Citation Classics in the Burn Literature During the Past 55 Years

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The objective of this study was to identify the 100 most cited, peer-reviewed burn-related articles over the past half century. Burn care presents ongoing challenges to both U.S. civilian and military healthcare personnel. Improvements in burn survival and quality of life are the result of advances in burn research. The Web of Science (including Science Citation Index) was searched for the most cited articles related to burn care, published from 1955 to the present. The most cited article was "Permanent coverage of large burn wounds with autologous cultured human epithelium," by G.G. Gallico et al, *New England Journal of Medicine*, 1984 (711 citations). Between the 1970s and the 1990s, there was a near doubling of the number of highly cited publications with each subsequent decade. A total of 85% of the articles were on the topics of pathophysiology (37%), wounds, tissue, or dressings (31%), or organ failure/sepsis (17%). B.A. Pruitt Jr. (2320 citations), D.N. Herndon (1972 citations), and A.D. Mason Jr. (1435 citations) were the most cited authors. This study identified some of the most important contributions to burn research and the areas of greatest scientific interest to the specialty during the past five decades, and highlights key research that has contributed to the evolution of modern burn care. (J Burn Care Res 2014;35:176–185)

Throughout modern history, physicians have been challenged to effectively manage burn injuries and related complications, including shock, sepsis, multiorgan failure, and the high risk of death.[1,2] Today, burns present ongoing problems for both U.S. civilian and military healthcare professionals. In the U.S. civilian population, fire and burn injuries account for approximately 2% of all fatal and 1% of all nonfatal injuries.[3] In wartime, burn injuries comprise between 5 and 20% of injuries and 4% of deaths.[4,5] Similar findings have been reported for the current wars in Iraq and Afghanistan.[6–8] Combat burn injuries and their treatment have importance beyond their overall incidence as they can result in extended care in an intensive care unit, rehabilitation, multiple reconstructive surgeries, and long-term disability.

Improvements in burn survival and quality of life are the result of advances in burn research in recent decades. Such progress is reflected in the scientific burn literature during the past 55 years. A review of the burn literature can be used to show the impact of this research on the scientific community and highlight important gaps remaining in knowledge. One way to determine the influence and contributions of individual articles is to measure the number of citations. Similarly, the contributions of individual authors can be measured by the number of times their work is cited in the peer-reviewed literature.[9]

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Citation analyses have been published on the topics of trauma,[10] vascular trauma,[11] combat casualty care,[12] and a number of other medical specialties. To our knowledge, they have not been reported for the burn care literature.

Therefore, the goal of this study was to identify and analyze the 100 most cited burn-related articles published in the peer-reviewed biomedical literature during the past five decades.

METHODS

The Web of Science (including Science Citation Index) was queried on September 2, 2011, for papers relating to burns published from 1955 (the earliest year for which data were available) up to and including the date of the search.[13]

The Web of Science, which is produced by the Institute for Scientific Information, provides Web access to the Science Citation Index, MEDLINE, and other citation indexes, which collectively index more than 12,000 journals worldwide, including open-access journals.[13] We searched for articles indexed by one or more of the following terms: "burns or thermal" and "wound or injury" or "inhalation injury." We also used "subject area" selection function of the Web of Science to further limit the topics of the publications accessed to 28 that were deemed to be of greatest relevance to burn care by the two experienced burn researchers (K.K.C. and B.T.K.). Examples of these subject areas are "surgery," "toxicology," and "rehabilitation." In addition to original research, we included reviews, editorials, and letters. These are referred to as "articles" in the remainder of this text. Abstracts for the 500 most cited articles identified by the search (or the full article when abstracts were not available) were then reviewed by the same two experienced burn researchers. The articles found not to have a specific focus on burns were excluded.

The 100 most cited articles were then selected for further analysis and compiled in a computerized spreadsheet. These top-cited articles were then analyzed by overall number of citations, number of top-cited articles by decade, the top-cited article for each decade, primary study topic (pathophysiology, wounds/dressings/tissue, organ failure/sepsis, inhalation injury, pain, resuscitation, psychological health, or other), population (adult, pediatric, nonclinical), top-cited author, and journal rank by number of top-cited articles. For the analysis of top-cited article by decade, if no top-cited article for that decade was in the top 100, the next most cited article by rank was selected. Descriptive statistical analyses were then performed using SAS Version 9.2 (SAS Institute Inc., Cary, NC).

Results

The 100 most cited articles are listed in Table 1. The number of citations ranged from 86 to 711 per article. The most cited article is no. [#] 1, Gallico et al, "Permanent coverage of large burn wounds with autologous cultured human epithelium," (1984) followed by no. 2, Wilmore et al, "Catecholamines: mediator of the hypermetabolic response to thermal injury" (1974); and no. 3, Burke et al, "Successful use of a physiologically acceptable artificial skin in the treatment of extensive burn injury" (1981). Throughout the remainder of this text, the 100 top-cited articles referred to are identified by their rank (eg, no. 1). The full references for each article are found in Table 1.

