

# Child Protection Evidence

## Systematic review on

# Burns

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While the format of each review has been revised to fit the style of the College and amalgamated into a comprehensive document, the content remains unchanged until reviewed and new evidence is identified and added to the evidence-base. Updated content will be indicated on individual review pages.

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# Table of contents

<b>Summary</b> .....	<b>4</b>
<b>Background</b> .....	<b>4</b>
<b>Methodology</b> .....	<b>5</b>
<b>Findings of clinical question 1</b> .....	<b>5</b>
1.1 Physical features of unintentional scalds .....	6
1.2 Physical features of intentional scalds .....	7
1.3 Scalds triage tool .....	9
1.4 Implications for practice .....	11
1.5 Research implications.....	11
1.6 Limitations of review findings.....	11
1.7 Current clinical criteria not substantiated by this review.....	12
<b>Findings of clinical question 2</b> .....	<b>12</b>
2.1 Contact burns .....	12
2.2 Flame burns .....	16
2.3 Microwave burns .....	17
2.4 Caustic burns .....	17
2.5 Implications for practice .....	18
2.6 Research implications.....	18
2.7 Limitations of review findings.....	18
<b>Findings of clinical question 3</b> .....	<b>19</b>
3.1 Exogenous skin disorders.....	19
3.2 Endogenous skin disorders.....	21
3.3 Intentional burns without malicious intent .....	22
3.4 Research implications.....	23
3.5 Implications for practice .....	23
3.6 Limitations of review findings.....	23
<b>Other useful resources</b> .....	<b>23</b>
Clinical question 1 .....	23
Clinical question 2 .....	24
Clinical question 3.....	25
<b>Related publications</b> .....	<b>25</b>
<b>References</b> .....	<b>27</b>
<b>Appendix 1 – Methodology</b> .....	<b>34</b>

Inclusion criteria.....	34
Ranking of abuse .....	35
Search strategy .....	36
Pre-review screening and critical appraisal .....	39

## Summary

Scald burns are the most common burn type in children who have been abused and the most common causative agent is tap water. Abusive scalds tend to be distributed on the buttocks, perineum, and lower extremities, with clear upper limits and scald symmetry especially when present on the lower extremities. In non-scald abusive burns contact burns are the most common. These burns tend to be distributed on the back, shoulders, and buttocks, with clearly demarcated edges often matching the object used.

The following systematic review evaluates the scientific literature on abusive and non-abusive burns in children published up until **October 2016**.

The review aimed to answer four questions:

- What are the clinical and social features that distinguish intentional and accidental scalds in children?
- What are the features of intentional non-scald burns?
- What conditions mimic intentional burns?
- How do you identify a burn due to neglect?

### Key findings:

- The prevalence of abusive burns is estimated to be 5.3% – 14% of children admitted to burns units<sup>1-3</sup> highest for those aged 0 – 1 years<sup>4</sup>
- Children with abusive burns were found to be significantly younger than those with accidental burns<sup>3</sup>. However when compared to children referred to child protection teams for all causes of physical abuse, those with burns were significantly older<sup>5</sup> and more likely to be boys (66% vs. 56%)

## Background

This systematic review evaluates the scientific literature on abusive and non-abusive burns in children published up until October 2016 and reflects the findings of eligible studies. The review aims to answer four clinical questions:

1. What are the clinical and social features that distinguish intentional and accidental scalds in children?
2. What are the features of intentional non-scald burns?
3. What conditions mimic intentional burns?
4. How do you identify a burn due to neglect?\*

\* To date, there are no studies which address this question

# Methodology

A literature search was performed using a number of databases for all original articles and conference abstracts published since 1950. Supplementary search techniques were used to identify further relevant references. See [Appendix 1](#) for full methodology including search strategy and inclusion criteria.

Potentially relevant studies underwent full text screening and critical appraisal. To ensure consistency, ranking was used to indicate the level of confidence that abuse had taken place and also for study types.

## Findings of clinical question 1

### What are the clinical and social features that distinguish intentional and accidental scalds in children?

Scalds are the commonest intentional burn injury recorded<sup>3,6,7</sup>. Studies which include all Emergency Department attendances have recorded a higher prevalence of intentional contact burns<sup>8</sup>. Apart from abusive head trauma, intentional burns are the most likely injury to cause death or long term morbidity. A child can sustain a full thickness scald in one second from liquids at a temperature of 60°C<sup>9</sup>.

Only comparative studies of abusive and non-abusive scalds are included for this question.

### Intentional and unintentional scalds

- Of 300 studies reviewed (12 foreign language articles), 35 studies were included<sup>2,3,5-37</sup>
- Age: ranging from 0-18 years
- Gender:
  - There was no apparent difference in the frequency between boys and girls between abusive and unintentional scalds:
    - Significantly more boys sustained abusive scalds<sup>19,35</sup>
    - One study showed that boys sustained more unintentional non-tap water scalds than girls (61.5% boys to 38.5% girls (total 104 children))<sup>23</sup>
- No study addressed the diagnosis of intentional scalds in **disabled children**

### Influence of ethnicity and socio-economic group

- None of the included studies addressed this issue

## Details of comparative studies

- Eleven included studies compared unintentional and intentional scalds<sup>2,3,5-7,10,12,20,23,26,36</sup>
- Majority of these studies were highly ranked for definition of abuse(1 or 2) and for defining unintentional causes (A or B)
- Age: ranging from 0-18 years

## Details of non-comparative studies

- 23 included studies addressed either unintentional<sup>32,34</sup> or intentional scalds<sup>8,9,11,13-19,21,22,24,25,27-31,33,37</sup>
- Age: ranging from 0-18 years

## Scald injuries may be defined by

- Agent (e.g. tap water, hot liquids)
- Mechanism (spill, flow, immersion)
- Pattern (depth, outline)
- Distribution (affected body part)

# 1.1 Physical features of unintentional scalds

## Agents of unintentional scalds

The majority of unintentional scald agents are non-tap water<sup>2,3,5,7,10,12,20,23,26,35</sup>,

- Hot beverages / liquids pulled off table top / stove or opening the microwave and pulling beverages / liquids out / preparation of convenience foods
- Water used in cooking

