

Demographics and Dynamics of Burn Surgeries: A Comprehensive Five-Year Review

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ABSTRACT

Objective: To evaluate the epidemiology and outcomes of surgical interventions for burn patients at a major tertiary care center in Karachi, Pakistan, to identify trends, demographic patterns, and clinical practices in burn management.

Methodology: The study was conducted at the Burn Center of Dr. Ruth K.M. Pfau Civil Hospital Karachi from January 2019 to December 2023. Data from 13,803 surgical procedures performed over five years were analyzed to assess procedural trends, patient demographics, and treatment outcomes.

Results: A total of 13,803 procedures were performed over five years, demonstrating a general upward trend in surgical activity. The most common procedures included Change of Dressing (29.1–40.2%), Debridement (34.3–43.7%), and Split Skin Grafts (up to 15.5%). Specialized procedures like Release of Contracture and Flap Coverage increased significantly, reflecting evolving clinical practices. Gender analysis revealed higher rates of complex surgeries in males, while females underwent more wound care procedures.

The findings highlight key demographic patterns, with young adults (18–30 years) and children being the most affected groups. Seasonal trends and annual variations in procedural volume were also observed. Compared to high-income countries, the Karachi Burn Center focuses on cost-effective wound management, emphasizing early interventions to mitigate complications like amputations and contractures.

Conclusion: The findings highlight key patterns in burn care within a resource-limited setting, providing valuable insights for improving clinical protocols and resource allocation. Further research is needed to enhance burn epidemiology data and expand access to specialized surgical care in Pakistan.

Keywords: Burns, Epidemiology, Outcomes, Surgery, Treatment

Authors' Contribution:

^{1,2}Conception; Literature research; manuscript design and drafting; ^{3,4}Critical analysis and manuscript review; ^{1,4}Data analysis; Manuscript Editing.

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Introduction

Each year more than 300,000 people die from fire-related burn injuries 95% of fire-related burn deaths occur in low- and middle-income countries (LMICs).¹ Burns are the fourth leading cause of injury following road traffic injuries, falls, and interpersonal violence, accounting for 5 - 12% of all injuries worldwide and around 11 million patients requiring medical attention.² As defined by the International Society of

Burn Injuries, a burn is an injury to the skin or other organic tissue primarily caused by thermal or other acute trauma.³ A burn occurs when some or all of the cells in the skin or other tissues are destroyed by hot liquids (scalds), hot solids (contact burns), or flames (flame burns). Injuries to the skin or other organic tissues due to radiation, radioactivity, electricity, friction, or contact with chemicals are also identified as burns.⁴

Globally in 2004, the incidence of burns severe enough to require medical attention was nearly 11 million people and fourth in all injuries, behind road traffic accidents, falls, and interpersonal violence—this is higher than the combined incidence of tuberculosis and HIV infections, and just slightly less than the incidence of all malignant neoplasms.⁵ Burns under 20% TBSA occur in 153 per 100,000 population of children aged 0–15 years, making them the fifth most common cause of non-fatal childhood injuries after intracranial injury, open wounds, poisoning, and forearm fractures.⁶

Globally, fire-related burns are responsible for about 265,000 deaths annually.⁷ Over 90% of fatal fire-related burns occur in developing or low- and middle-income countries (LMICs) with South-East Asia alone accounting for over half of these fire-related deaths.⁸ Like other injury mechanisms, the prevention of burns requires adequate knowledge of the epidemiological characteristics and associated risk factors. However, while much has been accomplished in the areas of primary and secondary prevention of fires and burns in many developed or high-income countries (HICs) such as the United States due to sustained research on the epidemiology and risk factors, the same cannot be said of many LMICs.⁹