Figure 1 shows the most cited article per decade during the past five decades. The most cited articles by decade were: no. 119, Rapaport et al, "Altered reactivity to skin homografts in severe thermal injury" (1960s); no. 2, Wilmore et al, "Catecholamines: mediator of the hypermetabolic response to thermal injury" (1970s); no. 1, Gallico et al, "Permanent coverage of large burn wounds with autologous cultured human epithelium" (1980s and the top-cited paper overall); no. 5, Wainwright's "Use of an acellular allograft dermal matrix (Alloderm) in the management of full-thickness burns" (1990s); and no. 17, Gore et al, "Association of hyperglycemia with increased mortality after burn injury" (2000s).

The number of articles in the top 100 by decade (Figure 1) illustrates the substantial increase in burn-related articles cited during the study period. The year of publication ranged from 1955 to 2007. Very few of the top-cited articles were published in the 1950s and none in the 1960s. Between the 1970s and the 1990s, there was a near doubling of the number of publications with each subsequent decade (92% increase from the 1970s to the 1980s and 76% between the 1980s and the 1990s). Fewer top-cited publications were identified from the 2000s, the most recent decade, compared with the numbers for the 1980s and 1990s.

As shown in Figure 2, the largest numbers of top-cited articles were primarily on the topics of pathophysiology (n = 37) and wounds/dressings/tissue (n = 31), followed by organ failure/sepsis (n = 17).

Table 1. The 100 most-cited articles in burn care by number of citations, 1955–2011

Rank	Article	Times Cited
#1	Gallico GG, et al. Permanent coverage of large burn wounds with autologous cultured human epithelium. *N Engl J Med* 1984;311:448–51.	711
#2	Wilmore DW, et al. Catecholamines—mediator of hypermetabolic response to thermal injury. *Ann Surg* 1974;180:653–9.	530
#3	Burke JF, et al. Successful use of a physiologically acceptable artificial skin in the treatment of extensive burn injury. *Ann Surg* 1981;194:413–28.	512
#4	Compton CC, et al. Skin regenerated from cultured epithelial autografts on full-thickness burn wounds from 6 days to 5 years after grafting—a light, electron-microscopic and immunohistochemical study. *Lab Invest* 1989; 60:600–12.	341
#5	Wainwright DJ. Use of an acellular allograft dermal matrix (Alloderm) in the management of full-thickness burns. *Burns* 1995;21:243–8.	310
#6	Wolfe RR, et al. Effect of severe burn injury on substrate cycling by glucose and fatty-acids. *N Engl J Med* 1987;317:403–8.	262
#7	Burke JF, et al. Glucose requirements following burn injury - parameters of optimal glucose-infusion and possible hepatic and respiratory abnormalities following excessive glucose intake. *Ann Surg* 1979;190:274–85.	234
#8	Miller CL, Baker CC, et al. Changes in lymphocyte activity after thermal injury—role of suppressor cells. *J Clin Invest* 1979;63:202–10.	232
#9	Shirani KZ, et al. The influence of inhalation injury and pneumonia on burn mortality. *Ann Surg* 1987;205:82–7.	232
#10	Cuono C, et al. Use of cultured epidermal autografts and dermal allografts as skin replacement after burn injury. *Lancet* 1986;1:1123–4.	227