## Mechanisms of unintentional scalds

- Unintentional scalds are predominantly spill injuries<sup>3,5-7,10,12,20,23,35</sup>
- Few unintentional scalds are caused by immersion<sup>3,5-7,10,12,20,23,35</sup>
- Children removing hot substances from the microwave<sup>23</sup>
- One study highlighted scalds involving children aged 7 to 14 years old, either spilling or supervising younger children who sustained the scalds<sup>23</sup>
- There is also a case report of unintentional scalds caused by flowing water<sup>34</sup>

## Distribution of unintentional scalds

Key areas which are vulnerable to unintentional scalds are<sup>7,20,32</sup>,

- Head, neck and trunk
- Face and upper body

## Patterns of unintentional scalds

- Lack of circumferential (glove or stocking) distribution<sup>12,34,36</sup>
- Irregular margin<sup>12,34,36</sup>
- Irregular burn depth<sup>12,34,36</sup>
- Asymmetric involvement<sup>2,5,12,34,36</sup>
- Over 80% were anterior and unilateral<sup>2</sup>

## Features of unintentional flowing water injuries

A single high ranked (A) unintentional study recreated the scene of the accident and confirmed the clinical features found when a child accidentally turns on a hot tap scalding themselves<sup>34</sup>

Pattern:

- Lack of circumferential (stocking) distribution
- Irregular margin
- Irregular burn depth
- Lack of splash marks. However a comparative study did not show any difference in splash marks between intentional and unintentional scalds<sup>35</sup>

Distribution:

- Asymmetric involvement of lower limbs

# 1.2 Physical features of intentional scalds

## Agents of intentional scalds

- The majority of intentional scald injuries are caused by hot tap water<sup>2,3,5,6,9,10,12,17,18,20,23,25,26,29,35,37</sup>

## Mechanisms of intentional scalds

- Forced immersion scald injuries are the commonest<sup>8,10,11,13-19,21,24,25,27-31,33,37</sup>
- Bath related immersion injuries were significantly more common in intentional injury<sup>3</sup>

## Distribution of intentional scalds

- Usually lower limbs<sup>2,3,7,9,10,14,17-19,24,26,28-30,37</sup>, especially the feet<sup>3</sup>
- Bilateral lower extremity scalds<sup>3,5,7,10,19,29,37</sup>
- A multivariate analysis identified children less than five years old, hot tap water scalds, bilateral scalds and posterior location as significant indicators of intentional burns<sup>2</sup>
- Lower extremities may be unilateral<sup>3,26</sup>
- Buttock and perineal scald<sup>3,7,10,17-19,24,28,29,33,37</sup> and the back<sup>3</sup>

- Combination buttock /perineal and bilateral lower extremity scalds<sup>3,7,9,10,14,17-19,24,28-30,33,37</sup>
- Posterior location of the burn is significantly associated with abuse (OR 2.6, 95% CI 1.3, 4.16)<sup>2</sup> and this was supported by another comparative study<sup>3</sup>

## Patterns of intentional scalds

- Scald margins have clear upper limits<sup>8,10,27,33,35-37</sup>
- Scalds are symmetrical<sup>7,15,24,29,36,37</sup>
- Skin fold sparing is found, e.g. in the popliteal area<sup>10,11,27,28,33,37</sup>
- Central sparing of buttocks, sometimes referred to as “doughnut ring” pattern, may be found in immersion injuries<sup>28,29</sup>
- Circumferential (glove or stocking distribution) scalds to upper or lower limbs<sup>9,15,18,29,31,37</sup>
- Stocking distribution scald involving just one limb has also been noted in studies of intentional burns alone<sup>17,29,31</sup>
- Uniform scald depth found in studies of intentional burns alone<sup>8,15,31</sup>

## Associated features

These were confirmed in studies of intentional scalds, and in some cases the corollary was found in non-abusive data also.

- Child sustained previous burn shown in studies of intentional burns alone<sup>10,17,21,22,28,29,31</sup> and one comparative study<sup>5</sup>
- Child’s development is inconsistent with the history of the injury shown in studies of intentional burns alone<sup>11,15</sup>
- Associated neglect or faltering growth shown in both comparative studies<sup>7</sup> and studies of intentional burns alone<sup>11,15-17,30,31</sup>
- A child who is passive or fearful on examination was reported in comparative studies<sup>6</sup> and studies non-comparative studies of either intentional burns or unintentional burns alone<sup>11,16,24,28,32,34</sup>
- Co-existing fractures found on skeletal survey were shown in comparative studies<sup>2,6,36</sup> and non-comparative studies of intentional or unintentional studies<sup>16,19,24,34</sup>
- Associated injury at the time of the scald was noted on examination by both comparative studies<sup>6,10,36</sup> and non-comparative studies of intentional or unintentional burns<sup>8,10,16-18,24,28-31,34</sup>
- History which was incompatible with the physical examination was reported in comparative studies<sup>6,10,20,35</sup> and non-comparative studies of intentional or unintentional burns alone<sup>8,10,11,15,17,24,28,31,34,37</sup>
- Hair samples for illicit drug use (cocaine, benzoylecgonine, cannabinoids and methamphetamine) were more commonly found in abused than unintentionally injured children<sup>2,35</sup>

## Historical and social features of intentional scalds

These were confirmed in studies of **intentional** scalds, and in some cases the corollary was found in **non-abusive** data also.

- Lack of parental concern was found in studies of intentional scalds alone<sup>16,28</sup>
- An unrelated adult presenting the child for medical attention was reported in studies of intentional burns alone<sup>8</sup>
- The presence of domestic violence was reported by two comparative studies<sup>5,6</sup>
- Differing accounts of the cause of the injury was reported by studies of intentional scalds alone<sup>10,15,33</sup>
- A history of prior abuse of the child was reported by both comparative<sup>6,7</sup> and non-comparative studies of intentional scalds<sup>10,21</sup>
- A trigger event such as soiling, enuresis or minor misbehaviour by the child was frequently recorded immediately prior to the scald both in comparative<sup>7</sup> and non-comparative studies of intentional burns alone<sup>10,16,18,21,24,27,30,31</sup>
- A Child or family who were already known to social services was reported in one comparative study<sup>7</sup>, and two non-comparative studies of intentional and unintentional scalds respectively<sup>16,34</sup>
- Intentional scalds were commonly attributed to a sibling in comparative studies<sup>20,36</sup> and studies of intentional scalds alone<sup>10,15,17,33</sup>
- Numerous prior accidental injuries noted in the intentionally scalded child in one comparative study<sup>6</sup> and non-comparative studies of intentional and unintentional scalds<sup>10,17,22,24,28,34</sup>. One comparative study found no difference in prior injuries in maltreated and non-maltreated children<sup>35</sup>

### 1.3 Scalds triage tool

No single factor makes a diagnosis of an abusive scald; this triage tool is drawn from the current scientific literature and lists indicators for abuse. This tool alone will not diagnose abuse.

