interruption or

adequate insulation. Removing a victim from a power source is thus done by stopping the current, or by using a non-conductor to separate the victim from the source. [5].

The next step of first aid is to remove the clothes exposed to hot liquids or chemicals to prevent the burns from getting deeper. It will also be removed: jewelry (rings, earrings, bracelets, chains, watches), belts that can hold heat and cause ischemia when edema occurs [10].

Washing is an essential aid measure in the case of chemical burns, where it is recommended that after the removal of visible clothing and deposits (if the agent is a powder), dilution and disposal of the chemical by washing with large amounts of water (may take one hour), avoiding the release of the substance on the non-irritated skin. The water irrigation of the affected area must begin at the site of the accident and continue to the hospital [11]. An attempt to neutralize the chemical agent is contraindicated in order not to cause an exothermic heat-generating reaction that causes worsening of local lesions.

Call 112 the Emergency Service for all high-risk situations for early initiation of specialist medical-surgical treatment. [1]

*High risk situations are represented by:*

- fire in closed space
- the suspicion of electrification
- The suspicion of chemical burn
- Any red tegument burn (second degree burn)
- Any white burn (grade III) larger than a child's palm
- Any burns on a child under 2 years of age
- Any burns to a child with disabilities or other known chronic diseases
- Any burns produced under conditions of uncertainty or suggestive of negligence or abuse of a minor [1]

Calling the Sole Emergency System can be particularly useful if parents or children have not been educated or trained for first aid. The trained interlocutor at the end of the thread can provide precious information until specialized help arrives.

It is important that, until the first qualified aid is given after cooling of the burning area, it is protected by sterile dressings (if available) and, if

not available, clean cloth will be used to reduce the risk infection.

As soon as possible, the child will be provided with thermal comfort and minor analgesics - by the parent or first aider. The adult will try to get understood by the child and he will be encouraged to communicate as much as possible to overcome the moment. Try to reduce anxiety and relieve the stress or traumatic situation, to master the situation, get out of the crisis and give the child the opportunity to calm down [11].

**Very important:**

- Do not apply empirical treatments for burns: honey, ink, milk, yoghurt, egg, oil, etc. !! despite the „benevolent“ advice of friends, neighbors or the internet.

- Do not break or untie the intact flies.

In all cases of burns, specialist medical examination is mandatory.

**While waiting for the ambulance:**

- Cool of the area according to the mentioned principles, protection of the wounds with sterile dressings or clean linen, provision of thermal comfort, administration of minor analgesics, reduction of anxiety. [1]

- Do not use hypotone fluids (water, tea) small baby who begins to accuse thirst; it is preferred to administer liquids with oral rehydration salts, as in the case of dehydration following digestive disorders. Simple water administration without compensating for sodium losses in an important baby's burn can lead to the onset of water intoxication and the rapid occurrence of hyponatremic convulsions. [1]

**Preventive measures:**

Of course, the best way to avoid an accident is to prevent it and in most cases burns can be prevented [1]

- The little child must be supervised and not left alone in the house or in the bathtub

- It is recommended to use thermostats for adjusting bath water temperature below 50 degrees Celsius;

- Hot water dishes should not be left on the edge of the table, on the floor, or on other surfaces that are at the fingertips of the child;

- Attention to the masses that hang, they represent a real danger when the child clings to them;

- It is recommended to isolate and secure the electrical installation;

- Electric appliances will not be left in the presence of the unattended child;

- The iron will never be left to the child;

- The child should not have access to briquettes, matches, any kind of chemicals. Explosive materials: firecrackers, fireworks will not be kept in the house, and their use will only be supervised by an adult; [1]

- The child should be educated as early as possible, from the moment he understands what's right and what's wrong. Existing risks and severity of possible accidents must be explained. [1]

- Lack of attention - talking on the phone, watching TV, talking etc. - during the maneuvers that may run the risk of accidents (while cooking, ironing or bathing the baby) can jeopardize the integrity of the child's health. The adult should be aware of this risk and act accordingly in order to reduce the possibility of accidents [1].

The medical staff at Emergency Primary Units has the opportunity to explain to parents the precautionary measures and essential first aid measures when a child is brought to the emergency room [11].

**The main prevention measures are:**

- Avoiding electrical improvisations, securing the plugs and preventing children from accessing electric objects and hot surfaces.

- Liquid or hot food (cups, pots, trays, etc.) must not be kept out of reach of children.

- The bath water temperature should be adjusted by a thermostat.

- The house must be equipped with smoke detectors, and children (and adults) must know the correct behavior in case of fire - [13]

- Evacuate the house as quickly as possible and avoid additional risks, prolonging unnecessary exposure to flames and smoke.

