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Hospitalized burns in Finland: 36305 cases from 1980–2010

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ABSTRACT

To analyse the epidemiology of burns in Finland, a comprehensive study was conducted among all hospitalized burn patients between 1980 and 2010. All patients with burn injury as the main diagnosis, 36305 cases in total, treated in the public and private sectors, were included.

Patient data were obtained from the Finnish Hospital Discharge Register (FHDR). The incidence of hospitalized injuries declined from over 30 to 17 per 100000 persons. Men were at higher risk than women in all age groups. Children aged under ten years were overrepresented throughout the period and the highest incidence was found among one year old boys. The median total length of stay shortened from seven days in 1980–1995 to five days in 1996–2010. The annual number of hospitalized patients is recently under 1000 cases (17/100000). The male predominance (70%) did not change but the age group with the most injuries shifted from 20–39 years to 40–59 years. Injuries were most common during the summer months.

This study of all hospitalized burn injuries of one entire country shows similar tendency of diminishing numbers and rising age of burn victims as in other western countries. The FHDR is a reliable source of data in epidemiological studies but precise recording of E- and N-codes in the registry would enable the accurate analysis of types and extent of injury.

1. Introduction

Although the effects of severe burn injuries have been studied widely, the epidemiology of injuries is still inadequately analysed in many countries. Reasons for this are multifactorial, at least partly due to unstandardized health care systems and lack of centralized data collection.

The World Health Organization estimated in 2004 that 11 million people annually suffer from burns severe enough to benefit from medical attention [1]. In Europe, 4–22% of burn patients admitted to the emergency department were hospitalized for treatment [2].

In Finland, the annual numbers of hospitalized burn patients as well as changes in the incidence have not been recently investigated, although a centralized database has existed for all hospital discharges since 1969. The most recent report on all hospitalized burn patients dates back to 1980 [3]. In that study by Seljavaara et al., an estimated 0.4% of the population seeks medical care due to burn injuries in Finland

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every year. Of these patients, 10% of adults and 20% of children underwent hospitalization. The purpose of this study was to analyse changes in burn treatment during 1980–2010 in Finland.

This study contains data on all 36305 hospitalized burn patients treated in Finland between 1980 and 2010. The establishment of two burn units in Finland (Helsinki in 1988, Kuopio in 1994) provides another interesting aspect to this study regarding the organization of care.

Patient data has been collected in the Finnish Hospital Discharge Register, which has operated since 1969. During the study period the treatment of burn injuries has become more aggressive and modern burn treatment has been concentrated in burn centres. In comparing our data with that of the 2011 Summary Report of the National Burn Repository (NBR) of United States [4], some conclusions can be drawn.

2. Materials and methods

Finland, with a population of 5.5 million, is a Nordic welfare country belonging to Western Europe. Being the fifth largest country geographically in Europe, Finland has a low population density, 17.9 inhabitants per square kilometre. Most inhabitants live in the southern part of the country. The hospital network consists of five university hospitals and their catchment areas, with more than 30 central and district hospitals located in the smaller cities. Nowadays many of the central hospitals also have plastic surgeons. The number of district hospitals has been diminishing and they have traditionally been run by general surgeons. The lowest level of care is provided by about 160 health centres, many of which provide also in-patient care in the smallest towns.

An interesting feature in the Finnish culture is the strong tradition of sauna bathing. It is estimated that in certain areas every fourth burn patient admitted to hospital care has sustained the injury in the sauna (hot water/contact with stove/injury caused by hot air) [5].

The study material consisted of all patients hospitalized due to burn injuries between 1 January 1980 and 31 December 2010 in Finland. Data were derived from the Finnish Hospital Discharge Register (FHDR), which registers all hospital admissions in the country and which has been shown to be a suitable data source for studying fire-related injuries [6]. The FHDR has complete legislative coverage of all inpatient care provided by both public and private sectors in Finland. Every care period with dates of admission and discharge as well as hospital identifier codes is recorded. The register contains data on variables such as ID-code, gender, age and ICD-diagnosis codes with nature of injury (N-code) and external cause of injury (E-code).

Patients hospitalized in Finland due to burn injuries were tracked according to the ICD 8/9/10 codes. A patient was classified as a burn patient if an ICD-code for burn injury was the main diagnosis. Outpatient cases were not studied and thus excluded from the study. When building the database for this study, the differences in the ICD versions were taken into account although exact matching is not possible in all categories. Explanations of the codes and their correspondence in the three versions are described in Table 1.