The red and white characteristics are based on a combination of high quality comparative studies (intentional and accidental scalds) and supported by non-comparative studies. The lighter blue characteristics are based on non-comparative studies alone.

When an intentional scald must be excluded

When an intentional scald must be considered

When an intentional scald is unlikely

When an intentional scald must be excluded	When an intentional scald must be considered	When an intentional scald is unlikely
<b>Mechanism:</b> <ul style="list-style-type: none"> <li>Immersion (2 comparative, 20 non-comparative studies)</li> </ul>	<b>Pattern:</b> <ul style="list-style-type: none"> <li>Uniform scald depth (3 non-comparative studies)</li> <li>Skin fold sparing (6 non-comparative studies)</li> <li>Central sparing buttocks (2 comparative studies)</li> </ul>	<b>Mechanism:</b> <ul style="list-style-type: none"> <li>Spill injury (6 comparative studies)</li> <li>Flowing water injury (1 non-comparative study)</li> </ul>
<b>Agent:</b> <ul style="list-style-type: none"> <li>Hot tap water (8 comparative, 6 non-comparative studies)</li> </ul>	<b>Distribution:</b> <ul style="list-style-type: none"> <li>Glove and stocking distribution (6 non-comparative studies)</li> <li>1 limb glove/stocking (3 non-comparative studies)</li> </ul>	<b>Agent:</b> <ul style="list-style-type: none"> <li>Non tap water (hot beverage) (8 comparative studies)</li> </ul>
<b>Pattern:</b> <ul style="list-style-type: none"> <li>Clear upper limits (3 comparative, 5 non-comparative studies)</li> <li>Scald symmetry (extremities) (2 comparative, 4 non-comparative studies)</li> </ul>	<b>Clinical features:</b> <ul style="list-style-type: none"> <li>Previous burn injury (7 non-comparative studies)</li> <li>Neglect/faltering growth (1 comparative study, 6 non-comparative studies)</li> <li>History inconsistent with assessed development (4 comparative, 10 non-comparative studies)</li> </ul>	<b>Pattern:</b> <ul style="list-style-type: none"> <li>Irregular margin and burn depth (1 non-comparative study)</li> <li>Lack stocking distribution (1 non-comparative study)</li> </ul>
<b>Distribution:</b> <ul style="list-style-type: none"> <li>Isolated scald buttocks/perineum (2 comparative, 8 non-comparative studies)</li> <li>+/- lower extremities (2 comparative, 11 non-comparative studies)</li> <li>Isolated scald lower extremities (4 comparative, 10 non-comparative studies)</li> </ul>	<b>Historical/social features (triggers such as):</b> <ul style="list-style-type: none"> <li>Soiling/enuresis/misbehavior (1 comparative, 8 non-comparative studies)</li> <li>Differing historical accounts (3 non-comparative studies)</li> <li>Lack of parental concern (2 non-comparative studies)</li> <li>Unrelated adult presenting child (1 non-comparative studies)</li> <li>Child known to social services (1 comparative study, 2 non-comparative studies)</li> </ul>	<b>Distribution:</b> <ul style="list-style-type: none"> <li>Asymmetric involvement lower limbs (1 non-comparative study)</li> <li>Head, neck and trunk or face and upper body (2 comparative studies, 1 non-comparative study)</li> </ul>
<b>Clinical features:</b> <ul style="list-style-type: none"> <li>Associated unrelated injury (3 comparative, 10 non-comparative studies)</li> <li>History incompatible with examination findings (4 comparative, 10 non-comparative studies)</li> <li>Co-existing fractures (3 comparative, 4 non-comparative studies)</li> </ul>		

When an intentional scald must be excluded	When an intentional scald must be considered	When an intentional scald is unlikely
<p><b>Historical/social features:</b></p> <ul style="list-style-type: none"> <li>• Passive, introverted, fearful child (1 comparative study, 6 non-comparative studies)</li> <li>• Previous abuse (2 comparative, 2 non-comparative studies)</li> <li>• Domestic violence (1 comparative study)</li> <li>• Numerous prior accidental injuries (1 comparative study, 6 non-comparative studies)</li> <li>• Sibling blamed for scald (2 comparative, 4 non-comparative studies)</li> </ul>		

## 1.4 Implications for practice

- A detailed history of the events (mechanism, agent) immediately prior to, and the scene of, the injury must be taken for all children with scalds
- If doubt remains, consideration must be made of the scene of injury assessment, including measurement of tap water temperature and height and location of scalding source
- In evaluating the plausibility of the burn mechanism, it is essential to determine if the burn is compatible with the child’s developmental stage
- This triage tool is based on current published evidence; a prospective study is required to fully validate the criteria

## 1.5 Research implications

Further research is needed in the following areas:

- Our scalds triage tool will require validation in all clinical settings where children present with scalds
- There remains a need for high quality comparative studies of intentional and unintentional scalds presenting to all clinical settings

## 1.6 Limitations of review findings

- The majority of studies were based on hospital or burns unit admissions. This biases the data towards the severe end of the spectrum
- The included studies span a wide time period (dates of included studies range from 1960 onwards) and, as such, definitions of abuse will have varied

- Many studies lack clinical detail as to the pattern of burn injury or co-existent clinical features in non-maltreated children

## 1.7 Current clinical criteria not substantiated by this review

### Distinguishing features of intentional scalds

- No studies addressed the ageing of burns by clinical examination. For this reason, defining the burn as older than described cannot be supported by published evidence
- Delay in seeking medical attention for scald injuries may be due to effective first aid masking the severity of the injury

## Findings of clinical question 2 Features of intentional non-scald burns

This category includes contact burns (e.g. cigarettes, domestic irons, etc), caustic burns, flame burns and microwave burns, all of which have been intentionally inflicted upon children. By far the commonest intentional non-scald burns are contact burns which may not warrant hospital admission; unfortunately to date, the literature relating to intentional non-scald burns is predominantly non-comparative and only four new studies have been identified since 2011<sup>3,5,35,38</sup>.

