UNC Hospitals' Comments in Opposition to Mission Hospital Petition for Special Need Adjustment for Burn Intensive Care Services in 2021 State Medical Facilities Plan

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UNC Hospitals appreciates the opportunity to comment on the petition submitted to the State Health Coordinating Council ("SHCC") by Mission Hospital ("Mission") for a special need adjustment for burn intensive care services. For the reasons outlined below, the SHCC should deny the petition.

The University of North Carolina Hospitals ("UNC Hospitals") is the home of one of two existing Burn Intensive Care Units in state of North Carolina. UNC Hospitals regularly works collaboratively with the only other burn center in the state, Wake Forest Baptist Health, to ensure that all North Carolina patients benefit from excellent burn care regardless of their location. As the largest burn center in the state with 21 operational (and 25 approved) burn ICU beds, UNC Hospitals has extensive experience in providing highly specialized burn care to the people of North Carolina. Based on a review of the petition submitted by Mission, UNC Hospitals offers its unique perspective on this petition, and urges the SHCC to deny it for the following reasons:

1. North Carolina Has Sufficient Bed Capacity to Provide Burn Services to Patients. While Mission claims that there is not sufficient burn care capacity in the state of North Carolina, UNC Hospitals believes that the SHCC's current methodology is appropriate for determining the need for more burn ICU beds in the state. The methodology takes into account the aggregate days of care at all facilities, and compares it to existing capacity at all facilities. There has not been a need determination triggered by the standard methodology, because the existing burn beds are not sufficiently utilized to warrant the addition of more beds. Notably, there are a total of 8 burn ICU beds which have been CON approved but have not yet become operational – 4 of these are at UNC Hospitals and 4 are at Wake Forest Baptist. The fact that these beds have not yet been

developed further supports the denial of Mission's petition, because not only do the existing providers have capacity to treat all patients currently in need, but based on these additional CON approvals they are approved to develop even more capacity with these additional beds. In other words, the demand for burn ICU services has been sufficiently met with existing operational capacity, and will continue to be sufficiently met with existing and approved capacity. The data support this conclusion. Between July 2019 and June 2020, UNC Hospitals received 1183 inpatient transfer requests to its burn care group. Of these, only 2 requests (less than 0.2%) had to be denied due to bed constraints, and neither patient was from Western North Carolina. *Source*: UNC Transfer Center Data.

Based on existing capacity and access to care at the two burn centers in the state, there is no need for an additional burn unit at Mission in Asheville, which would unnecessarily duplicate existing and approved services in contravention of the underpinnings of the CON law.

2. North Carolina Has Sufficient Geographic Access to Burn Services. Geographically, the entire state has access to burn services. The current location of the two burn care centers in Winston-Salem and Chapel Hill effectively provide coverage to the entire state, both to the west and to the east, respectively. The statewide EMS system ensures that all patients in the state have access and transportation to the sophisticated level of care that is required for burn patients.

   Mission argues that the location of the current burn centers is not sufficient to serve patients in the western region of North Carolina and that the addition of Burn ICU beds in the western North Carolina region will increase access to quality services and patient safety. These arguments are without merit. While Mission cites the drive time from the Western region to the nearest burn centers as a justification for the addition of a burn care center in Asheville, this drive time (2.5 - 4 hours) for such highly specialized services is very much in line with most regions of the United States. A study conducted in 2009 found that in the southern region of the United States, 76.5% of the population lived more than 2 hours away from the nearest burn center by ground transportation and 53.8% lived more than 4 hours away.[1] In the United States as a whole, 53.7% of the population lived more than 2 hours away from a burn center. While this drive time is longer than patients may travel for other services, the specialized nature of burn care makes it a common and necessary distance.[2]

[1] Klein, M. (2009). Geographic Access to Burn Center Hospitals. HHS. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3045670/#R29

[2] The typical distance to travel for burn services may be most starkly contrasted with dialysis services. Dialysis services are required for ESRD patients three times a week on an ongoing and regular basis, without any anticipated termination of the need for services (save for transplant patients). Thus, it is often necessary for many dialysis treatment centers to be developed to ensure patients have care as close to home as possible. In contrast, a burn patient will receive treatment as a result of an isolated episode and after treatment has concluded, would not be likely to have an ongoing need for regular treatment at the burn center.