Burn injury is an important yet under-researched area in Pakistan. The Global Burden of Disease 2010 study estimates that the age-standardized mortality rate for injury caused by fire, heat, and hot substances is 5.8 per 100,000 populations in Pakistan.¹⁰ A burn facility-based study from Karachi estimated burn-associated mortality rate among adults between 15 - 55 years to be even higher at 10.2 per 100,000 populations.¹¹ Existing data make it difficult to estimate the true burden of burn injuries on the general population and little is known about the epidemiology of burn injury in the population that does not present to specialized burn centers. This is an important knowledge gap as specialized burn centers are not accessible to a large portion of the Pakistani population. Emergency

departments (EDs) are a logical first point of contact for the care of burn injury patients.¹²

According to the World Health Organization, burn injuries account for 180,000 deaths annually, with the majority of such injuries occurring in low- and middle-income countries. In Pakistan, there is a shortage of burn rehabilitation centers. Civil Hospital Karachi is the only hospital in the Sindh province that has a burns center, catering to patients from all parts of the province.¹³

The aim of this study is to determine the epidemiology and outcomes of burns patients presented in the burns OT at Dr. Ruth K.M. Pfau Civil Hospital Karachi.

Methodology

This was a cross-sectional study conducted over 4.5 years, from January 1, 2019, to December 31, 2023, in the Department of Burns at Dr. Ruth K.M. Pfau Civil Hospital Karachi. The study aimed to evaluate the surgical interventions performed on burn patients during this period, using a retrospective review of hospital records. The cross-sectional design was chosen to provide an overview of all surgical procedures conducted during the specified timeframe, highlighting trends and outcomes.

The study population included all patients who underwent surgical procedures in the burns operation theater. No restrictions were placed on age, gender, type of burn injury, or extent of damage. Both elective and emergency procedures were included, regardless of whether they were performed under general, local anesthesia, or without anesthesia in emergency cases. However, patients who refused surgical treatment were excluded from the study.

Census sampling was applied, as all eligible cases from the records were included in the analysis. Data was collected from hospital records, including the operation theater logs, outpatient department records, and the Burns Unit database. Trained data collectors extracted information on the type of

procedure, anesthesia used, and urgency (elective vs. emergency). The primary variable was the type of surgery, while secondary variables included the anesthesia type and urgency of the procedure.

The data collection and analysis were completed over a defined period, with regular audits to ensure accuracy. Data collectors were trained, and a portion of the data was double-checked for consistency. No external funding was used for this study; institutional support was provided by Dr. Ruth K.M. Pfau Civil Hospital Karachi.

Ethical approval was obtained from the institutional review board of Dr. Ruth K.M. Pfau Civil Hospital Karachi (NO.MS/CHK/P-III/5896) Dated 09-07-2025. Since this was a retrospective study, patient consent was not required, but confidentiality was maintained by anonymizing the data. Data analysis was performed using SPSS version 25, applying descriptive statistics to summarize the frequency and distribution of surgical procedures. Chi-square tests were used to evaluate associations between categorical variables, with statistical significance set at $p < 0.05$.

Results

Over the five-year period from January 2019 to December 2023, the audit of the Burn Operating Theatre (OT) revealed significant trends in surgical activity. A total of 13,803 procedures were completed during this time, with annual fluctuations and a general upward trend in the number of surgeries performed. In 2019, 2,648 procedures were conducted, accounting for 20.6% of the total workload (Figure 1). This number decreased to 2,265 procedures in 2020, representing 17.69% of the workload. However, despite this decline, the overall volume remained substantial. In 2021, there was a slight rebound in the number of procedures, reaching 2,381, or 18.59% of the workload. The upward trajectory continued into 2022, with 2,616 procedures performed (20.43% of the total). By 2023, the highest number of procedures was

recorded, totaling 2,893, which constituted 22.59% of the overall workload. These annual variations could be influenced by multiple factors, such as resource availability, patient admissions, and seasonal demand for burn care (Figure 1).

