

# Patients with burn injuries admitted to Norwegian hospitals – a population-based study

**BACKGROUND** The objective of this article is to elucidate the scope of burn injuries in Norway, on the basis of those patients who had sustained a burn injury that caused hospitalisation through a calendar year.

**MATERIAL AND METHOD** The article is based on data retrieved from the Norwegian Patient Registry on patients discharged from Norwegian hospitals in 2012 with a burn injury as their main diagnosis, supplemented with activity data for children admitted to the Burn Unit, Haukeland University Hospital, Bergen, during the period 2013–15.

**RESULTS** In 2012, altogether 620 people (12.4/100 000 inhabitants) were hospitalised with burn injuries. Of these patients, 393 (63.4%) were men. A total of 375 patients (60%) were hospitalised more than once, and 124 (20%) were admitted to more than one hospital. Altogether 367 patients (59%) were hospitalised for less than eight days. Average hospitalisation time for the group as a whole was 11.3 days (SD 18.8 days). Many of the burn-injured patients were young: the average age was 27.4 years (SD 26.0 years). As many as 183 patients (30%) were less than three years old. Children in this age group were admitted for burn injuries 12 times more frequently than children  $\geq 5$  years and adults.

**INTERPRETATION** We found no definite reduction in burn injuries as a cause for admission to Norwegian hospitals in 2012 when compared to results from previous studies for the period 1992–2007. There ought to be a major potential for more effective prevention of burn injuries in the age group  $< 3$  years, in which scalding (78%) and contact with hot surfaces (most often stoves) (17%) are the main mechanisms of injury.

Burn injuries treated in Norwegian hospitals have been described in the Journal of the Norwegian Medical Association previously and the most recent description was based on data from 1998 (1). Since 2009, the data files in the Norwegian Patient Registry (NPR) have included a patient-specific, consecutive numbering used as a pseudonym for the national identification number. The same consecutive number is used across all years and sectors for which data are reported to the registry. This number enables elucidation of patients who are readmitted for the same disease and monitoring of patients who are transferred between different hospitals. In this article we have aimed to highlight information on those patients who had sustained burns of a severity that merited admission to a Norwegian hospital over a specific calendar year (2012).

Many small and minor burn injuries are treated in outpatient clinics. In this study, we have placed the main emphasis on patients with more extensive burn injuries, defined as having merited hospitalisation for more than 24 hours for the burn injuries sustained (or cases where the injuries were so severe that the patient died on the day of admission).

## Material and method

In September 2013, data were retrieved from among all admissions to Norwegian hospitals that provide somatic emergency services. The search included all patients discharged during the period 1 January–31 December 2012 with burn injuries (ICD-10) (2): T20–T25, T29 or T30, all with .0–.3 as the third digit, or T31.0–T31.9 as their main diagnosis. Patients with smoke inhalation injuries (T58 or T59.7–T59.9) as their main diagnosis and burn injuries as a secondary diagnosis were also included.

This raw material was then processed further before it was supplied from the Norwegian Patient Registry, so as to exclude patients who were only registered with an admission for burn injuries with a hospitalisation period of 0 days (Figure 1). The remaining data included 620 unique patients (with a total of 1 976 admissions) who were subjected to further analysis.

The anonymised data were supplied by the Norwegian Patient Registry in a tabular format. For individuals, the information included only their year of birth, gender, number of admissions with burn injuries as the main diagnosis and total hospitalisation time. In age groups with few patients, age

## Henning Onarheim

*henning.onarheim@helse-bergen.no*

Department of Anaesthesia and Intensive Care  
Haukeland University Hospital  
and

Department of Clinical Medicine  
University of Bergen, N-5021 Bergen, Norway

## Ragnvald Ljones Brekke

Department of Plastic Surgery and Burn Unit  
Surgical Clinic  
Haukeland University Hospital, N-5021 Bergen,  
Norway