#11	Hansbrough JF, et al. Burn wound closure with cultured autologous keratinocytes and fibroblasts attached to a collagen-glycosaminoglycan substrate. *JAMA* 1989;262:2125–30.	218
#12	Ryan CM, et al. Objective estimates of the probability of death from burn injuries. *N Engl J Med* 1998;338:362–6.	215
#13	Deitch EA. Intestinal permeability is increased in burn patients shortly after injury. *Surgery* 1990;107:411–6.	211
#14	Czaja AJ, et al. Acute gastroduodenal disease after thermal injury - endoscopic evaluation of incidence and natural-history. *N Engl J Med* 1974;291:925–9.	200
#15	Wilmore DW, et al. Anabolic effects of human growth-hormone and high caloric feedings following thermal injury. *Surg Gynecol Obstet* 1974;138:875–84.	197
#16	Meller D, et al. Amniotic membrane transplantation for acute chemical or thermal burns. *Ophthalmology* 2000; 107:980–9.	192
#17	Gore DC, et al. Association of hyperglycemia with increased mortality after severe burn injury. *J Trauma* 2001;51:540–4.	181
#18	Pruitt BA, et al. Burn wound infections: current status. *World J Surg* 1998;22:135–45.	170
#19	Rumbaugh KP, et al. Contribution of quorum sensing to the virulence of *Pseudomonas aeruginosa* in burn wound infections. *Infect Immun* 1999;67:5854–62.	170
#20	Till GO, et al. Oxygen radical dependent lung damage following thermal-injury of rat skin. *J Trauma* 1983;23:269–77.	169
#21	Bisson JI, et al. Randomised controlled trial of psychological debriefing for victims of acute burn trauma. *Br J Psychiatry* 1997;171:78–81.	168
#22	Allison F, et al. Studies on the pathogenesis of acute inflammation. 1. The inflammatory reaction to thermal injury as observed in the rabbit ear chamber. *J Exp Med* 1955;102:655–68.	162
#23	Alexander JW, et al. Sequential, prospective analysis of immunological abnormalities and infection following severe thermal injury. *Ann Surg* 1978;188:809–16.	161
#24	Herndon DN, et al. Reversal of catabolism by beta-blockade after severe burns. *N Engl J Med* 2001;345:1223–29.	161
#25	Alexander JW, et al. The importance of lipid type in the diet after burn injury. *Ann Surg* 1986;204:1–8.	157
#26	Wilmore DW, et al. Influence of the burn wound on local and systemic responses to injury. *Ann Surg* 1977;186:444–58.	156
#27	Gore DC, et al. Effect of exogenous growth-hormone on whole-body and isolated-limb protein kinetics in burned patients. *Arch Surg* 1991;126:38–43.	156
#28	Moore FD, et al. Neutrophil activation in thermal-injury as assessed by increased expression of complement receptors. *N Engl J Med* 1986;314:948–53.	155
#29	Perry S, et al. Predictors of posttraumatic-stress-disorder after burn injury. *Am J Psychiatry* 1992;149:931–5.	154
#30	Maejima K, et al. Bacterial translocation from the gastrointestinal tracts of rats receiving thermal-injury. *Infect Immun* 1984;43:6–10.	153
#31	Pellegrini G, et al. The control of epidermal stem cells (holoclones) in the treatment of massive full-thickness burns with autologous keratinocytes cultured on fibrin. *Transplantation* 1999;68:868–79.	153
#32	Lanser ME, et al. Opsonic glycoprotein (plasma fibronectin) levels after burn injury—relationship to extent of burn and development of sepsis. *Ann Surg* 1980;192:776–82.	151
#33	Woodley DT, et al. Burn wounds resurfaced by cultured epidermal autografts show abnormal reconstitution of anchoring fibrils. *JAMA* 1988;259:2566–71.	150