**Discussions**

Burns are always serious, even in the best conditions of local and general treatment. This event is extremely traumatic for the child and his family, often leave definitive marks on the child's

body and psyche. During times of cosmetic sequelae, especially if they are located on visible areas of the body (face, hands, feet), become predominant for the patient, are perceived as a disability. Repeated scar revisions and complex procedures of plastic surgery have so far failed to remove the traces of serious burns. The family and patient want to be „as before,“ „look as if the accident had not occurred, it is often not possible. Prophylaxis is all the more important as the burn is generating mortality and significant social costs. [1]

The case of the Grigore Alexandrescu Children's Emergency Clinical Hospital in Bucharest results in a bigger need of information to the public about the necessary initial measures necessary in case of burns (wound cooling, protection from infection, induction of specialized work) and a very abundant folklore, predominantly non-medical, with a wide variety of products that are applied to the burned wound as first aid measures (oil, honey, salt, flour, egg, ink, vinegar, earth, broth, ointment, spray „Burns“, etc.). Also worrying is the fact that some patients receive from pharmacies the indication of using one product or another for the acute phase, which delay the presentation to the doctor. [1]

Burns are the fourth leading cause of death among children in the United States (after motorcycle, car and drowning accidents). [10]. The most common are children aged 0-3 years, the proposed causes being dependence on parents and relatives, their increased curiosity and misunderstanding of potential dangers. [14].

Hot fluid burns are the most common type of burning in children and 80% occur in the presence of adults [15].

The treatment of a child with burns is characterized by the fact that, during a period of growth, reparative intervention cannot be sufficient to avoid or treat post-combustion sequelae. The duration of treatment can be prolonged throughout life and may require dozens of interventions, physical therapy and sustained recovery efforts. A burn that concerns deep skin layers and produces necrosis causes skin defects that heal through extensive fibrosis and retractile scars.

Burning trauma, associated pain, intensive and long-term treatment, with numerous

interventions, have a strong psychological impact on a child whose ability to protect and respond to aggression is not crystallized. Psychological support is especially important for this child to overcome the moment and start recovering.

In addition, by location and extension, burns can cause aesthetic sequelae that can turn the child, avoiding friends and colleagues, absent from school, and altering school performance. The psychological impact of trauma and its sequelae can make the child's social integration more difficult and alter the relationship with family and loved ones. Primary prophylaxis, which aims at avoiding an accident, is based on observing prevention methods and educating the population in the health field for the proper delivery of first aid.

Health education (through prevention and first aid courses) is mandatory in the family, nurseries, kindergartens, schools and even further. Access to education must be provided by both parents and teachers (educators, teachers, teachers) and medical (family doctors, school doctors, and other specialists, nurses). From the moment they go to kindergarten, children have to be educated to be aware of the risks of an accident. Children's education is very important, knowing that they are most receptive to such measures, provided that these courses are done in a format that ensures age-based understanding: themed games, cartoons, etc.

Preventive and first aid strategies developed by the major arts centers have allowed the incidence and severity of burns to decrease and the reduction in hospitalization and mortality rate, particularly in civilized countries, on the other. [12]

The use of an educational program in the Great Britain between 2015-2016 and the application of simple measures to educate parents, relatives, the social environment and the child showed a 29% reduction in incidence of burns, according to a study published in 2017 in Elsevier [16 ].

The level of medical education in our country needs improvement, which is why medical society and beyond, need to invest more in health education through first aid courses, information brochures, prevention campaigns in the education system.



**The implementation of preventive means can be done by applying three main categories of measures: [13]**

1. *Legislative measures: the obligation to install smoke alarms, extinguishers and fire protection equipment, use of non-combustion cigarettes, proper insulation of wires and electrical appliances.*
2. *Educational measures: preparing children and adults for safe and healthy behavior.*
3. *Technological measures related to the presence of smoke, automatic fire extinguishing, the use of flame retardants, etc.*

It has been shown that most burns can be avoided, therefore prevention is the most effective method. Ward counseling and first aid burnout training are essential educational goals for the population to master their knowledge of emergency medical care for pediatric burns to improve their vital and functional prognosis the child burned.

### Conclusions

1. Surviving during childhood, burns can have a severe evolutionary potential, associating high costs, functional and aesthetic sequelae that require numerous serial interventions.

2. The treatment of a burned-out child is for a long time („lifelong patient“) and requires the involvement of a multi-disciplinary team: surgeons, dermatologists, kinetherapists and psychologists, who must collaborate effectively to recover the patient.
3. Burns can also have an important psychological impact on the child, affecting the learning process and school performance, and even family and social integration.
4. The costs of treating a burned child are not limited to a period of time; surgical maneuvers extend throughout the period of growth - up to 18 years in parallel with kinetherapy, and psychological therapy will last a lifetime [17].
5. Prevention of thermal accidents has proven its effectiveness at international level.
6. If burns occur, until specialty treatment is applied, **first aid measures become essential**. These may influence the functional and even vital prognosis of the burned patient [1].

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Conflict of interest  
NONE DECLARED

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