## Anne Berit Guttormsen

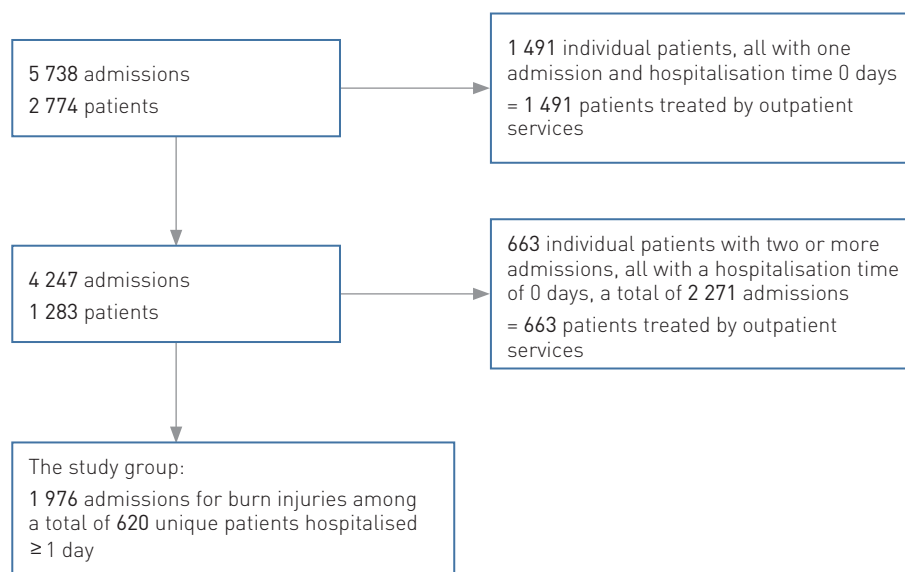
Department of Anaesthesia and Intensive Care  
Haukeland University Hospital  
and  
Department of Clinical Medicine  
University of Bergen, N-5021 Bergen, Norway

## MAIN MESSAGE

Each year, more than 620 patients are admitted to Norwegian hospitals with burn injuries

Measures to prevent burn injuries should target children under three years in particular. They are especially exposed to scalding injuries, and in 2012, they were admitted with burn injuries 12 times more frequently than children  $\geq 5$  years and adults

Despite the emphasis on preventive measures, we cannot with any certainty observe a reduction in the number of burn injury cases in Norwegian hospitals



**Figure 1** Selection of the study group: admissions to hospitals for burn injuries in 2012 (from the Norwegian Patient Registry)

was stated as intervals (e.g. 78–82 years), and for these patients age has been estimated as the mean value of the stated age interval (80 years in the example).

Hospitalisation time has been calculated as the date of discharge *minus* the date of admission. For patients with multiple admissions, the total hospitalisation time was calculated as the duration of two or more hospitalisation periods.

Age has been calculated as 2012 *minus* the year of birth, since access to dates of birth was not granted for reasons of privacy protection. This gives rise to a certain degree of systematic imprecision, and the estimated incidence

of burn injuries in the youngest age group (< 3 years) may thus be somewhat low.

At the institutional level, information was supplied on the total number of patients, number of admissions and the total number of hospitalisation days.

To elucidate the causes of burn injuries in little children, additional information on the type of injury, circumstances, area of injury, hospitalisation times and number of operations was retrieved from a local quality registry at the Burn Unit, Haukeland University Hospital, Bergen, for all children < 3 years who were admitted during the period 2013–2015.

Incidence has been estimated by total population and gender in various age groups in Norway as of 1 January 2012 (total population 4 985 870) (3).

#### Statistics

If not otherwise stated, results are presented as mean values and standard deviations. The incidences of burn injuries among men and women respectively in different age groups have been compared by chi-square testing (PRISM 5.0, GraphPad Software, La Jolla, CA, USA).

#### Approvals

The Directorate of Health, represented by the Norwegian Patient Registry, has approved the application and supplied the statistics and anonymised information. The study has been approved by the Western Norway Regional Committee for Medical and Health Research Ethics (2013/538).

#### Results

The data retrieved from the Norwegian Patient Registry included 620 individual patients with burn injuries (Figure 1). This is equivalent to 12.4 patients admitted for burn injuries per 100 000 inhabitants per year.

Altogether 393 patients (63.4%) were men. Figure 2 shows the number of patients with burn injuries per 100 000 inhabitants in various age groups and by gender. There was a significant preponderance of burn injuries among males, in children < 3 years as well as the age groups 10–59 years.