### Intentional non-scald burns

- Of 300 studies reviewed (12 foreign language articles), 35 studies were included<sup>3,5,9,16,18-20,24,25,35,38-62</sup>
- Age: ranging from 0-14 years
- Gender: There were no large scale epidemiological studies that determined gender breakdown
- One study included two children with physical disability and learning impairment<sup>57</sup>

### Influence of ethnicity and socio-economic group

- None of the included studies addressed this issue

## 2.1 Contact burns

There were no **comparative studies** that specifically set out to identify features that differentiate between intentional and unintentional non-scald burns.

The following data is taken from studies of intentional non-scald burns or studies that described cases of both intentional and unintentional non-scald burns (studies of unintentional cases alone were not analysed)<sup>3,9,18-20,24,25,35,38,41-43,45,46,48,50,53,55-59</sup>.

- Contact burns were the most commonly described non-scald burns:
- Intentional burns were most commonly reported on the back, shoulders and / or buttocks
- Intentional burns had sharply demarcated edges which could be matched to the specific implement in many cases
- In contrast to other physical injuries, intentional non-scald burns occurred throughout childhood

Due to the paucity of literature, the inclusion criteria were lowered to include single case reports.

Three comparative studies confirmed that contact burns were the most common non-scald burns in maltreated and non-maltreated children<sup>3,5,35</sup>. One study showed that 5% of abusive burns in children < 10 years old were contact burns compared to 10% in the non-abused group<sup>3</sup>.

## **Intentional burns from domestic irons**

**Location of intentional iron burns, where provided**<sup>18-20,38,45,55,57</sup>:

- Leg, back of hand
- A burn to the palm of the hand as punishment
- Shoulder / upper arm
- Back and crest of pelvis

**Burn characteristics of intentional iron burns (where provided):**

- Intentional burns had clear demarcation of burn margins
- Age range: 0 – 14 years

## Unintentional burns from domestic irons

Location of unintentional iron burns (total: two cases)<sup>20</sup>:

- Palm of hand (one case)
- Back of hand (one case)

Burn characteristics of unintentional iron burns<sup>20</sup>:

- Rank of accident: C

## Intentional burns from hairdryers

Location of intentional hairdryer burns (total: eight cases)<sup>19,41,56,57,59</sup>:

- Both buttocks
- Face
- Soles of feet
- Back
- Abdomen

Burn characteristic of intentional hairdryer burns<sup>19,41,56,57,59</sup>:

- All intentional burns had clear demarcation of burn margins
- Some cases had precise imprints of the grid on the face of the dryer, enabling the exact matching of the implement used
- Intentional burns – 2nd to 3rd degree or full thickness
- Age range: 0 – 6 years

## Unintentional burns from hairdryers

Location and characteristics of unintentional hairdryer burns (total: one case)<sup>56</sup>:

- Shoulder, back of neck and edge of ear, clearly demarcated (one case)
- Rank of accident: B

## Intentional burns from cigarettes

- **No studies defined** the characteristics of an **unintentional** cigarette burn
- Many studies mentioned **intentional** cigarette burns<sup>18,20,46,48,55,57,58</sup> and six studies recorded the characteristics of these

Location of intentional cigarette burns:

- Fingers<sup>46</sup>
- Base of thumb<sup>48</sup>
- Palm of hand<sup>20</sup>
- Hand and back<sup>55</sup>

- Trunk<sup>58</sup>

#### **Burn characteristics of intentional cigarette burns:**

- Circular punched out burn, 1 cm diameter<sup>48</sup>
- Deep circular burn<sup>20,46</sup>
- Covering small areas, often in groups<sup>18</sup>
- Small rounded scars<sup>55</sup>
- One study containing detailed images described multiple cigarette burns, all regular in size and round, some with a vesicular appearance and others that were raised<sup>58</sup>
- Age of cases: 2-13 years

### **Intentional burns from cigarette lighters**

- Three studies described intentional burns from cigarette lighters<sup>50,57</sup>: One fatal case with multiple burns from a cigarette lighter

#### **Location of intentional burns:**

- Face, chest, abdomen, back and forearms (total: one case)

#### **Burn characteristics of intentional cigarette lighter burns:**

- Clearly demarcated lesions matching the top of the cigarette lighter
- Age: 3, 13 years

### **Intentional burns from grease / oil**

Three studies described intentional burns from grease / oil (total: four cases)<sup>9,24,53</sup>:

- In two cases, the location of the burns were not given<sup>9</sup>
- In one case the child was burnt on the back and shoulder<sup>24</sup>
- In another case the child was burnt on the thighs and arms<sup>53</sup>

#### **Burn characteristics of intentional grease / oil burns:**

- Where noted, the burns were 2nd degree burns
- In one case the mother admitted burning the child with a metal spatula dipped in boiling oil leaving 30 circular / oval shaped burns<sup>53</sup>
- Age range: 0 – 14 years

### **Intentional burns from unidentified objects**

Location of intentional burns (total: nine cases)<sup>9</sup>:

- Trunk and buttocks were most frequent
- Age range: 1 month – 12 years

## Intentional burns from other objects

Intentional single cases<sup>19,20,25,38,42,43,55,57</sup>;

- Stun gun injury to chest, abdomen and thighs<sup>42</sup>
- Frostbite to feet (two cases)<sup>19,43</sup>
- Stove or radiator (four cases)<sup>19,43</sup>
- Light bulb<sup>19</sup>
- Melted plastic<sup>19</sup>
- Curling tongs burn to leg<sup>19,20</sup>
- Radiator burns to back of hand/ wrists<sup>20</sup>
- Car bonnet<sup>25</sup>
- Burning cloth to calf of leg<sup>55</sup>
- Electric water heater to the leg<sup>38</sup>
- Glowing knife (one case)<sup>57</sup>
- Age range: 0 – 14 years