The length of stay (LOS) in hospital was calculated from the date of arrival to the date of discharge. If a patient was sent for further treatment to another hospital, the LOSs were added together if the time lapse between recordings was a maximum of 2 days and if a code for burn injury remained as the main diagnosis. With this method, all primary inpatient care of the same injury was captured. Each patient was coded with the highest treatment level that the patient had received.

To avoid late reconstructions being considered as new burn injuries, only one acute hospitalization period per patient was included in the study. With this method, admissions after the acute phase were not coded as new injuries. Although no data exist, repeated burn injuries may occur, but are very rare in our clinical experience and would not significantly affect the results.

The recording of E-codes in the FHDR has been incomplete [6]. On the basis of the current registry, analysis of the mechanism and severity of injury would be unreliable due to missing E-code values. This section was therefore left unanalysed.

The annual numbers of inhabitants were provided by Statistics Finland, the Finnish public authority specifically established for statistics. The population rose from 4787778 (1980) to 5375276 (2010) inhabitants.

For analyses, the time period of this study was divided into two parts: 1980–1995 and 1996–2010. The earlier period represents a time when burn care was more conservative than today and centralization of treatment was just beginning. During the later period both burn units in Finland were working with modern methods.

Table 1 – Classification of burn injury according to ICD 8/9/10.

Site of injury	ICD 8	ICD 9	ICD 10
Eye/periorbital area	940	940	T26
Head/neck	941	941	T20
Trunk	942	942	T21
Shoulder/brachium/antebrachium, except wrist	943	943	T22
Wrist/hand	944	944	T23
Lower extremity, except ankle/foot	945	945	T24
Ankle/foot	945	945	T25
Multiple areas/unspecified	946-949	946	T29-T32
Internal organs		947	
Respiratory tract/other internal organs			T27–T28
Other unspecified burn injury	949		

To analyse the trends in the epidemiology of the burn injuries after 2010, the annual numbers of patients were collected from Finjury, a register that collects data from FHDR. However, Finjury has no personal identification and therefore same hospital stay can be calculated twice if it continues over a turn of a year. Still, the years are comparable with each other and analysing trends is possible.

3. Results

The total number of patients was 36305, with 10840 females (29.9%) and 25465 males (70.1%). The proportion of male patients remained virtually the same (71% in 1980–1995 and 69% in 1996–2010). The incidence of hospitalized patients diminished from over 30 per 100000 in the early 1980s to about 17 per 100000 inhabitants at the end of the study. The incidence of female patients diminished from 18 to 10 and male patients from almost 50 to 24 per 100000 inhabitants (Fig. 1). During the study period, the total annual number of patients gradually diminished from almost 1600 to under 1000.

The highest incidence was found among one year old children (Fig. 2). Between 1980–1995, the incidence of one year old boys was 251 and during the later period 192/100000. The incidence among one year old girls was 132 and 120/100000, respectively.

Children aged less than ten years were overrepresented throughout the study period (Table 2, Fig. 3). Of all hospitalized burn patients, 25% in 1980–1995 and 22% in 1996–2010 represented the age group 0–9 years.

The median LOS was seven days in 1980–1995 and five days in 1996–2010. The mean LOS decreased from 14 to 12.4 days.

The incidence of hospitalized injuries was highest during the warm summer months, peaking in June at 11%. The incidence was lowest during the cold season (November–April) (Fig. 4).

The proportion of patients treated in university hospitals or burn units increased from 31% to 42% (Fig. 5). Annually the mean number of patients increased by 4%. The mean number of patients treated in central hospitals, district hospitals and health centres decreased by 19%, 43% and 56%, respectively.

The anatomical sites of injuries remained the same. Burns in the upper extremity and in the head and neck area were the most common main diagnoses. The proportion of upper extremity injuries was 22% in 1980–1995 and 24% in 1996–2010. The corresponding proportions of head and neck injuries were 22% and 19%, respectively.