(*Continued*)

Table 1. (*Continued*)

Rank	Article	Times Cited
#34	Choiniere M, et al. Comparisons between patients' and nurses' assessment of pain and medication efficacy in severe burn injuries. *Pain* 1990;40:143–52.	150
#35	Klasen HJ. A historical review of the use of silver in the treatment of burns. II. Renewed interest for silver. *Burns* 2000;26:131–8.	149
#36	Thompson PB, et al. Effect on mortality of inhalation injury. *J Trauma* 1986;26:163–5.	143
#37	Wischmeyer PE, et al. Glutamine administration reduces Gram-negative bacteremia in severely burned patients: a prospective, randomized, double-blind trial versus isonitrogenous control. *Crit Care Med* 2001;29:2075–80.	137
#38	Wolf SE, et al. Mortality determinants in massive pediatric burns - an analysis of 103 children with >=80% TBSA burns (>=70% full-thickness). *Ann Surg* 1997;29:2075–80.	132
#39	Aulick JLH, Wilmore DW. Increased peripheral amino-acid release following burn injury. *Surgery* 1979;85:560–5.	130
#40	Madden MR, et al. Grafting of cultured allogeneic epidermis on 2nd-degree and 3rd-degree burn wounds on 26 patients. *J Trauma* 1986;26:955–62.	129
#41	Hart DW, et al. Persistence of muscle catabolism after severe burn. *Surgery* 2000;128:312–9.	128
#42	Deitch EA, et al. Thermal-injury promotes bacterial translocation from the gastrointestinal-tract in mice with impaired t-cell mediated immunity. *Arch Surg* 1986;121:97–101.	125
#43	Cannon JG, et al. Circulating interleukin-1-beta and tumor necrosis factor-beta concentrations after burn injury in humans. *Crit Care Med* 1992;20:1414–9.	125
#44	Sakurai Y, et al. Stimulation of muscle protein-synthesis by long-term insulin infusion in severely burned patients. *Ann Surg* 1995;222:283–97.	123
#45	Drost AC, et al. Plasma cytokines following thermal-injury and their relationship with patient mortality, burn size, and time postburn. *J Trauma* 1993;35:335–9.	122
#46	Ronfard V, et al. Long-term regeneration of human epidermis on third degree burns transplanted with autologous cultured epithelium grown on a fibrin matrix. *Transplantation* 2000;70:1588–98.	122
#47	Schwacha MG. Macrophages and post-burn immune dysfunction. *Burns* 2003;29:1–14.	121
#48	Rodriguez JL, et al. Correlation of the local and systemic cytokine response with clinical outcome following thermal-injury. *J Trauma* 1993;34:684–95.	120
#49	Moss NM, et al. Temporal correlation of impaired immune-response after thermal-injury with susceptibility to infection in a murine model. *Surgery* 1988;104:882–7.	119
#50	Jones WG, et al. Bacterial translocation and intestinal atrophy after thermal-injury and burn wound sepsis. *Ann Surg* 1990;211:399–405.	117
#51	Jones I, et al. A guide to biological skin substitutes. *Br J Plast Surg* 2002;55:185–93.	114
#52	Gilpin DA, et al. Recombinant human growth-hormone accelerates wound-healing in children with large cutaneous burns. *Ann Surg* 1994;220:19–24.	111
#53	Boyce ST, et al. Comparative-assessment of cultured skin substitutes and native skin autograft for treatment of full-thickness burns. *Ann Surg* 1995;222:743–52.	110
#54	Bruck HM, et al. Opportunistic fungal infection of burn wound with phycomycetes and Aspergillus—clinical–pathologic review. *Arch Surg* 1971;102:476–82.	109
#55	Alexander JW, et al. Distribution and survival of *Escherichia coli* translocating from the intestine after thermal-injury. *Ann Surg* 1991;213:558–67.	109
#56	Richard P, et al. *Pseudomonas aeruginosa* outbreak in a burn unit—role of antimicrobials in the emergence of multiply resistant strains. *J Infect Dis* 1994;170:377–83.	109
#57	Horton, JW. Free radicals and lipid peroxidation mediated injury in burn trauma: the role of antioxidant therapy. *Toxicology* 2003;189:75–88.	109
#58	He ZH, et al. Progranulin is a mediator of the wound response. *Nat Med* 2003;9:225–9.	108
#59	Curreri PW, et al. Burn injury- analysis of survival and hospitalization time for 937 patients. *Ann Surg* 1980;192:472–8.	106
#60	Ninnemann JL, Stockland AE. Participation of prostaglandin-e in immunosuppression following thermal-injury. *J Trauma* 1984;24:201–7.	106
#61	Goodwin CW, et al. Randomized trial of efficacy of crystalloid and colloid resuscitation on hemodynamic-response and lung water following thermal-injury. *Ann Surg* 1983;197:520–31.	105
#62	Youn YK, et al. The role of mediators in the response to thermal-injury. *World J Surg* 1992;16:30–6.	104
#63	Drost AC, et al. Plasma cytokines after thermal-injury and their relationship to infection. *Ann Surg* 1993;218:74–8.	104
#64	Nguyen TT, et al. Current treatment of severely burned patients. *Ann Surg* 1996;223:14–25.	104
#65	Ferrando AA, et al. A submaximal dose of insulin promotes net skeletal muscle protein synthesis in patients with severe burns. *Ann Surg* 1999;229:11–8.	104

(*Continued*)

Table 1. (*Continued*)