## 2.2 Flame burns

### Intentional flame burns

- House fires were **excluded** from this review which encompasses the majority of flame burns.
- Flame burns were responsible for 3% of abusive burns vs 30% on non-abusive burns in children < 10 years<sup>3</sup>

Cases of intentional flame burns included:<sup>3,16,19,24,25,35,43</sup>;

- Two attempted incinerations
- One cigarette thrown in baby's incubator
- Two fire burns
- Flame burns, no details provided

**Location** of intentional flame burn / incineration<sup>16,19,24,25,43</sup>. Extensive over the body:

- Characteristics – all fatal extensive burns, consistent with history
- One study described a burning match held to the face or thigh of the child (ten cases)<sup>38</sup>
- Age range: 0 – 10 years

### Unintentional flame burns

- One case 7.75 year old with mental retardation had her nappy set alight unintentionally by a sibling<sup>49</sup>

## 2.3 Microwave burns

### Intentional microwave burns

- Two children placed in microwave<sup>39</sup>

**Location of intentional microwave burns (total: two cases)<sup>39</sup>:**

- Five week old baby – burns to left hand and wrist, thorax, right foot, left thigh
- 14 month old – burns to mid-back

**Characteristics of intentional microwave burns<sup>39</sup>:**

- One case displayed a full thickness burn
- One case had 2nd and 3rd degree burns
- Sharply demarcated burns
- One case was biopsied and showed characteristic sparing of the subcutaneous fat beneath burned epidermis and dermis, and below fat significantly burned muscle with no nuclear streaming

## 2.4 Caustic burns

### Intentional caustic burns

- Seven studies describe international caustic burns<sup>3,19,38,43,44,51,55</sup>.
- Caustic burns were rare in either abuse (1.4%) or non-abusive burns (0.9%) in < 10 year olds<sup>3</sup>

**Location of intentional caustic burns:**

- Acidic liquid in ear<sup>51</sup>
- Acid dripped on head<sup>55</sup>
- Mouth and pharynx – forced drinking of caustic cleaner<sup>43</sup>
- Acid thrown on face / eye<sup>44</sup>
- In one case the location of injury was not recorded<sup>19</sup>
- Three adolescents had caustic burns to exposed body parts as punishment by employers<sup>38</sup>

### Unintentional caustic burns

**Characteristics of unintentional caustic burns (initially mistaken for abusive burns)<sup>40,47,52,54,60-62</sup>:**

- Appeared without apparent explanation in four cases
- Mostly deep burns
- Appeared to be no pain initially, which is consistent with burn type
- Diagnosis made as result of careful history and, where appropriate, testing clothing for chemicals

- Traditional remedy involving copper sulphate
- Age range: 0 – 11 years

## Causes

- Alkaline battery fluid<sup>61</sup>
- Bathed in bleach<sup>60</sup>
- Carried Ca Chloride crystals in pocket<sup>62</sup>
- Topical analgesic with salicylate and menthol, aggravated by hot water, toothpaste and potato puree<sup>54</sup>
- Prescribed potassium permanganate solution with undissolved crystals<sup>40</sup>
- Laundry detergent spilled onto clothes<sup>47</sup>
- Copper sulphate mixed with egg white dripped in circular pattern on dorsum of hands, headache remedy<sup>52</sup>

## 2.5 Implications for practice

Intentional non-scald burns:

- Careful history
- Examination of clothing for suspected caustic burns
- Matching the burn to the potential burn agent
- In contrast to other physical injuries, children up to teenage years are subjected to intentional non-scald burns

## 2.6 Research implications

- There is an urgent need for large-scale comparative studies of contact burns, including intentional and unintentional burns, highlighting distinguishing features between these two groups
- A comparative study looking at intentional and unintentional cigarette burns in children would be of great value
- There is a need for studies to determine the prevalence of non-scald burns in children who are abused

## 2.7 Limitations of review findings

Intentional non-scald burns:

- Small numbers of children described
- No comparative studies of cigarette burns
- Lack of detailed comparative data for all non-scald burns

# Findings of clinical question 3

## Intentional burns mimickers

Many skin disorders, endogenous or exogenous, may be mistaken for intentional burns. We have systematically reviewed this literature to define their characteristics and enable this distinction. A number of traditional remedies involve burns and it is important to recognise these.

### Mimickers of intentional burns

Of 289 studies reviewed (12 foreign language articles), 30 studies included where various conditions were initially considered to be caused by abuse<sup>45,47,63-90</sup>:

- Age range: 0–15 years
- Gender: Where data broken down by gender, 17 girls, 16 boys
- No study addressed the diagnosis of mimickers of intentional scalds in disabled children

## 3.1 Exogenous skin disorders

### Drug induced conditions: mimickers of intentional burns

#### Cetirime reaction

- Two studies described Cetirime reactions<sup>78,83</sup>. One case to the perineum and upper thigh<sup>83</sup> and one to the anterior chest<sup>78</sup>, both aggravated by the area being occluded

#### Laxative induced dermatitis

- Four cases<sup>79</sup> who had ingested commercial laxative – leading to diarrhoea and sharply demarcated area of erythema with multiple bullous lesions over buttocks
- Extended 5 cm from anus, sparing skin around anus and perineum in  $\frac{3}{4}$  cases
- Continued to extend to precise limits of the nappy
- Lesions progressed from blisters to large bullae

#### Caustic burn

- Single case<sup>47</sup> of partial thickness burn due to laundry detergent on medial aspect of thigh
- Delayed presentation

### Pressure / friction injuries

- Four cases<sup>71</sup>, mistaken for burns, all had U-shaped curvilinear marks on the backs of their legs

- One case was matched to a swing seat; one to the upper margin of boots; two felt to be pressure injuries
- Remarkably similar descriptions and course to congenital curvilinear palpable hyperpigmentation

## Unintentional electrical burns

- A seven-year-old using an enuresis blanket; 5mm papules and ulcers distributed linearly on the dorsal aspect of the right forearm – due to faulty enuresis blanket<sup>69</sup>

## Unintentional contact burns

- Four cases<sup>88</sup> from walking on very hot surfaces
- Burns to the plantar surface of the foot