In every age group the incidence was higher during the earlier part of the study (Fig. 3). A relatively high incidence was found during 1980–1995 among age group 20–29 but not during the later period. The growing age is associated with higher incidence of the injuries. The incidence started to rise after the age of 70, although the patient numbers are small. Due to shape of the population pyramid, the two most common adult age groups were 20–29 and 30–39 years (1980–1995) and 40–49 and 50–59 years (1996–2010). The reduction in the number of patients was highest among patients aged less than 40 years. By contrast, in the older age groups, the changes were smaller or the number of patients even increased.

According to Finjury database, no specific changes in incidence has occured after the study period between 2011–2015 (Fig. 6). The incidence is at it's highest among 0–4 year old children, males are at higher risk in all age groups than females and growing age is associated with higher incidence.

4. Discussion

The incidence of all hospitalized burn injuries in Finland from 1980 to 2010 decreased in all age groups. When comparing the years 1980 and 2010, the incidence declined by 46%, from 31.7 to 17.0 per 100000 persons. The incidence in Finland in 2010 (about 17/100000/year) is comparable with the incidence in our Western neighbours of Sweden (15.6/100000/year in 1987–2004) and Norway (15.5/100000/year in 2007) [7,8]. The highest incidence can be found in age group 0–4 years, especially among one year old boys. Although years 2011–2015 were not analysed as precisely as earlier years, the Finjury data suggests the epidemiology is similar during ongoing decade.

The male predominance (70%) was similar to that reported in an earlier Finnish study and from other Western countries (US 70%, Sweden 69%, Norway 65%, Canada 71%, Lithuania 67%) [4,7,8–10]. Male predominance and increasing median age were observed in another Finnish survey from the Kuopio Burn Unit, Eastern Finland, from 1994–2006, but this study did not include all burns in the country [5]. Over the three decades studied here, the adult age group with the highest number of burn injuries shifted from 20–39 years to 40–59 years. This finding can be explained by the increasing mean age of the

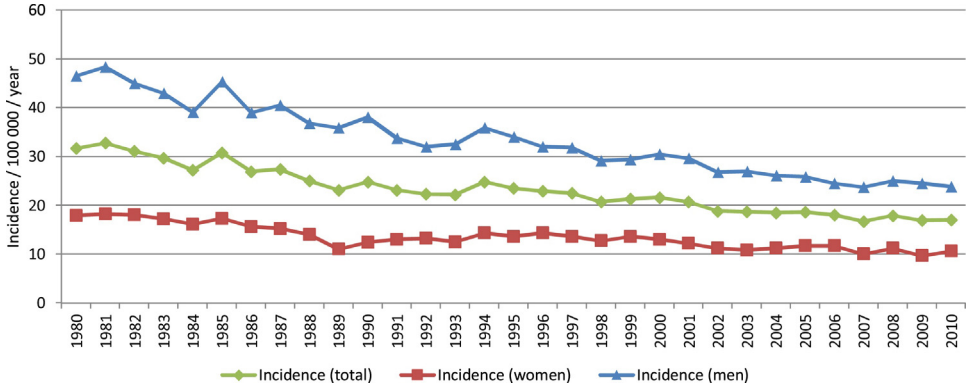

Fig. 1 – Annual incidence per 100000 inhabitants/year.

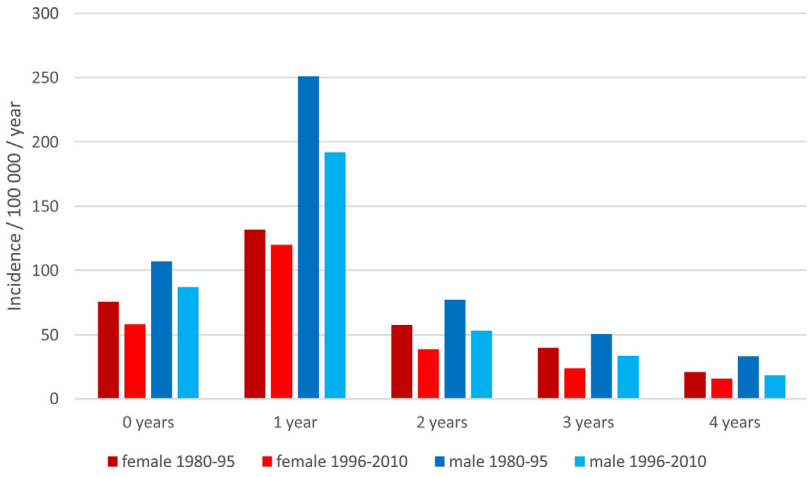

Fig. 2 – Burn incidence/100000/year of 0–4year old children.