More than one-third of the patients with burn injuries were children, and as many as 216 patients (34.8%) were younger than five years. The large proportion of young children accounts for the low average age of the patients with burn injuries: 27.4 years (SD (26.0 years), with a median age of 22.5 years.

The total number of hospitalisation days ( $n = 6\,981$ ) indicates that on average, 20 Norwegian hospital beds are occupied by patients with burn injuries on a daily basis. The hospitalisation time was strongly skewed towards short hospitalisation periods (average hospitalisation time amounted to 11.3 days (SD 18.8 days), median hospitalisation time was five days) (Table 1). Altogether 367 patients (59.2%) had been hospitalised for less than eight days. Those 15 patients whose hospitalisation periods exceeded eight weeks were at the other extreme, with a total of 1 438 hospitalisation days, equivalent to 20.6% of all hospitalisation days due to burn injuries.

The 620 patients were registered with a total of 1 976 admissions. Altogether 375 patients (60%) had been admitted more than once. Multiple admissions of the same patients are likely to reflect that many patients with burn injuries return for one (or more)

**Table 1** Burn injuries in Norway in 2012: age distribution, number of patients and hospitalisation time (for patients with multiple admissions for burn injuries, the duration has been calculated as the sum of all hospitalisation periods)<sup>1</sup>

Age (years)	Number of patients		Hospitalisation time (days) <sup>1</sup>		
	Men	Women	Total	Average (SD)	Median
< 3	116	67	1 964	10.7 (13.1)	6
3–4	13	20	277	8.4 (7.9)	7
5–9	13	19	152	4.8 (5.3)	2
10–19	26	11	285	7.7 (10.7)	1
20–39	92	33	1 175	9.4 (24.5)	2
40–59	89	35	1 448	11.7 (19.3)	4
60–79	36	28	1 362	21.8 (27.2)	10.5
≥ 80	8	14	318	14.3 (12.3)	14
Sum	393	227	6 981	11.3 (18.8)	5

change of bandages/wound care, that some are readmitted with persistent wound problems, and that patients with burn injuries are transferred between hospitals. One patient in every five had been admitted for burn injuries to more than one hospital. Of these, altogether 109 patients (17.6%) had been admitted to two hospitals, and 15 patients (3.4%) had been admitted to three or more hospitals.

In addition to those 620 patients who had been hospitalised for burn injuries, another 2 154 patients had been in contact with a hospital after sustaining burn injuries, but without being admitted (Figure 1).

Haukeland University Hospital functions as a national centre for advanced treatment of burn injuries. In 2012, a total of 103 of the 620 patients (16.7%) had been treated in this hospital, with a total of 2 148 hospitalisation days for burn injuries (30.7% of all hospitalisation days).

Seven patients, three men and four women, were registered as deceased on discharge. Six of them had hospitalisation periods ranging from one day to three weeks, while the last one died after a lengthy period in hospital. Of those whose burn injuries proved fatal, one patient was younger than 15 years and four were 70 years or older.

Altogether 183 of the patients (29.5%) were younger than three years. In this age group, burn injuries thus occur 12 times more frequently than among adults and children older than five years (Figure 2).

In the period 2013–2015, a total of 344 patients with burn injuries were admitted to the Burn Unit at Haukeland University Hospital. Altogether 114 (33%) of these patients were children < 3 years. Of these, as many as 89 (78%) had suffered scalding injuries, while 19 (17%) had sustained burns from contact with hot surfaces (Table 2).

## Discussion

Our review of patients with burn injuries admitted to all Norwegian hospitals in 2012 shows that this type of injury remains a substantial cause of hospitalisation. What is most disturbing is the fact that children under three years are admitted 12 times more frequently than children  $\geq 5$  years and adults. Many burn injuries in young children can be prevented through greater vigilance regarding hazardous situations, especially in the home: hot liquids, unsecured hot-water taps and hot surfaces (wood-burning stoves).

The retrieval of data from the Norwegian Patient Registry provides an opportunity for collating information linked to patients with multiple admissions (readmissions) or multiple stays in different hospitals for the same injury.