Rank	Article	Times Cited
#66	Poon VKM, Burd A. In vitro cytotoxicity of silver: implication for clinical wound care. *Burns* 2004;30:140–147.	101
#67	Huang KF, et al. Insulin-like growth factor 1 (IGF-1) reduces gut atrophy and bacterial translocation after severe burn injury. *Arch Surg* 1993;128:47–54.	100
#68	Hoffman HG, et al. Virtual reality as an adjunctive pain control during burn wound care in adolescent patients. *Pain* 2000;85:305–9.	100
#69	Nijsten MWN, et al. Interleukin-6 and its relation to the humoral immune-response and clinical-parameters in burned patients. *Surgery* 1991;109:761–7.	99
#70	Smith DL, et al. Effect of inhalation injury, burn size, and age on mortality—a study of 1447 consecutive burn patients. *J Trauma* 1994;37:655–9.	99
#71	Atiyeh BS, et al. Effect of silver on burn wound infection control and healing: review of the literature. *Burns* 2007;33:139–48.	99
#72	Mcelwee HP, et al. Cimetidine affords protection equal to antacids in prevention of stress ulceration following thermal-injury. *Surgery* 1979;86:620–6.	97
#73	Hansbrough JF, et al. Evaluation of a biodegradable matrix containing cultured human fibroblasts as a dermal replacement beneath meshed skin-grafts on athymic mice. *Surgery* 1992;111:438–6.	96
#74	Saffle JR, et al. Multiple organ failure in patients with thermal-injury. *Crit Care Med* 1993;21:1673–83.	96
#75	Stadelmann WK, et al. Physiology and healing dynamics of chronic cutaneous wounds. *Am J Surg* 1998;176:26S–38S.	96
#76	Boyce ST, et al. The 1999 clinical research award—cultured skin substitutes combined with Integra Artificial Skin to replace native skin autograft and allograft for the closure of excised full-thickness burns. *J Burn Care Rehabil* 1999;20:453–61.	96
#77	Horch RE; Kopp, et al. Tissue engineering of cultured skin substitutes. *J Cell Mol Med* 2005;9:592–608.	96
#78	Davis JM, et al. Neutrophil de-granulation and abnormal chemotaxis after thermal-injury. *J Immunol* 1980;124:1467–71.	95
#79	Fox CL, Modak SM. Mechanism of silver sulfadiazine action on burn wound infections. *Antimicrob Agents Chemother* 1974;5:582–8.	94
#80	Levoyer T, et al. Alterations in intestinal permeability after thermal-injury. *Arch Surg* 1992;127:26–30.	94
#81	Faunce DE, et al. Effects of acute ethanol exposure on cellular immune responses in a murine model of thermal injury. *J Leukoc Biol* 1997;62:733–40.	93
#82	Jun JH, Yaksh TL. The effect of intrathecal gabapentin and 3-isobutyl gamma-aminobutyric acid on the hyperalgesia observed after thermal injury in the rat. *Anesth Analg* 1998;86:348–54.	93
#83	Fu XB, et al. Randomised placebo-controlled trial of use of topical recombinant bovine basic fibroblast growth factor for second-degree burns. *Lancet* 1998;352:1661–4.	93
#84	Yin HQ, et al. Comparative evaluation of the antimicrobial activity of ACTICOAT antimicrobial barrier dressing. *J Burn Care Rehabil* 1999;20:195–200.	93
#85	Hart DW, et al. Determinants of skeletal muscle catabolism after severe burn. *Ann Surg* 2000;232:455–63.	93
#86	Zedler S, et al. T-cell reactivity and its predictive role in immunosuppression after burns. *Crit Care Med* 1999;27:66–72.	92
#87	Wright JB, et al. Efficacy of topical silver against fungal burn wound pathogens. *Am J Infect Control* 1999;27:344–50.	92
#88	Munster AM, et al. Effect of thermal injury on serum immunoglobulins. *Ann Surg* 1970;172:965–9.	91
#89	Munster AM, et al. Cell-mediated immunity after thermal injury. *Ann Surg* 1973;177:139–43.	90
#90	Clark AS, et al. Systemic response to thermal-injury in rats—accelerated protein-degradation and altered glucose-utilization in muscle. *J Clin Invest* 1984;74:888–97.	90
#91	Tompkins RG, et al. Significant reductions in mortality for children with burn injuries through the use of prompt eschar excision. *Ann Surg* 1988;208:577–85.	90
#92	Rue LW, et al. Wound closure and outcome in extensively burned patients treated with cultured autologous keratinocytes. *J Trauma* 1993;34:662–8.	90
#93	Mallonee S, et al. Surveillance and prevention of residential-fire injuries. *N Engl J Med* 1996;335:27–31.	90
#94	Oriordain MG, et al. Modulation of macrophage hyperactivity improves survival in a burn-sepsis model. *Arch Surg* 1992;127:152–7.	89
#95	Subrahmanyam M. Topical application of honey in treatment of burns. *Br J Surg* 1991;78:497–8.	88
#96	Jahoor F, et al. Dynamics of the protein metabolic response to burn injury. *Metabolism* 1988;37:330–7.	87
#97	Sriprachya-Anunt S, et al. Infections complicating pulsed carbon dioxide laser resurfacing for photo aged facial skin. *Dermatol Surg* 1997;23:527–35.	87
#98	Tredget EE, et al. A matched-pair, randomized study evaluating the efficacy and safety of Acticoat silver-coated dressing for the treatment of burn wounds. *J Burn Care Rehabil* 1998;19:531–7.	87
#99	Herndon DN, et al. Support of the metabolic response to burn injury. *Lancet* 2004;363:1895–1902.	87
#100	Navar PD, et al. Effect of inhalation injury on fluid resuscitation requirements after thermal-injury. *Am J Surg* 2004; 363:1895–1902.	86