## Insect lesions

- Three post-mortem cases where there were sudden unexplained deaths and what appeared to be multiple superficial skin lesions on exposed skin (arms, face, neck, legs) due to cockroaches eating skin. These lesions were with burns<sup>68</sup>
- Two live cases noted to have unexplained curvilinear marks, brownish-red in hue – caused by millipede inside clothing<sup>67,73</sup>. Swelling and tenderness may be present

## Photodermatitis

Sun exposure following chemical contact elicits skin lesions:

### Location and agent:

- Buttocks due to **rue**<sup>76</sup>
- Face and neck due to **perfume**<sup>64,74</sup>
- Dripping pattern over cheeks, chin, upper chest, backs of hands and red streaks down front of chest due to **lime juice**<sup>66</sup>
- Linear blistering lesions to shoulders and back due to **wild parsnip**<sup>65</sup>
- Shoulders and arms due to **citrus drink** being thrown at child<sup>64</sup>
- Forearm, shin, face and chin due to **plant exposure**<sup>82</sup>

### Characteristics:

- Initial redness leading to blistering lesions which follow the pattern of contact with plant / psoralen
- All had sun exposure following chemical contact
- All lesions appeared to occur spontaneously
- All appeared on sun-exposed area of skin
- May be delayed presentation

## Infections

### Staphylococcal scalded skin syndrome

One study described two cases with these type of infections<sup>86</sup>:

- Case One had 8mm ulceration on forehead, 15mm x 35mm lesion on left cheek and 15mm x 18mm lesion on abdomen, with new lesions appearing over next few days.
- Case Two had bullous lesions to trunk, thorax, genitalia, right upper limb, back and left cheek, with new lesions appearing over following days.
- Culture was positive for staphylococcus aureus in both cases.

### Bullous impetigo

- Two cases both of which occurred “de novo”<sup>45,85</sup>
- In one case, lesions in areas of skin that were touching one another<sup>85</sup>

### Toxic shock

- Single case<sup>84</sup>, systemically ill for two weeks.
- Multiple circular lesions on back, thought to be cigarette burns
- Erythema in a number of areas
- Died of toxic shock; diagnosis confirmed on microbiology

### Tinea Capitis

- Single case<sup>81</sup>; ten-year-old; back of scalp

## 3.2 Endogenous skin disorders

### Eczema

- Sustained non-abusive friction burn and presented to burns unit<sup>75</sup>
- Noted to have punctate lesions and linear abrasions over the torso and extremities, thought to be cigarette burns and abuse
- Poor social history
- Confirmed eczema

#### Characteristics:

- No deep craters; irregular margins; sparing of palms and soles of feet

### Congenital insensitivity to pain

- Leading to repeated burns to hands and mouth<sup>89</sup>
- History led to diagnosis

## Congenital curvilinear palpable hyperpigmentation

- Occurring spontaneously from one month after birth; appearing as loops with curved centre in a superior position on the calf<sup>90</sup>
- Both palpable, symmetrical to both legs; one case had associated developmental delay

## Vulvar haemangioma

- A perineal lesion in a five week old thought to be a burn was later diagnosed as an ulcerated capillary haemangioma<sup>80</sup>

## 3.3 Intentional burns without malicious intent

### Traditional remedies

- These intentional burns result from heat sources or chemicals which are inflicted as a traditional remedy for illness<sup>63,70,72,77,87</sup>
- They occur predominantly among South Asian populations
- They are also described in Somalian children
- Age range: 0 – 15 years

### Hot boiled egg

- Two cases<sup>77</sup>, both of whom had hit their head accidentally
- Contact burn with hot boiled egg to face, administered as a cure for bruising

### Moxibustion

Two studies described Moxibustion<sup>70,72</sup>:

#### Burn agent:

- Moxa herb
- Burning yarn
- Cigarette

#### Location:

- Around umbilicus / abdomen
- Back
- Lower rib cage
- Dorsum of wrists, elbows and ankles
- Temple

### Cupping

- Circular superficial burns to the back<sup>63,87</sup>

## 3.4 Research implications

It is of value to continue to report cases of other conditions, which were mistaken for intentional burns.

## 3.5 Implications for practice

- Mimickers are often presented by parents who are unable to explain the cause of injury; full and careful history must always be taken
- Careful history of sun and possible psoralen exposure must be sought when a blistering rash occurs de novo
- Consideration must be given to traditional remedies, particularly in South Asian populations
- Skin disorders are characterised by progression of the lesions; swabs for culture and sensitivity are advised
- Congenital curvilinear hyperpigmentation may be mistaken for contact burns to posterior calf in infants

## 3.6 Limitations of review findings

Findings could not be extrapolated to wider populations.

## Other useful resources

The review identified a number of interesting findings that were outside of the inclusion criteria. These are as follows:

### Clinical question 1

#### Intentional and unintentional scalds

- A study examining **perineum** scalds of a non-abusive nature<sup>91,92</sup>
- Children receiving **steam inhalation** sustained scalds to thighs, genitalia or abdomen due to spilling the container<sup>91,92</sup>
- A study defined the **developmental stage** of children and their **ability to climb into a bath**<sup>93</sup>
- A study which highlighted peoples' lack of awareness of home **tap water temperature**<sup>94</sup>
- A classic study defining the time taken to burn skin at different **water temperatures**<sup>95,96</sup>
- Burns due to **neglect** outnumber those due to intentional injury (9.3% neglect vs 0.9% intentional out of 440 children)<sup>1</sup>

- Four studies (two American and two from the United Kingdom (UK)) found some correlation between low **economic status** and incidence of intentional scalds<sup>97-100</sup>
- One American study implied the opposite, although the definition of higher **economic status** was weak<sup>43</sup>
- Admissions to burns units are higher for children living in **deprived areas** (1 UK study)<sup>101</sup>
- One American study addressed **ethnicity** and found no correlation<sup>102</sup>
- A UK study showed that Asian / Asian British and African / African British had a higher percentage of burns admissions than the local population<sup>101</sup>
- Children with **ADHD** sustain more burns than those without<sup>103,104</sup>
- “**Shower steamer**” burn to the abdomen of 17 month old child standing above the jet of steam<sup>105</sup>