Table 2 – Age distribution in 1980–1995 and 1996–2010.

	1980–1995		1996–2010		
Age (years)	Mean annual number of patients		Mean annual number of patients		Change between time periods
0-9	328	25%	227	22%	−31%
10-19	138	10%	91	9.0%	−34%
20-29	194	15%	106	10%	−45%
30-39	171	13%	99	9.7%	−42%
40-49	155	12%	133	13%	−14%
50-59	115	8.7%	132	13%	+15%
60-69	87	6.6%	88	8.6%	+1.1%
70-79	86	6.5%	82	8.1%	−4.7%
80-89	41	3.0%	50	4.9%	+22%
90-	3.4	0.26%	6.5	0.64%	+91%
Total	100%		100%		

Finnish population and high birth rate in the 1940s. Secondly, the incidence among 20-29 years old citizens decreased more than among the other adult age groups.

The LOS shortened from a median of 7 to 5 days, or from a mean of 14 to 12.4 days, and this reduction is in line with the trends reported from other developed countries USA [4],

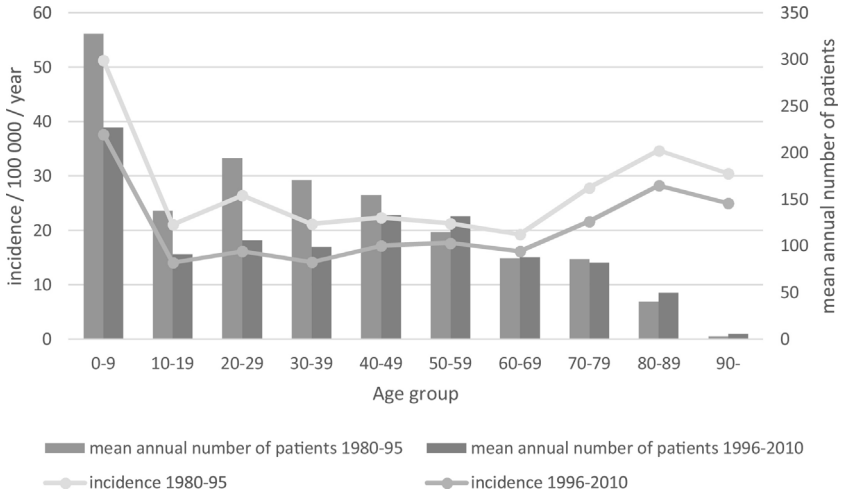

Fig. 3 – Incidence/100000/year and mean annual number of patients according to age.

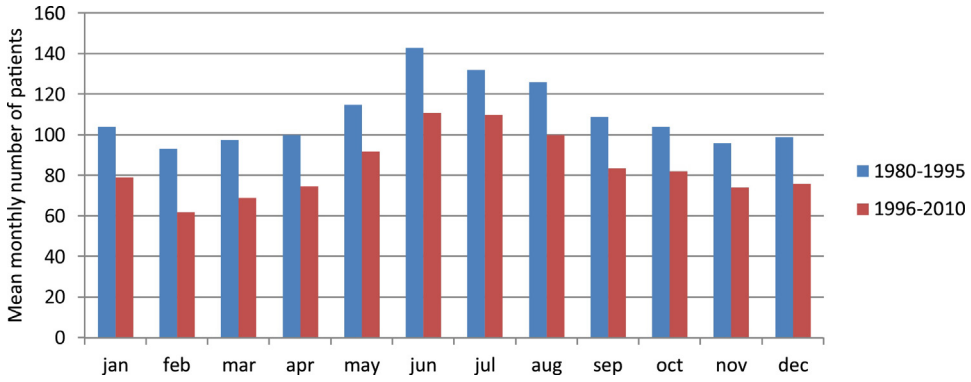

Fig. 4 – Mean monthly number of patients.