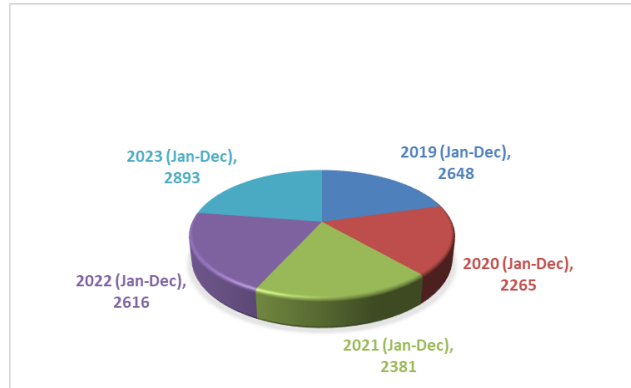


Figure 1. Total no of procedures performed in burns OT (Jan 2019-Dec 2023)

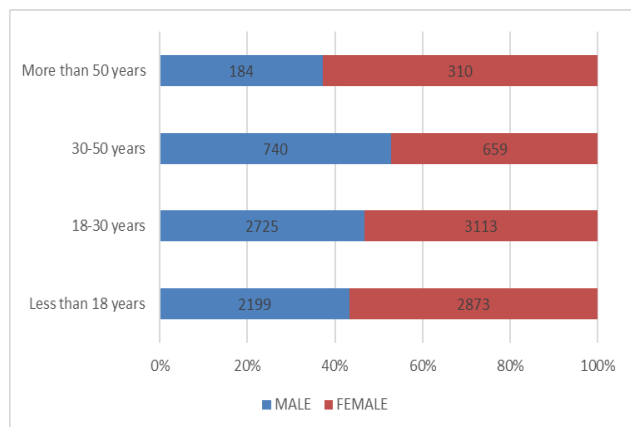


Figure 2. Age distribution according to gender

Monthly analysis revealed peaks in procedural activity during specific periods, particularly in January, March, July, September, October, and December across the years 2019, 2022, and 2023. In these months, procedure volumes ranged from 200 to 326, potentially reflecting seasonal trends or shifts in burn injury incidence. Conversely, in 2020 and 2021, certain months like February, April, May, and June saw lower procedure counts, ranging from 47 to 281, likely due to external factors such as holidays or lower hospital admissions.

Name of Procedure	2019 (Jan-Dec)	2020 (Jan-Dec)	2021 (Jan-Dec)	2022 (Jan-Dec)	2023 (Jan-Dec)
Split Skin Graft (Ssg)	348 (13.14%)	196 (8.56%)	262 (10.96%)	339 (13.5%)	447 (15.45%)
Change Of Dressing (Cod)	994 (37.54%)	838 (37.0%)	971 (40.23%)	945 (37.8%)	843 (29.1%)
Debridement (D/B)	909 (34.33%)	990 (43.7%)	960 (40.17%)	861 (34.5%)	1079 (37.30%)
Full-Thickness Skin Graft (Ftsg)	28 (1.06%)	10 (0.44%)	20 (0.8%)	22 (0.88%)	9 (0.3%)
Below Elbow Amputations (Bea)	32 (1.21%)	17 (0.75%)	6 (0.25%)	22 (0.885)	46 (1.59%)
Above Elbow Amputations (Aea)	43 (1.62%)	29 (1.28%)	19 (0.79%)	37 (1.48%)	34 (0.86%)
Above Knee Amputations (Aka)	41 (1.55%)	21 (0.93%)	13 (0.54%)	31 (1.24%)	25 (1.18%)
Below Knee Amputations (Bka)	31 (1.17%)	16 (0.71%)	9 (0.38%)	24 (0.96%)	19 (0.86%)
Release Of Contracture (Roc)	38 (1.44%)	30 (1.32%)	29 (1.21%)	84 (3.37%)	92 (3.18%)
Disarticulation	41 (1.55%)	16 (0.71%)	51 (2.13%)	18 (0.72%)	23 (0.80%)
Esharotomy	1 (0.04%)	1 (0.04%)	4 (0.17%)	5 (0.20%)	20 (0.69%)
Fasciotomy	20 (0.76%)	14 (0.62%)	0	7 (0.28%)	13 (0.45%)
Closure Of Stump	105 (3.97%)	68 (3.00%)	17 (0.71%)	64 (2.56%)	130 (4.49%)
Removal Of Foreign Body	1 (0.04%)	0	0	0	4 (0.14%)
Flap Coverage	16 (0.60%)	19 (0.84%)	29 (1.21%)	37 (1.48%)	109 (3.7%)