This study has methodological limita-



**Figure 2** Age-adjusted incidence of patients with burn injuries admitted to Norwegian hospitals in 2012. Based on data retrieved from the Norwegian Patient Registry. Information on the number of inhabitants in different age groups was retrieved from Statistics Norway [3]. \* $p < 0.05$ ; \*\* $p < 0.005$ ; \*\*\* $p < 0.0001$  for gender differences

tions: at the individual level, we only had access to information on year of birth, gender, the number of admissions and the total number of hospitalisation days. Access to more detailed information at the individual level, especially about diagnoses and coding for the external cause of injury, might have provided further opportunities for analysis without any real risk of compromising confidentiality.

A strength of this study, however, is that the source data can be assumed to be near-complete. The number of patients identified as having sustained burn injuries will nevertheless be a minimum number. To identify patients with acute burn injuries, without including patients who had burn injuries as a (more or less coincidental) secondary diagnosis, we searched for patients who had burn injuries as their main diagnosis (or with smoke inhalation injuries as their main diagnosis and burn injuries as a secondary dia-

gnosis). Thereby, we may potentially have failed to capture certain patients with burn injuries, for example if A41.0 (sepsis due to *Staphylococcus aureus*, which is a real complication) was stated as the main diagnosis and the burn injury as a secondary diagnosis. The hospitalisation periods may also be slightly underestimated, since we did not include all stays for the relatively few patients who had multiple admissions before year-end as well as early in the new year.

The total scope of burn injury treatment may also be slightly underestimated, since we may potentially have failed to capture patients who were readmitted with other complications in their course of treatment after a burn injury. Nor did the data retrieval include admissions to further rehabilitation after a burn injury, nor did we focus on those who were hospitalised to undergo reconstructive surgery as part of the treatment sequence after a burn injury.

**Table 2** Causes of injury in children < 3 years. Based on children admitted to the Burn Unit, Haukeland University Hospital, in the period 2013–15

Type of injury	Number of children	Hospitalisation time (days)	Number of operations
Scalding	89	1 315	39
Contact burns	19	248	7
Other causes (hair catching fire: 3, chemical: 1, electrical: 1, friction: 1)	6	85	9
Total	114	1 648	55

**Table 3** Hospital admissions for burn injuries in Norway over a 35-year period. Figures for 1977, 1992 and 1999 are not corrected for readmissions and patients transferred between hospitals<sup>1</sup>

Year	Patients admitted for burn injuries	Population as of 1 January (3)	Patients/100 000/year	First author (reference)
1977	793 <sup>1</sup>	4 035 202	19.7 <sup>1</sup>	NOU 1979: 41 (10)
1992	709 <sup>1</sup>	4 273 634	16.6 <sup>1</sup>	Onarheim (9)
1999	707 <sup>1</sup>	4 445 329	15.9 <sup>1</sup>	Onarheim (1)
2007	726	4 681 134	15.5	Onarheim (4)
2012	620	4 985 870	12.4	This material

In addition to our 620 patients, another 2 154 persons had contacted a hospital for burn injuries, but without being admitted (Figure 1). In other words, somewhat less than 3 000 persons with burn injuries contact Norwegian hospitals each year. In addition to these, a considerable number of minor burn injuries are treated in medical centres and local A&E clinics.

Patients with burn injuries represent a very heterogeneous group when it comes to the extent of the damaged skin surface and the depth of injury. Experience from a previous Norwegian study showed that coding for burns according to the extent of body surface involved (ICD-10; T31.0–T31.9) had been entered so rarely (in only 23%) (4) as to provide an insufficient basis for analysis of the extent of the injuries. Nor did the present material include available codes for external causes of diseases, injuries and deaths (V0n-Y98), which might have helped provide information on the causes of injury.

In each of the years 1999–2010, an average of 58 people died in fires (3). The vast majority of those who perish do so at the site of the fire. Of the 620 patients who were admitted to hospital with burn injuries in 2012, seven died (1.1%). This is a lower proportion of deaths than was found in two previous Norwegian studies (1, 4), but in line with a national study of burn injuries undertaken in England in 2010, in which the 30-day mortality of patients with such injuries amounted to 0.9% (5).