Mission also argues that based on an average length of stay (ALOS) of 15.33 days based on conversations with Doctors Hospital of Augusta (DHA) in Georgia, patients should be treated closer to home. However, based on the experience of UNC Hospitals treating patients from the western region of the state, this ALOS figure is significantly inflated. Between UNC FY 17-19, UNC Hospitals' ALOS for all burn patients was 9.6 days (see full chart in Appendix), and ALOS for patients from the Western Region specifically was 8.6 days (see subset of data in chart below).

Patient County	ALOS	Encounters
ALEXANDER	9.00	1
BUNCOMBE	7.00	2
BURKE	4.50	2
CALDWELL	9.60	5
CATAWBA	6.50	2
CLEVELAND	7.80	5
GRAHAM	46.00	1
HENDERSON	7.00	3
JACKSON	6.00	3
MCDOWELL	4.00	1
RUTHERFORD	7.20	5
SWAIN	9.00	2
Grand Total	**8.59**	**32**

Note: Burn Patients from the Western Region treated at UNC Hospitals between July 2016 and June 2019. Burn-injured patients were identified by ICD-10 codes provided by Mission Hospital in Attachment B of their Petition. *Source*: Truven/IBM IP State Data.

By treating patients effectively and keeping ALOS as short as possible, UNC Hospitals is providing access to high quality care as efficiently as possible, delivering tremendous healthcare value. The shorter ALOS also minimizes the length of time patients and their families may need to be away from home for treatment.

It is worth noting that UNC Hospitals does not stand to gain or lose financially in any meaningful way due to the outcome of this decision. As illustrated, the majority of burn patients seen at UNC Hospitals are not from the western region; encounters for patients from the western region during this time frame comprised less than 1% of UNC Hospitals' total encounters. Our concern is exclusively the value and quality of care provided to North Carolinians. Based on the location and capacity at the existing two burn centers in the state, there is no need for an additional burn unit at Mission.

3. An Additional Burn Unit Could Negatively Impact Quality. Expanding the number of burn ICU beds to a third facility will lead to a reduction in clinical activity across all three sites, as well as at locations in neighboring states. Research demonstrates that a decrease in clinical activity in specialized areas of healthcare is associated with a decrease in quality of care. As such, Mission's

proposal may lead to a decrease in the quality of burn-related care for all residents of North Carolina.

Evidence of decreased quality of care due to decreased utilization has been demonstrated in other highly specialized areas of healthcare.[3] Many experts agree that due to the highly specialized nature of burn care, it is best to limit the number of burn care centers and approach burn care from a regionalized perspective. Some experts suggest that there may already be too many burn care programs in the United States. [4]

It also appears HCA has made opening new burn centers across the country a priority, developing multiple new burn units in areas with existing burn services. Methodist Healthcare (which is 50-50 co-owned between Methodist Healthcare Ministries of South Texas, Inc., and HCA Healthcare) recently opened a new regional burn and reconstructive unit in San Antonio, Texas, despite the presence of an existing burn unit in San Antonio at the US Army Institute of Surgical Research (USAISR). Additionally, Medical City Healthcare in Plano, Texas, which is also part of HCA Healthcare, has recently added a burn unit despite the presence of an existing burn unit within 20 miles at Parkland Hospital in nearby Dallas. Notably, there is no CON law in Texas to regulate development of additional burn units. The research provided suggests that the abundance of highly specialized centers in such close proximity is not clinically optimal and could negatively impact quality.

Additionally, in its Petition, Mission cites the need to transport some burn patients by helicopter (and associated clinic and patient care concerns) as a reason for their proposed adjustment, and cites concern that transportation of burn patients may lead to complications in a patient's recovery process. However, the impact of transport on clinical outcomes should not be considered as a justification for a new burn care center. Research has shown that the outcomes of burn patients requiring transfer from a preliminary care facility to a specialized burn center are <u>not different</u> than the outcomes of patients admitted directly to the specialized burn center.[5] This analysis included an assessment of length of stay, number of operations, hospital charges and mortality. Thus, contrary to the assertions in Mission's petition, quality is not sacrificed because patients may be required to be transported in order to receive the highly specialized care they need.