	Less than 18 Years	18-30 Years	30-50 Years	More than 50 Years
Split Skin Graft (Ssg)	628	700	196	68
Change of Dressing (Cod)	1821	2074	513	167
Debridement (D/B)	2002	2304	504	196
Full-Thickness Skin Graft (Ftsg)	19	37	12	1
Below Elbow Amputations (Bea)	45	57	18	3
Above Elbow Amputations (Aea)	62	81	15	7
Above Knee Amputations (Aka)	52	63	12	4
Below Knee Amputations (Bka)	41	51	10	1
Release Of Contracture (Roc)	122	141	24	16
Disarticulation	39	52	13	3
Esharotomy	5	3	12	2
Fasciotomy	25	25	2	2
Closure Of Stump	136	173	44	15
Removal Of Foreign Body	5	0	0	0
Flap Coverage	70	77	24	9

The most commonly performed procedures included Change of Dressing (COD), Debridement (D/B), and Split Skin Grafts (SSG). COD accounted for a large share, ranging from 29.1% in 2023 to 40.23%

in 2021, while D/B procedures represented between 34.33% and 43.7% of the annual workload (Table 1). SSG percentages varied, peaking at 15.45% in 2023. These high-frequency procedures indicate a focus on

wound care and grafting in burn treatment. Amputation rates exhibited variability over time. Below Elbow Amputations (BEA) ranged from 0.25% in 2021 to 1.59% in 2023, while Above Elbow Amputations (AEA) showed a range from 0.79% in 2021 to 1.62% in 2019 (Table 1). A similar trend was observed with Below Knee Amputations (BKA) and Above Knee Amputations (AKA), though these accounted for smaller percentages.

Notably, there was an increase in specialized procedures over time. For example, Release of Contracture (ROC) grew from 1.44% in 2019 to 3.18% in 2023, and Flap Coverage surgeries rose from 0.60% in 2019 to 3.7% in 2023 (Table I). Closure of Stump procedures showed variability, with 0.71% in 2021 and a substantial increase to 4.49% in 2023. This variation suggests changes in patient case mix or evolving clinical practices. Escharotomies, though relatively rare, increased in frequency during the period.

Analysis of patient demographics revealed that the majority of SSG procedures were performed on individuals aged 18–30 years (700 patients), followed closely by those under 18 years (628 patients) (Table 2). COD and D/B were the most frequently performed procedures across all age groups, with notable concentrations among patients under 18 (2,002 COD and 1,821 D/B procedures) and those aged 18–30 (2,304 COD and 2,074 D/B procedures). Amputations and more complex reconstructive procedures, such as ROC and Flap Coverage, were seen across all age groups, with a slight predilection for younger adults.

Gender analysis revealed that females underwent more COD and D/B procedures than males, with 2,559 and 2,876 procedures, respectively, compared to 2,016 and 2,130 for males. The distribution of SSG procedures was fairly balanced, with 811 performed on males and 781 on females (Figure 2). Interestingly, males were more likely to undergo Full-Thickness Skin Grafts (FTSG), with 60 male cases compared to only 9 female cases. In terms of amputations, males were more frequently subjected

to BEA, AEA, and AKA procedures than females. However, females had higher rates of ROC and Flap Coverage procedures, further suggesting gender-specific treatment patterns in burn care (Table. III)