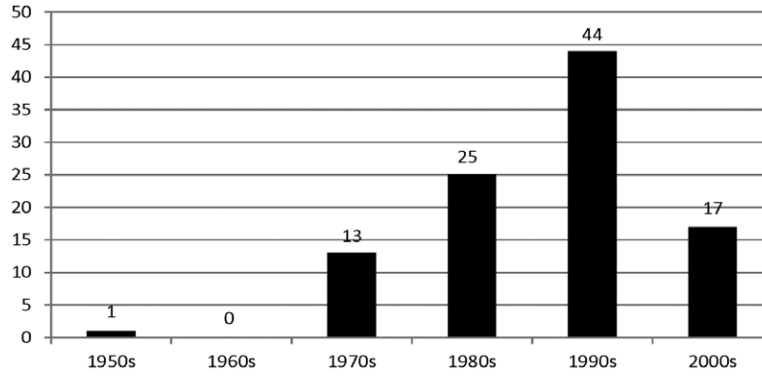

Figure 1. Number of burn articles by decade, 1955–2011.

These three, collectively, were the topics of 85% of the top-cited articles.

With regard to study population, the largest number of top-cited studies were those of adults (n = 77), with only two studies focused on children and one on both children and adults. A total of 20 studies were preclinical (data not shown).

Figure 2 lists the authors with more than one top-cited article ranked according to number of citations. Drs. B.A. Pruitt and D.N. Herndon both had the largest number of top-cited articles (n = 14) and the greatest number of citations. R.R. Wolfe had the third-most articles in the top 100 (n = 9).

As shown in Table 3, the journals that published the largest numbers of top-cited burn articles were the *Annals of Surgery* (n = 23), followed by the *Journal of Trauma* (n = 8), and the *New England Journal of Medicine* and *Surgery*, each of which had seven top-cited articles.

DISCUSSION

This study identified some of the most important contributions to burn research and the areas of greatest scientific interest to the specialty during the past five decades. These articles helped shape the direction of clinical research, applied preclinical research and basic science, and thus contributed to the evolution of modern burn care. They also had an impact on the broader trauma literature, and advanced our understanding of the pathophysiology of thermal injury.

Top 100

"Permanent coverage of large burn wounds with autologous cultured human epithelium," by Gallico et al, published in the *New England Journal of Medicine*, was the top-cited paper overall. This study described a technique for developing new skin from the patient's own cells, thereby facilitating grafting in patients with a high burn TBSA and limited donor skin. The second most cited article, Wilmore et al's study of the role of catecholamines in the hypermetabolic response to burns, provided important insights regarding the appropriate nutritional support for burn patients. The third most cited article by Burke et al, described successful use of artificial skin (Integra). These top-three articles are distinguished by having been highly cited in peer-reviewed reports of subsequent burn-related clinical trials, in

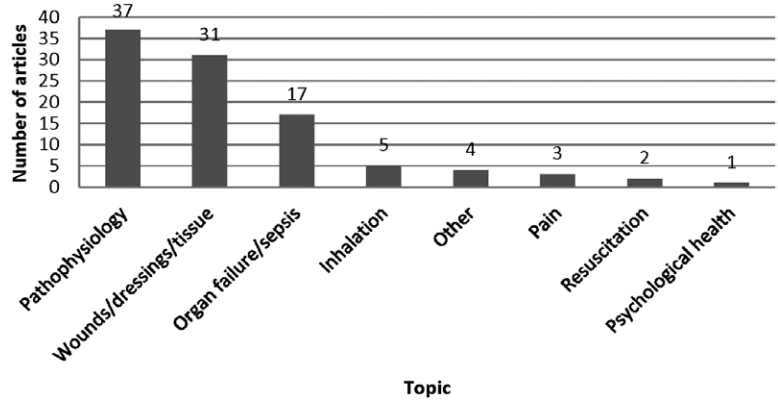

Figure 2. Primary topic of the most frequently cited burn articles, 1955–2011.

Table 2. Authors with more than one top cited burn article among the 100 most cited, by number of publications and number of citations, 1955–2011