European studies show a great variation in the reported incidence of burn injuries: from two to 29 hospitalised burn victims per 100 000 inhabitants per year (6). For Norway, in this study we have found an incidence of burn injuries requiring hospitalisation equivalent to 12.4 per 100 000 inhabitants per year. Our figures match those from Sweden (for 2004): 13.1 patients with burn injuries per 100 000 inhabitants per year (7), as well as a Dutch study from 2011 reporting 8.5 patients with burn injuries per 100 000 inhabitants per year (8). In a study from England, on the other hand, Brewster and

collaborators (5) reported 24 patients with burn injuries per 100 000 inhabitants per year, but this last figure had not been corrected for readmissions.

Altogether 30% of all hospitalisation days caused by burn injuries in 2012 were associated with stays at Haukeland University Hospital. In the period 2008–2015, we noticed an increase in activity at the Burn Unit – there was a 60% increase in the number of referrals and a 60% increase in hospitalisation days (Onarheim, unpublished data). Even though the total number of burn victims or the extent of burns is not necessarily increasing, a larger proportion currently seem to be referred to specialist care units. A similar tendency was observed in the Netherlands in the period 1995–2010: a 60% increase in the number of patients treated in the three Dutch burn units, while the number of burn injuries nationwide remained constant (8).

The collation of our incidence data with figures from four earlier Norwegian studies conducted over a period of 35 years (1, 4, 9, 10) showed that the number of burn injuries in 2012 was 35% lower than in the oldest material, with data from 1977 (10) (Table 3). Because of differences in the procedure used to retrieve data and in the opportunities to correct for readmissions and transfers between hospitals, it is not possible to conclude with any certainty that we have been successful in reducing the incidence of burn injuries in 2012, judging from the number of burn victims admitted to hospital in Norway when compared to the situation twenty years earlier (9).

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#### Henning Onarheim (born 1954)

MD, PhD, specialist in anaesthesiology, senior consultant and professor II.

The author has completed the ICMJE form and declares no conflicts of interest.

#### Ragnvald Ljones Brekke (born 1977)

MD, specialist in plastic surgery and head of the Burn Centre.

The author has completed the ICMJE form and declares no conflicts of interest.

#### Anne Berit Guttormsen (born 1958)

MD, PhD, specialist in anaesthesiology, senior consultant and professor.

The author has completed the ICMJE form and declares no conflicts of interest.

#### References

1. Onarheim H, Vindenes HA. Sykehusopphold for brannskade. Tidsskr Nor Lægeforen 2004; 124: 2130–2.
2. ICD-10. Den internasjonale statistiske klassifikasjonen av sykdommer og beslektede helseproblemer. Oslo: Sosial- og helsedirektoratet, 2005.
3. Statistisk årbok 2013. Oslo: Statistisk sentralbyrå, 2013.
4. Onarheim H, Jensen SA, Rosenberg BE et al. The epidemiology of patients with burn injuries admitted to Norwegian hospitals in 2007. Burns 2009; 35: 1142–6.
5. Brewster CT, Coyle B, Varma S. Trends in hospital admissions for burns in England, 1991–2010: a descriptive population-based study. Burns 2013; 39: 1526–34.
6. Brusselaers N, Monstrey S, Vogelaers D et al. Severe burn injury in Europe: a systematic review of the incidence, etiology, morbidity, and mortality. Crit Care 2010; 14: R188.
7. Åkerlund E, Huss FRM, Sjöberg F. Burns in Sweden: an analysis of 24,538 cases during the period 1987–2004. Burns 2007; 33: 31–6.
8. Dokter J, Vloemans AF, Beerhuizen GI et al. Epidemiology and trends in severe burns in the Netherlands. Burns 2014; 40: 1406–14.
9. Onarheim H, Røttingen JT. Brannskadede innlagt i sykehus i 1992. Færre skadetilfeller og kortere liggetid også i Norge? Tidsskr Nor Lægeforen 1994; 114: 2244–6.
10. Norges offentlige utredninger. Brannskadebehandling og -beredskap i Norge. NOU 1979: 41. Oslo: Universitetsforlaget, 1979.

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