Table III. Detail of Each Procedure Performed in OT Burns Patient According to Gender		
	Male	Female
Split Skin Graft (Ssg)	811	781
Change of Dressing (Cod)	2016	2559
Debridement (D/B)	2130	2876
Full-Thickness Skin Graft (Ftsg)	60	9
Below Elbow Amputations (Bea)	69	54
Above Elbow Amputations (Aea)	104	61
Above Knee Amputations (Aka)	90	41
Below Knee Amputations (Bka)	57	46
Release of Contracture (Roc)	110	193
Disarticulation	57	50
Esharotomy	8	14
Fasciotomy	17	37
Closure of Stump	241	127
Removal of Foreign Body	2	3
Flap Coverage	76	104

Discussion

This comprehensive audit of the Burn Center at Dr. Ruth K.M. Pfau Civil Hospital Karachi, covering the period from January 2019 to December 2023, provides a detailed analysis of procedural patterns and demographic trends in burn-related surgeries. The findings offer valuable insights into the trends and dynamics of burn care, serving as a critical resource for optimizing clinical decision-making, resource allocation, and the development of tailored burn care protocols. A comparison of burn care data from North America and Dr. Ruth K.M. Pfau Civil Hospital Karachi highlights key differences in patient demographics and treatment focus. In North

America, most burn centers treat 501–1,000 patients annually, with 74.55% being adults and 25.45% children, and a near-equal gender distribution. The average ICU stay for major burn cases is 8–10 days.¹⁴ In Karachi, there are a higher proportion of young adults (47.6%) and children (40.3%), with a majority of patients being female (54%). Males are more likely to undergo complex procedures, such as amputations. While North American burn centers emphasize ICU care for severe burns, the Karachi center focuses on cost-effective wound management and early interventions to reduce complications like amputations and contractures in a younger patient population.

In northern Iran, 91.41% of burn patients received a single skin graft, with 60.14% having grafts smaller than 10%, an average graft-to-burn ratio of 0.75, and a 4.12% mortality rate due to early grafting. At Dr. Ruth K.M. Pfau Civil Hospital Karachi, Split Skin Grafts (SSG) was similarly common, but the focus was on infection control, debridement, and follow-up care to reduce complications. While Karachi's data lacks specifics on graft size and mortality rates, its proactive post-surgical care likely aims to mitigate the complications seen in the Iranian context.¹⁵

In 2019, there were approximately 8,378,122 new burn cases globally, nearly evenly split between men and women, with the highest incidence in the 10–19 age group. Burns led to 111,292 deaths, predominantly in children aged 1–4 years. The overall burden of burns, measured in Disability-Adjusted Life Years (DALYs), was 7,460,448.65, with 67% attributed to Years of Life Lost (YLLs) and 33% to Years Lived with Disability (YLDs). The data indicated a decreasing trend in the incidence, DALYs, and deaths across most regions, negatively correlated with Socio-Demographic Index (SDI) levels, universal health coverage (UHC), and gross domestic product (GDP).¹⁶ In comparison, at Dr. Ruth K.M. Pfau Civil Hospital Karachi, the focus has been on managing burn injuries, particularly among younger patients. The data indicate that a significant

proportion of burn patients fall within the pediatric and young adult demographics, with a noteworthy incidence of burns in those under 18 years.

In the study by Dorothy Bbaale et al., a questionnaire on skin grafting practices in burn treatment was completed by 84 centers across 22 African countries, predominantly from those with low Human Development Index (HDI) scores (87.7%). Split thickness skin grafting (STSG) was performed in 63% of centers, with 72.8% noting reduced hospital stays and 54.3% reporting improved scarring. However, risks like donor site infections (8.6%) and severe bleeding (7.4%) were also mentioned, alongside barriers such as inadequate equipment and training.¹⁷ Both studies reveal challenges in effective skin grafting in resource-limited settings, but Karachi's emphasis on continuous training and improved facilities may lead to fewer complications compared to those faced in the African context. This comparison highlights the importance of targeted interventions to enhance burn treatment practices in both regions. One of the most notable findings is the variability in the number of surgical cases performed annually. While there was a peak in 2019 with 2,648 cases, the following years saw fluctuating numbers, ultimately reaching 2,893 by 2023. This variation may be linked to multiple factors such as shifts in burn injury rates, advancements in non-surgical treatments, and external influences like healthcare access changes or broader socio-economic conditions. For example, the impact of the COVID-19 pandemic could have contributed to fluctuations in hospital admissions and surgical volumes during 2020 and 2021. Understanding these fluctuations could help optimize resource planning, improve patient flow, and enhance response strategies in burn centers. The analysis of specific surgical procedures reveals important shifts in the approach to burn care over the years. In 2019, Split Skin Grafts (SSG) was the dominant procedure, reflecting the focus on wound closure and grafting. However, the years that followed saw a rise in complex surgeries, such as amputations, particularly