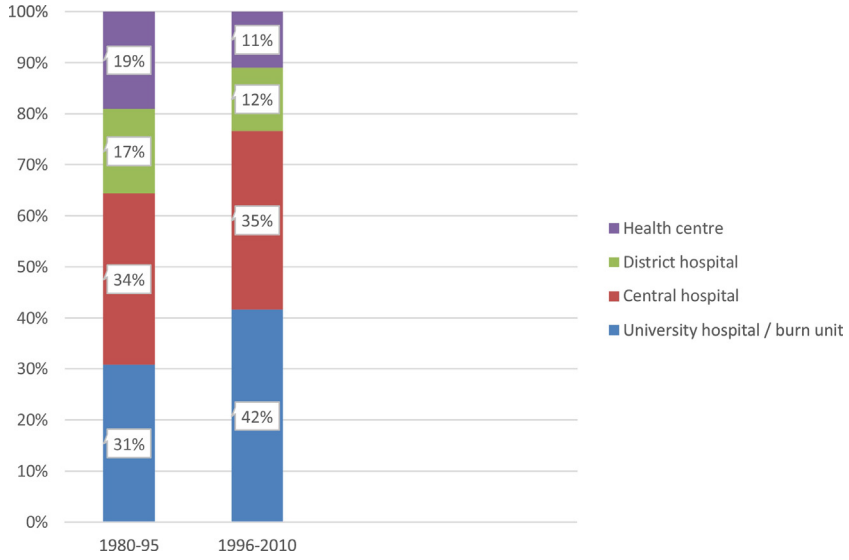

Fig. 5 – Proportion of patients treated in each level.

Australia [11] and Germany [12]. In a Swedish population [7], the median LOS was 3 days (mean 10.6). In Norway, the mean total period of hospitalization in 2007 was 11.3 days [8]. In the US, the mean LOS declined from 11 to 7 days during 2001–2010 [4]. However, the US health care system is different and the numbers are not provided on a regional basis because all hospitals in a given region do not participate in the national registry (NTRACS). Therefore, the numbers are not directly

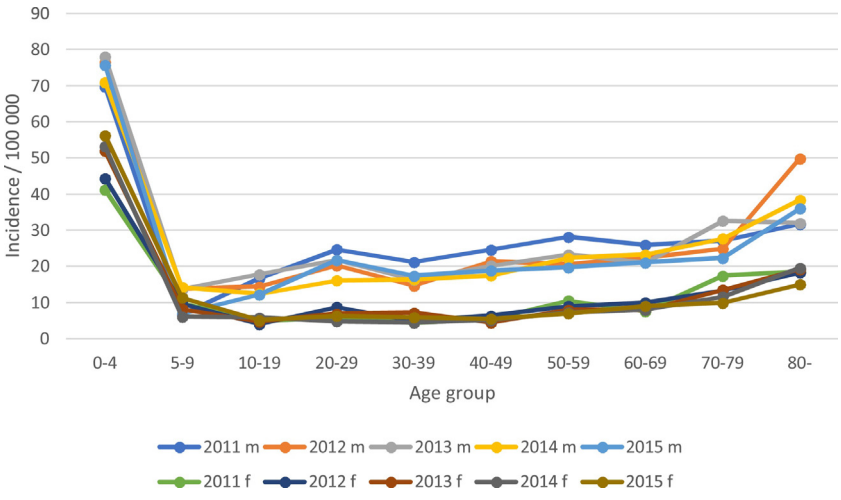

Fig. 6 – Incidence/100000 between 2011–2015 among females and males.

comparable, nor are they comparable between the Nordic countries since we do not necessarily know the %TBSA or depth of the burns. Furthermore, there are differences between the studies with respect to calculating the LOS in the changes of clinics and whether to include all admitted patients or only those hospitalized for a burn injury.

The declining incidence of hospitalized burn injuries is likely due to the diminishing number of severe injuries and an increase in outpatient care. A common trend is to treat patients on an outpatient basis when possible. The number of people living in rural areas has diminished substantially in recent years [13]. There may be factors in the rural lifestyle that contribute to higher incidence of burns such as easier access for children to flammable materials or looser control of daily activities. Also, when less people live in rural areas with long distances, outpatient care has become easier to organize. We believe that safety regulations in workplaces and citizens' awareness of dangers through education have had an effect on the positive trend.