4. <u>A Third Burn Unit Will Create Additional Staffing Challenges</u>. Additionally, the difficulty in recruiting and retaining experienced Burn ICU nurses cannot be ignored. There is already a shortage of nurses experienced in providing highly specialized burn care, and staffing an

[3] Karamlou, T. (2020). Access or excess? Examining the argument for regionalized cardiac care. *JTCVS*.

[4] *See* Exhibit 1. Heimbach, D. (2003). Regionalization of Burn Care - A Concept Whose TIme Has Come. *American Burn Association*. https://academic.oup.com/jbcr/article-abstract/24/3/173/4733748?redirectedFrom=PDF

[5] *See* Exhibit 2. Klein, M. et al. (2006). An outcome analysis of patients transferred to a regional burn center; Transfer status does not impact survival. *Burns*. https://pubmed.ncbi.nlm.nih.gov/17011131/

additional center would lead to additional strain on current resources, and could potentially lead to inexperienced nurses being expected to care for complex burn patients. The addition of a third burn care center in the state will lead to increased challenges in recruitment for experienced Burn ICU nurses, which is already a significant difficulty. Creation of another source of demand for such a valued resource will further stress retention and recruitment efforts within the two existing centers, which will ultimately have a negative impact on the quality of patient care being delivered.

5. A Third Burn Unit Will Result in Higher Costs and Unnecessary Duplication. Finally, Mission claims that building a new burn center will decrease costs for patients. However, developing and staffing a new high quality burn center is not an efficient allocation of resources when sufficient capacity already exists to care for these patients. Instead, it is an unnecessary duplication of existing resources, which will ultimately lead to higher costs for patients, and which the CON law is designed to prevent. UNC Hospitals believes that maintaining low healthcare costs for patients of North Carolina is more effectively achieved by maintaining the two existing burn centers and adding additional beds to those centers when the need arises. This is the approach documented in the standard need methodology in the SMFP, and UNC Hospitals urges the SHCC to adhere to the planning process outlined therein.

In summary, UNC Hospitals respectfully requests that the SHCC deny Mission's petition for eight additional Burn ICU beds in Western North Carolina. The addition of an eight bed Burn ICU at Mission Hospital is not necessary to provide access to care for the patients of North Carolina, and approval of the petition risks decreasing the overall quality of burn care and specialized staff available to serve patients in North Carolina. Particularly when viewed through the lens of quality, access, and value, which are the basic principles governing development of the SMFP, the petition must be denied. Thank you for the opportunity to provide these comments on this important issue.

APPENDIX

AVERAGE LENGTH OF STAY: UNC FY17-FY19

Patient County	ALOS	Encounters
AIKEN	6.00	1
ALAMANCE	7.29	136
ALBEMARLE	12.00	1
ALEXANDER	9.00	1
ALLEGHENY	4.00	1
ANSON	3.14	7
BARRY	24.00	1
BEAUFORT	13.95	19
BEDFORD	9.00	1
BERTIE	7.00	10
BLADEN	9.19	26
BRUNSWICK	7.90	59
BUNCOMBE	7.00	2
BURKE	4.50	2
CABARRUS	28.33	3
CALDWELL	9.60	5
CAMDEN	6.00	1
CARTERET	25.74	27
CARVER	17.00	1
CASWELL	5.59	17
CATAWBA	6.50	2
CHARLESTON	7.50	2
CHATHAM	12.94	36
CHESTERFIELD	15.17	6
CHOWAN	12.00	2
CLEVELAND	7.80	5
COLUMBUS	11.94	49
CRAVEN	8.88	58
CULPEPER	4.50	2
CUMBERLAND	13.66	222
DANVILLE CITY	13.46	35
DARE	3.00	1
DARLINGTON	6.00	1
DAVIDSON	7.00	6
DAVIE	38.00	1
DILLON	6.00	1
DORCHESTER	4.00	1
DUPLIN	11.46	28
DURHAM	8.40	164
EDGECOMBE	7.02	48
ERIE	13.00	1
FAIRFIELD	3.00	1
FAYETTE	4.00	1
FLORENCE	2.50	2
FRANKLIN	7.64	42
FULTON	4.00	1