## Clinical question 2

### Intentional non-scald burns

- Three cases of **sulphuric acid burns** due to methamphetamine manufacture, deemed to be **secondary to neglect**<sup>106,107</sup>
  - Each case suffered extensive burns to the mouth, larynx/pharynx and oesophagus. Two also experienced extensive burns to their neck, chest and abdomen<sup>106,107</sup> and another to their hands<sup>107</sup>
- A three year old child with **pharyngeal caustic burn of intentional cause**, rank 1 for abuse<sup>108</sup>
  - This study highlights the frequency of non-abusive alkaline caustic ingestions, predominantly in children aged less than three years<sup>108</sup>
- An **estimate of the age of burns** by using inflammatory cell markers has been conducted on **adult post-mortem samples**<sup>109</sup>
- Children with **ADHD** sustain more burns than those without<sup>103,104</sup>
- **Hair straighteners** are becoming an increasingly common cause of unintentional contact burns<sup>110-112</sup>
  - A recent Australian series identified 22 children over a 5 year period ranging in age from 9 months to 14 years with a peak age of 43.4 months<sup>111</sup>
- Injuries from hair straighteners are predominantly in children less than four years of age, affecting dorsal and ventral aspects of hands or dorsal and plantar aspects of feet<sup>112</sup>
- Study highlighting prevalence of **sunburn** in areas of low sun exposure (Ireland) where 46% of children aged less than 12 years experienced sunburn, despite 83% of parents using some sun protection for their children<sup>113</sup>
- A survey of over 2000 children aged less than five years seen in the Emergency Department (ED) annually in the US for non-intentional **cigarette burns** or poisonings. The commonest location for the burns was on the eyelids or face (87%), and the commonest age was less

than two years old (82%). One assumption may be that children were far more likely to be brought to the ED for burns in such locations than to limbs<sup>114</sup>

- Older children may self-inflict burns with aerosol cans ('frosties') which are deep dermal burns and may not present until sometime later<sup>115</sup>

## Clinical question 3

### Traditional remedies

- Three cases of extensive photodermatitis to **both hands** due to **lime juice and sun exposure**<sup>116</sup>. Phytophotodermatitis has also been described following the application of a fig-leave decoction believed to heal developmental retardation (Turkey)<sup>117</sup>
- Some **traditional remedies** are recognised as being used and potentially causing burns to children. These include the use of **garlic**<sup>118</sup>, although no primary studies relating to its use in children have been identified to date

### Accidental burns mimicking abuse

- A burn to the lateral thigh in an eleven month old infant as a consequence of an over-heated plastic **car seat**<sup>119</sup>
- Alkaline caustic burn sustained by a child hugging the father who was covered with **cement dust**<sup>12</sup>

## Related publications

### Publications arising from burns review

Maguire S, Moynihan S, Mann M, Potokar T, Kemp AM. A systematic review of the features that indicate intentional scalds in children. *Burns*. 2008;34(8):1072-1081

Kemp AM, Maguire S, Lumb RC, Harris SM, Mann MK. Contact, cigarette and flame burns in physical abuse: a systematic review. *Child Abuse Review*. 2014;23(1):35-47

### Primary study arising from Burns review

Davies M, Maguire S, Okolie C, Watkins W, Kemp AM. How much do parents know about first aid for burns? *Burns*. 2013;39(6):1083-1090.

### Other useful related publications

Kemp AM, Jones S, Lawson Z, Maguire SA. Patterns of burns and scalds in children. *Archives of Disease in Childhood*. 2014;99(4):316-321

**Maguire S, Okolie C, Kemp AM. Burns as a consequence of child maltreatment. Paediatrics & Child Health. 2014 August 22 [In Press, Corrected Proof]**

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## Appendix 1 – Methodology

We performed an all-language literature search of original articles, their references and conference abstracts, published since 1950. The initial search strategy was developed across OVID Medline databases using keywords and Medical Subject Headings (MeSH headings) and was modified appropriately to search the remaining bibliographic databases. The search sensitivity was augmented by the use of a range of supplementary ‘snowballing’ techniques including consultation with subject experts and relevant organisations, and hand searching selected websites, non-indexed journals and the references of all full-text articles. The current update was run between 2015 and 2016.

Standardised data extraction and critical appraisal forms were based on criteria defined by the National Health Service’s Centre for Reviews and Dissemination<sup>120</sup>. We also used a selection of systematic review advisory articles to develop our critical appraisal forms<sup>121-125</sup>. Articles were independently reviewed by two reviewers. A third review was undertaken to resolve disagreement between the initial reviewers when determining either the evidence type of the article or whether the study met the inclusion criteria. Decisions related to inclusion and exclusion criteria were guided by Cardiff Child Protection Systematic Reviews, who laid out the basic parameters for selecting the studies. The review programme has now been taken over by RCPCH who have adopted the same degree of rigorous methodology.

The panel of reviewers included paediatricians, designated and named doctors and specialist nurses in child protection. All reviewers have undergone standardised critical appraisal training, based on the CRD critical appraisal standards<sup>121</sup>, and this was supported by a dedicated electronic critical appraisal module.

## Inclusion criteria

The inclusion criteria used in this update of the review are listed in the tables below.

### General criteria

Inclusion	Exclusion
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Papers with all evidence types	Personal practice
English and non-English articles	Review articles
Patients between 0-18 years of age	Methodologically flawed articles
Intentional scald burns	Management of burns
Confirmation of an accidental aetiology where rank of accident A or B	Burns due to neglect
Ranking of abuse 1 – 3	Complications of burns

## Additional criteria for specific review questions

Inclusion	Exclusion
<b>General inclusion criteria plus:</b>	<b>General exclusion criteria plus:</b>
Intentional non-scald burns	House fires
Rank of accident A, B or C	
Ranking of abuse 1 – 4	
Non-abusive cigarette burns alone	

## Ranking of abuse

Distinguishing abuse from non-abuse is central to our review questions. The systematic reviews span more than 40 years and include international publications. Standards for defining abuse have changed markedly over time and across continents. To optimise the ability to apply a consistent quality standard across all publications, we have devised the following ranking score based upon legal and social care child protection decision processes where “1” indicates the highest level of confidence that abuse has taken place. These rankings are used throughout our systematic reviews (where appropriate).

Since its introduction, rank 1 in this classification has been expanded to include ‘independently witnessed, and reported by the child’.