New treatment techniques and materials have also shortened the need for hospital stay. In borderline cases, instead of hospitalization, the modern wound care materials have made outpatient care possible. Daily dressing changes are not needed as often as before. Acticoat®, the first silver-containing dressing in common use in Finland, was introduced in 1998. Mepilex Ag® was launched in 2007. Suprathel®, a polylactic acid-based copolymer membrane, has been marketed and used since 2004, especially for treatment of dermal burns of children. The two latter products have shortened the hospital care of children in scald injuries by enabling fewer dressing changes and faster discharge. However, this is not the only contributing factor since when analysing the decline in the incidence of treated patients, the change has been gradual and no sharp drop due to the above-mentioned products is apparent.

In Finland during 2000–2009, the annual incidence of especially fire-related injuries with inpatient care was 5.6 per 100 000 persons i.e. less than every third hospitalized burn was caused by fire. The reason for this and relatively high incidence of fire-related deaths (>2/100 000) is not entirely clear [14]. The corresponding figure in Sweden is 1.20, in Norway 1.33, in Denmark 1.28 and in USA 1.21 [4,7,8,15]. Alcohol-prone middle-aged and elderly people living alone are at the highest risk [14]. The exact effect of preventive measures at the national level is unclear. A smoke alarm has been obligatory in every apartment in Finland since 1 September 2000. Since the beginning of the year 2010, it has been mandatory to have at least one smoke alarm on every floor and for every 60 square metres. Consequently, the number of severe burns originating in bedrooms and in detached houses has decreased [16]. Another measure was to forbid the selling of "normal" cigarettes. According to the legislation, cigarettes sold in Finland must be of the self-extinguishing type since 1 April 2010 [16]. The number of fire-related deaths recorded in 2010–2012 (mean 76) decreased by one quarter compared to years 2007–2009 (mean 100), but this was partially temporary, and only a minor drop in the number of fire-related deaths is observed today (82 deaths in 2016) [16,17]. The reason for this has not been investigated, but most probably these injuries are connected to the abuse of alcohol and drugs and lack of compliance with fire regulations. Non-self-extinguishing cigarettes can be acquired in the neighboring countries very cheaply, and together, these factors and the wide use of wood ovens for heating have diminished the effect of these measures.

The increase in the proportion of patients treated at the highest level was 35%. If the trend continues, in the near future half of the patients will be treated in the national Burn Centre or university hospitals. The increased number of plastic surgeons in central hospitals since the 1990s has helped them to maintain their relative proportion to patients. The number of district hospitals has decreased, and in the ones remaining modern burn treatment skills are lacking. The number of patients has been diminishing as expected.

The incidence of hospitalized burn injuries has been low during wintertime, although especially during the earlier part of the study period it was common to heat houses with wood in the countryside. The higher incidence in the summertime may be due to activities at summer cottages (489 200 in Finland in 2010) [18], especially sauna bathing, which is often associated with alcohol consumption. According to the data from the Kuopio Burn Unit, Eastern Finland, every fourth burn was sauna-related in their catchment area [5]. However, also in Canada and in the Netherlands hospital admission rates were highest in the summer months [9,19]. In North Carolina, patients had the largest burns both during summer and winter [20].

Overall, the completeness of data in the FHDR has proven to be very good [21]. The health care system in Finland is for the most part state-run and data collection applies to all health care institutions (including the private sector). Practically all inpatient discharges can be found in the registry. However, collection of data on e.g. mechanism of injury is not as structured or complete as in the hospitals contributing to the NBR report [4]. If the proportion of E-codes reported in the FHDR was higher, the mechanisms of injury could be analysed thoroughly. Furthermore, based on our clinical experience, emphasis should be placed on choosing the correct ICD-code for each patient, a task that is easily neglected in the continuously increasing amount of daily paperwork.

5. Conclusions

The incidence of hospitalized burn injuries has decreased in Finland over the last three decades almost 50%, from about 32 to about 17/100 000 inhabitants. At the same time, the mean and median LOS have shortened. The male dominance of burn patients has remained. The incidence is highest in children and especially one year old boys are at high risk. Among adult patients, the age group with the most injuries shifted from 20–39 years to 40–59 years. The role of burn centres and university hospitals has become increasingly important, and the goal of centralizing the treatment of severely injured burn patients has taken some large steps forward.

Although the Finnish Hospital Discharge Register is a good tool for analysing the number of treated patients and their diagnoses, it has some weaknesses, especially when the types of injuries or E-codes are considered. An evaluation of

outpatient care would complete the statistics of burn injuries in Finland, statistics that have only been available since 2011.

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Conflicts of interest

None.

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