in 2021, where flap coverage became more prominent. This shift suggests a growing emphasis on functional and aesthetic outcomes as well as the management of more severe burns requiring reconstruction. Additionally, the rise in contracture release procedures from 2022 to 2023 highlights the increasing importance of addressing long-term functional impairments in burn survivors, further emphasizing the need for a comprehensive approach to post-burn rehabilitation and care.

Yong Zhang's study in Suzhou, China, included 3,258 adult burn patients, with 64.3% male and the largest age group being 30–59 years (63.04%). Scalds (41.31%) and flames (39.01%) were the leading causes of burns, with 54.97% classified as moderate burns. The study reported a low morbidity rate (0.68%) and highlighted that mortality was linked to age, burn etiology, and total body surface area.¹⁸ In contrast, Dr. Ruth K.M. Pfau Civil Hospital Karachi reported that 47.6% of burn patients are young adults aged 18–30, while 40.3% are children under 18. This highlights a critical need for specialized pediatric care and targeted prevention efforts for young adults, emphasizing the different demographic challenges faced by both centers. While Zhang's study focuses on adult burn injuries, Karachi's data underscores the vulnerability of younger populations, suggesting tailored interventions for both age groups.

Gender-specific patterns were also identified, with females accounting for a larger portion of burn patients (54%). Interestingly, while males were more likely to undergo above-elbow and above-knee amputations, contracture release procedures were more common among female patients. These differences could be influenced by varying burn mechanisms, injury severity, and care-seeking behaviors across genders. For instance, males might be more exposed to severe, traumatic burns, while females may face different recovery challenges that lead to higher rates of contracture formation. Addressing these gender-specific patterns can improve the effectiveness of treatment strategies

and enhance patient outcomes, particularly by tailoring interventions to the specific needs and recovery paths of men and women.

From a clinical standpoint, these findings have several implications for the Burn Center at Dr. Ruth K.M. Pfau Civil Hospital Karachi. The fluctuating surgical workload suggests the need for ongoing evaluation of resource allocation, staffing, and burn prevention strategies. By conducting regular assessments, the center can ensure it adapts to evolving patient needs and varying case volumes effectively.

The changing trends in surgical procedures highlight the importance of maintaining a dynamic, evidence-based approach to burn care. As surgical techniques evolve and patient profiles shift, it is essential for clinicians to remain up-to-date on best practices in wound management, grafting, and contracture release. The high frequency of amputations, particularly among younger patients, further emphasizes the need for early rehabilitation and psychological support services to facilitate better long-term outcomes. Rehabilitation should not only focus on physical recovery but also on the emotional and social well-being of patients, as burns often have profound psychological impacts. Finally, the gender-specific differences in surgical outcomes underline the importance of customized patient education and support initiatives. By understanding the factors that contribute to these disparities, the Burn Center can develop more personalized care plans, addressing the unique challenges faced by male and female burn patients. This approach will ultimately lead to improved satisfaction and better long-term recovery for burn survivors.

Conclusion

In conclusion, the findings of this audit underscore the importance of a patient-centered and adaptive approach to burn care. The trends in surgical procedures, demographic shifts, and gender-specific differences offer valuable insights that will help

shape future clinical strategies, resource planning, and prevention efforts at the Burn Center. By embracing these insights, the center can continue to meet the evolving needs of burn patients, ensuring high-quality care and optimal outcomes for all.

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