Patient County	ALOS	Encounters
GASTON	11.75	8
GATES	8.00	1
GEORGETOWN	7.00	1
GRAHAM	46.00	1
GRANVILLE	7.43	44
GREENE	25.67	6
GREENWOOD	2.50	2
GUILFORD	7.32	19
GWINNETT	4.00	1
HALIFAX	15.49	39
HAMPDEN	2.00	1
HANOVER	6.00	1
HARNETT	9.64	81
HARRISON	6.00	1
HENDERSON	7.00	3
HENRICO	9.00	1
HENRY	4.25	4
HERTFORD	8.40	5
HILLSBOROUGH	4.00	1
HOKE	9.68	41
HORRY	6.00	2
IREDELL	6.50	2
JACKSON	6.00	3
JEFFERSON	2.00	1
JOHNSTON	5.51	144
JONES	1.50	2
LEE	9.57	61
LENOIR	14.50	54
LINCOLN	6.00	1
LOS ANGELES	5.00	1
MARION	48.00	3
MARLBORO	18.63	24
MARTIN	7.94	16
MARTINSVILLE CITY	11.00	1
MCDOWELL	4.00	1
MECKLENBURG	16.05	37
MIAMI-DADE	8.00	1
MONROE	6.67	3
MONTGOMERY	6.00	21
MOORE	7.63	51
MUSCOGEE	3.00	1
NASH	7.28	76
NEWPORT NEWS CITY	88.00	1
NORFOLK CITY	3.00	2

Patient County	ALOS	Encounters
NORTHAMPTON	4.70	10
ONSLOW	9.30	127
ORANGE	9.44	85
OSCEOLA	14.00	1
PAMLICO	11.20	5
PASSAIC	5.00	1
PATRICK	1.00	1
PENDER	10.66	58
PERQUIMANS	9.00	3
PERSON	6.82	33
PICKENS	7.00	1
PITT	13.12	42
PITTSYLVANIA	12.00	15
PRINCE GEORGES	5.00	2
PUTNAM	8.00	1
RANDOLPH	10.33	18
RICHLAND	5.00	1
RICHMOND	5.46	63
ROBESON	9.04	197
ROCKINGHAM	13.93	14
ROWAN	8.00	2
RUTHERFORD	7.20	5
SAMPSON	11.08	52
SCOTLAND	6.82	39
SPARTANBURG	1.00	1
SPOTSYLVANIA	11.00	1
STANLY	1.50	2
SUFFOLK	2.00	2
SWAIN	9.00	2
UNION	11.78	9
UNKNOWN	18.00	1
VANCE	8.80	49
WAKE	8.32	533
WARREN	13.50	14
WASHINGTON	7.50	4
WAYNE	13.27	70
WILLIAMSBURG	10.00	1
WILSON	10.22	50
WOOD	2.00	1
YADKIN	1.00	1
YORK	5.80	5
Grand Total	**9.57**	**3436**

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EXHIBIT 1

Regionalization of Burn Care—A Concept Whose Time Has Come

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Dr. David Heimbach has been the Director of the Burn Center in Seattle, Washington for more than thirty years. He has been extremely active in the American Burn Association and International Society for Burn Injuries. He was Program Chairman of the American Burn Association and subsequently President in 1988. He is the Immediate Past President of the International Society for Burn Injuries and was the Chair of the ABA/ACS Burn Center Verification Committee for six years. He has published articles in every phase of burn management, including wound coverage, burn shock resuscitation, inhalation injury, rehabilitation, and prevention. We are privileged to have Dr. Heimbach present his ideas on a new paradigm of regionalization of burn care.

Optimal burn care criteria have been established and refined by the American Burn Association over the past 20 years, with each iteration published in the American College of Surgeons document "Optimal Care of the Injured Patient." To provide optimal care, there must of course be a physical place containing the necessary monitoring and specialized equipment needed for the burn patient. More important, however, there must be a specialized team of caregivers, to include surgeons, nurses, therapists, nutritionists, social service, psychologists, and operating theater personnel. Further, these people need to be available 24 hours per day and must be busy enough to maintain their burn skills. There must be a large enough critical mass of staff to provide coverage for vacation, illness, and holidays. There must be a community outreach program for education, prehospital care, emergency care, and transportation. There must be capability for long-term follow-up, reconstruction, and reentry into society. In an environment without socialized health care, the patient mix should be such that the burn hospital is not financially penalized by caring for all burn patients who seek care. Finally, there must be a systematic approach to burn care so that everyone knows the "plan" and can explain it to patient and family. We know that these goals cannot be met in a community hospital without an organized burn service.