Authors	Number of Publications	Number of Citations
B.A. Pruitt	14	2320
D.N. Herndon	14	1829
R.R. Wolfe	9	1348
A.D. Mason	7	1435
S.E. Wolf	6	799
D.L. Chinkes	5	609
R.G. Tompkins	5	607
D.W. Wilmore	4	1013
J.F. Burke	4	961
E.A. Deitch	4	609
G.T. Shires	4	469
W.G. Cioffi	4	410
F. Jahoor	3	505
D.C. Gore	3	430
J.W. Alexander	3	427
S.T. Boyce	3	424
C.W. Goodwin	3	404
D.W. Hart	3	382
J.A. Mannick	3	363
G.D. Warden	3	292
J.R. Saffle	3	272
C.C. Compton	2	1052
G.G. Gallico	2	1052
N.E. O'Connor	2	1052
C.C. Bondoc	2	602
W.C. Quinby	2	602
C.C. Baker	2	352
C.K. Ogle	2	318
M.L. Cooper	2	314
J.F. Hansbrough	2	314
D.A. Schoenfeld	2	305
G.O. Till	2	289
M. Desai	2	268
H.D. Peterson	2	249
H.J. Klasen	2	248
R.E. Barrow	2	243
J.L. Rodriguez	2	240
A.A. Ferrando	2	232
T.T. Nguyen	2	227
D.G. Burleson	2	226
A.C. Drost	2	226
M.K. Obeng	2	221
D.A. Gilpin	2	215
M.L. Rodrick	2	208
R.J. Kagan	2	206
N.A. Meyer	2	200
F.D. Foley	2	199
A.A. Meyer	2	189
R.E. Burrell	2	185
W.F. McManus	2	184
A.M. Munster	2	181

numerous review articles, in reports of clinical trials in other areas of medicine, and in preclinical research articles. This large and varied citation history highlights the impact of these articles on the field and supports the notion that number of citations can be a useful metric for assessing their overall impact.

Evolution: Top-Cited by Decade

The most cited articles by decade are indicative of the evolution and major advances in the burn care specialty during the past 55 years.

Though not in the top 100, the most cited article of the 1960s (no. 119) was Rapaport et al's study of the response of severely burned rats to skin homografts compared with a control group (Figure 3). This study, which controlled for some factors that could contribute to the immunologic response, provided evidence for a prolongation of survival of skin homografts in severely burned individuals, and proposed several theories regarding the immunologic response that might have contributed to the longer survival.

The no. 2 article, by Wilmore et al. (1974), the most highly cited article of the 1970s, described the primary role of catecholamines in peripheral lipolysis and protein catabolism. This reflects the advances made in the 1970s in understanding the body's hypermetabolic response to trauma.[14–16]

The most cited article of the 1980s and overall, no. 1, by Gallico et al, described the use of cultured autologous epidermal cells to treat large full-thickness burns. Despite the success of split-thickness skin grafts (STSGs), surgeons are still limited by the fact that severely burned individuals do not have sufficient donor sites. Gallico et al described a procedure in which a 4-cm^2 biopsy is collected, trypsonized, and cultured to produce epidermal sheets that are 2- to 8-cells thick. The study included two case examples in which cultured epidermis was used to cover approximately half of the open wounds on patients who originally presented with 97 and 98% TBSA burns. Of note, it was in the 1980s that the third most cited article overall was published, John Burke and Ioannis Yannis's report describing a temporary artificial skin (Integra).

No. 5, a report by Wainright et al and the most cited article of the 1990s, reflects the continuing advances during that decade in using decellularized allogenic dermis to improve the performance of STSGs. This case report described the development of an acellular dermal matrix processed from cadaver skin (Allograft). The authors demonstrated that this material did not trigger an immune response and was able to supply continuous basement membrane

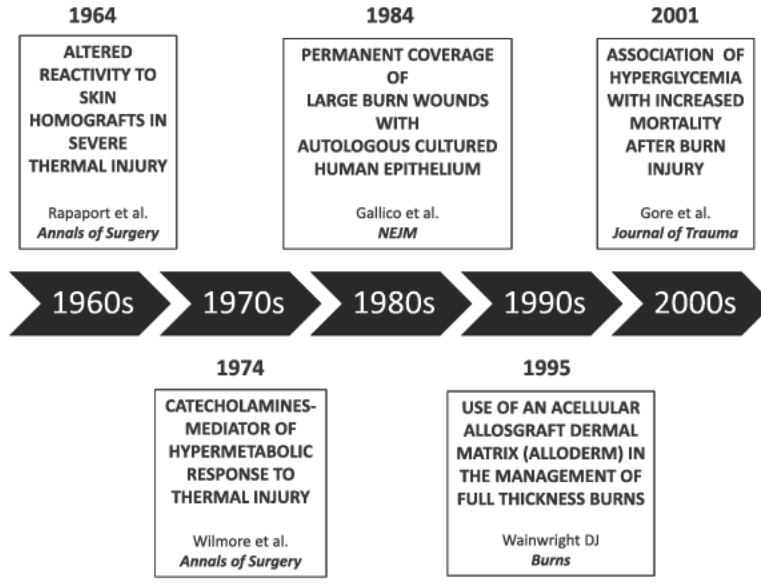

Figure 3. Most frequently cited burn articles by decade, 1955–2011. Because none of the articles in the top-cited 100 were published in the 1960s, we selected the next most-cited article, which had 79 citations and was ranked no. 119.

and dermal layers, which supported the formation of continuous epidermis from STSGs. In addition, this report documented improved cosmesis compared with STSG alone.