Ranking	Criteria used to define abuse
1	Abuse confirmed at case conference or civil or criminal court proceedings or admitted by perpetrator
2	Abuse confirmed by stated criteria including multidisciplinary assessment

3	Abuse defined by stated criteria
4	Abuse stated but no supporting detail given
5	Suspected abuse

## Search strategy

Table five presents the search terms used in Medline database search, truncation and wildcard characters were adapted to the different databases where necessary. Changes to the search strategy were adopted only after consultation with the clinical expert sub-committee.

1. Infant/	46. (Accidental or non-accidental scald:).mp.
2. Child/	47. thermal injur:.mp.
3. Child Preschool/	48. chemical burn:.mp.
4. exp Adolescent/	49. ((intentional or deliberate) adj5 (burn* or scald*)).mp.
5. (child: or infant: or baby or toddler:).mp.	50. scald:.mp.
6. (youth or adolescence: or teen*).mp.	51. splash burn:.mp.
7. or/1-6	52. flash burn:.mp.
8. child abuse.mp.	53. friction burn:.mp.
9. child protection.mp.	54. blast burn:.mp.
10. child maltreatment.mp.	55. blast injur:.mp.
11. (battered child or shaken baby or battered baby).mp.	56. caustic burn.mp.
12. Child neglect*.mp.	57. (child: adj3 burn:).mp.
13. or/8-12	58. (iron adj3 burn).mp.
14. (non-accidental injur: or nonaccidental injur:).mp.	59. (tub: adj3 burn:).mp.
15. (non-accidental trauma or nonaccidental trauma).mp.	60. (bath adj3 burn:).mp.
16. (non-accidental: and injur:).mp.	61. (tap water adj3 burn).mp.
17. soft tissue injur:.mp.	62. (radiant heat adj3 burn:).mp.
18. (physical abuse or physical neglect or physical harm).mp.	63. (radiator adj3 burn:).mp.
19. ((inadequa* or neglect*) adj3 supervis*).mp.	64. (pullover adj3 burn).mp.
	65. (caustic adj3 burn:).mp.
	66. electrical burn.mp.

20. supervisory neglect.mp.	67. (Microwave* adj3 burn*).mp.
21. (neglect* or home alone).mp.	68. (hair straightener or curling tongs).mp.
22. (risk adj3 harm).mp.	69. or/25-68
23. (or/14-22) and 7	70. (Substance Abuse or drugs).mp.
24. 13 or 23	71. illicit substances.mp.
25. exp Burns/ or burn:.mp.	72. (methamphetamine or crack cocaine or crystal meth).mp.
26. Burns, Chemical/	73. exp Street Drugs/
27. Immersion.mp.	74. **Substance Abuse Detection”/
28. Cigarette burn:.mp.	75. (or/70-74) and 25
29. Inflicted burn:.mp.	76. accidental burn:.mp.
30. Electric burn:.mp.	77. unintentional burn:.mp.
31. Spill injur:.mp.	78. unintentional injur:.mp.
32. Splash injur:.mp.	79. accidental scald:.mp.
33. Contact burn:.mp.	80. unintentional scald:.mp.
34. flame burn:.mp.	81. or/76-80
35. Patterned injur:.mp.	82. 69 or 75 or 81
36. Doughnut pattern.mp.	83. 24 and 82
37. Waterline pattern.mp.	84. Patient Care Management/
38. Branding injur:.mp.	85. Review.pt.
39. Blister:.mp.	86. management.ti.
40. Pour Burn:.mp.	87. Prevention.ti.
41. Dry contact burn:.mp.	88. burnout.tw.
42. mirror image burn:.mp.	89. or/84-88
43. stocking burn:.mp.	90. 83 not 89
44. ((rope or glove) adj3 burn:).mp.	91. limit 90 to yr="2011 -Current"
45. (Accidental or non-accidental burn:).mp.	

## Databases searched

Fifteen databases were searched. In previous iterations of this review four journals which were hand searched and two websites as well. For this update and going forward hand searching will no longer be carried out. A complete list of the resources searched can be found below.

Databases	Time period searched
ASSIA (Applied Social Sciences Index and Abstracts)	1987 – 2016
CareDate	1970 – 2005*
Child Data	1958 – 2009†
CINAHL (Cumulative Index to Nursing and Allied Health Literature)	1982 – 2016
Cochrane Library (formerly All EBM Reviews – Cochrane DSR, ACP Journal Club, DARE, and CCTR)	1996 – 2016
EMBASE	1980 – 2016
MEDLINE	1950 – 2016
MEDLINE In-Process and Other Non-Indexed Citations	2006 – 2016
Open SIGLE (System for Information on Grey Literature in Europe)	1980 – 2005*
Pubmed (searching Epub ahead of print)	2016
Scopus	1966 – 2016
TRIP Plus	1997 – 2008**
Web of Knowledge – ISI Proceedings	1990 – 2016
Web of Knowledge – ISI Science Citation Index	1981 – 2016
Web of Knowledge – ISI Social Science Citation Index	1981 – 2016
* ceased indexing † institutional access terminated ** due to lack of relevancy stopped searching	
Journals 'hand searched'	Time period searched
Child Abuse and Neglect	1977 – 2015
Child Abuse Review	1992 – 2015
Websites searched	Date accessed
The Alberta Research Centre for Health Evidence (ARCHE)	March 2015
Child Welfare Information Gateway (formerly National Clearinghouse on Child Abuse and Neglect)	March 2015

## Pre-review screening and critical appraisal

Papers found in the database and hand searches underwent three rounds of screening before they were included in this update. The first round was a title screen where papers that obviously did not meet the inclusion criteria were excluded. The second was an abstract screen where papers that did not meet the inclusion criteria based on the information provided in the abstract were excluded. In this round the pre-review screening form was completed for each paper. These first two stages were carried out by a systematic reviewer at the RCPCH and a clinical expert. Finally a full text screen with a critical appraisal was carried out by members of the clinical expert sub-committee. Critical appraisal forms were completed for each of the papers reviewed at this stage. Examples of the pre-review screening and critical appraisal forms used in previous reviews are available on request ([clinical.standards@rcpch.ac.uk](mailto:clinical.standards@rcpch.ac.uk)).