The most cited article of the 2000s was no. 17 by Gore et al. The stress of large burn injury can result in hyperglycemia,[17] because of elevated levels of hepatic gluconeogenesis and reduced glucose uptake.[18] Gore et al observed that in 58 consecutive pediatric patients with more than 60% TBSA burns, those with poor glucose control died at a higher rate, had poorer graft uptake, and had more positive blood cultures. This retrospective study suggested that improving glucose control in these severely injured patients might reduce mortality.

Table 3. Top 10 journals by numbers of top-cited burn articles and citations, 1955–2011

Name of Journal	Number of Articles	Number of Citations
Annals of Surgery	23	3722
Journal of Trauma	8	1016
New England Journal of Medicine	7	1794
Surgery	7	880
Archives of Surgery	6	673
Burns	5	780
Critical Care Medicine	4	450
Journal of Burn Care & Rehabilitation	3	276
Lancet	3	407
Journal of the American Medical Association	2	368

Number by Decade

The largest increase in top-cited publications occurred from one article in the 1950s to 13 in the 1970s; this period is considered the dawn of modern burn research. The near doubling of top-cited articles each decade from the 1970s to the 1990s suggests that this was a period of high interest and scientific productivity in burn care research. The lower number of publications in the 2000s compared with that in the 1990s likely reflects the fact that articles that were published recently have had less time to be cited than articles published earlier.

Topics

Pathophysiology was by far the leading topic of the top 100 most cited burn articles.

Considering the evolution of burn research, it is not surprising that the most popular topic was pathophysiology. Burns are complex injuries, affect multiple organ systems, and can lead to sepsis and death. Modern treatments including the use of grafts, nutritional modifications, and fluid resuscitation have developed because of improvements in our understanding of the burn injury paradigm and the body's consequent hypermetabolic response.

Some important topics in burn care were not represented among the top 100 most cited articles. Inhalation injury, burn resuscitation, pain control, and burn rehabilitation had few or no papers among the top 100. The absence of these topics may suggest that to date studies on these topics have not had the same level of interest and impact on burn research

as the topics of the most-cited articles. Alternatively, it is possible that these topics represent the areas with the greatest potential for increased interest and impact in burn research in the future.

Study Population

The most studied age group was adults, the study population for more than three-fourths of the top-cited articles. Only three top-cited articles focused on the pediatric population, a fact that may be related to the limited generalizability of pediatric study findings to the adult population.

No burn research papers that reflect the current U.S. conflicts in Iraq and Afghanistan are featured in the top 100. Arguably, important advances have been made in treating service members' burns from these current conflicts. However, since this research has been published in the 2000s, there has not been enough lead time for the impact to be measured via citation analysis.

Authors

The top-cited authors were the fathers of modern burn care: Drs. Pruitt, Herndon, and Mason. Of note, these researchers often worked together. An example of their collaborative efforts is their contribution to research on concomitant inhalation injury. In article no. 9, Shirani, Pruitt, and Mason (1987) documented that smoke inhalation injury as well as pneumonia and greater age and burn size independently contribute to increased mortality.

All three of these leaders in burn research also had experience within the U.S. Army, and their research on injuries among service members is a reflection of the effects of combat and war on the medical community at large. From World War II through the wars in Korea and Vietnam, increasing numbers of soldiers survived battlefield injuries, including severe burns. As a young draftee, Dr. Pruitt was a surgical trainee at Brooke Army Medical Center, Fort Sam Houston, Texas. He was later assigned to the burns ward as a staff surgeon, deployed to Vietnam to assist in the aeromedical evacuation of wounded soldiers, and also led a combat-evacuation hospital.[19] These formative years during which Dr. Pruitt was engaged in battlefield medicine involved the treatment of severe trauma and burns and provided the foundation for his later contributions to burn research.

Our report is limited by the fact that more recently published articles have not had as much time to be cited as those published earlier, thus biasing our findings toward older publications. However, the top-cited articles from earlier periods appear to represent "citation classics." Future review will allow us to appreciate the impact of these more recent articles on research during the first decade of the 21st century. Perhaps most importantly, citation analysis does not evaluate the quality of these studies nor attempt to assess their usefulness and impact on clinical practice.

Despite these limitations, our study provides an informative analysis of burn research publications and citations; it also identifies the topics and areas of greatest interest in the past five decades. By identifying the most-cited articles per decade, this analysis also illustrates the evolution of research on burn care. At the same time, our findings shed light on the topics that were not well represented, and highlight possible gaps in burn research, providing information that could help guide future valuable research.

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