If one buys into the above concept, three integrally related questions must be asked:

1. Is there an economy of scale in burn center size, and can small, self-designated units provide the same optimal burn care as larger verified centers?
2. Is a given population served as well by several small burn centers as a single larger center?
3. How big a population should be served by a burn center? This of course will vary according to the incidence of burns in the population, the resources available, and to some extent the distances involved.

Based on U.S. census statistics in 2000 and the self-designated Burn Care Resources listing published by the American Burn Association in 1999, some suppositions can be made. Currently included in the American Burn Association list of burn care facilities (1999–2000) are 139 U.S. self-designated burn care facilities serving a total population of 280 million, or one burn center for two million population. These centers advertise a total of 1950 burn beds, an average of 14 beds per center. Assuming that most, although certainly not all, significant burns are cared for in the listed centers, the overall average population per burn bed (presumably both intensive and acute care) is 144,000. This varies quite a bit by region (New England, 102,000; Mountain West, 142,000; Midwest, 153,000; Mid Atlantic, 162,000; South, 174,000; and Pacific, 182,000) and individually by state. Washington, D.C. has one bed for 33,000 and Minnesota one bed for 82,000, whereas Florida and Wisconsin each have one bed for about 240,000. Assuming that the listed facilities maintain only about 70% occupancy, the actual number of needed beds might approach one bed per 200,000 population. The available listings do not, of course, take into account the occupancy of the burn beds, nor do they reflect the population characteristics. For example, it is likely that more beds will be needed in areas with crowded cities (Michigan and Ohio with 1/119,000) than in more

rural areas (South Dakota with 1/260,000) or areas where home heating is not necessary, as in Hawaii (1/204,000 people, not including tourists).

Of 139 centers listed, 46 have fewer than 10 beds (33%). One six-bed unit in Hawaii for a population of 1.2 million (not including tourists) seems quite appropriate because of its long distance from the mainland. On the other hand, 8 of California's 17 centers have fewer than 10 beds. In one Midwestern state four of five centers have fewer than 10 beds, whereas only two of Texas' eight centers have fewer than 10 beds. Looking at these data nationwide, I would propose that there are geographic areas of duplication and that an economy of scale might actually improve the outcomes to be expected for individual patients as a result of focusing the expertise into fewer centers.

The optimal size for a burn center has never been well established. The smaller the center the more difficult it is to maintain trained staff and provide vacation/illness coverage and consistent therapy, and outreach programs very likely fall by the wayside. In general, units with fewer than 10 beds do not fit criteria for Verification and very few have sought it. This does not mean that they can't provide excellent care, but perhaps consolidating with others might provide the best economy of scale and state-of- the-art care. Furthermore, there is an acute national shortage of burn surgeons. My clinical burn fellow finishing in July 2002 was offered 12 academic job interviews within 24 hours of sending an e-mail. An area with three eight-bed units likely would support only one part-time burn surgeon each, whereas if they combined into one 24-bed center, they not only could collectively have more resources, but even some time not on call.

Without criticizing the care delivered in smaller units, one must also ask the question whether the population is being efficiently served by multiple centers in the same geographic area. As an example, if one assumes that 25 beds brings economy of scale permitting a full complement of physician, nursing, therapy, dietary, social service, and operating theater full-time equivalents, are the patients in California better served by 17 centers as now, or would they be better served by 6 strategically located centers of 25 beds each? Also (as example only), are the people of Missouri optimally served with six centers listing 108 beds (one bed per 51,000 population), or would the 5.6 million people living there be best served with a single center of 25 to 30 beds?

In some cases state boundaries would have to be crossed, but there is already ample precedence for this. Delaware, Idaho, New Hampshire, North Dakota, and Rhode Island, with a total population of 4.5 million, have no listed burn care facilities. In the United States the finances of interstate transfer can be tricky, because states differ in their Medicaid reimbursement patterns.

As an example of the above concepts, the University of Washington Burn Center has, by evolution, become the regional burn center for the states of Washington, Alaska, Montana, and Idaho. These states have a population of seven million, and a land mass nearly one-fourth of the United States. By the above calculations this population would require about 40 burn beds, which, in fact, are provided by our center. Despite awesome distances and rural conditions, jet air transport invariably brings patients to the center within the first burn day. Our regional burn foundation provides housing for families in need without charge. We care for about 500 patients per year, with 175 being younger than age 18 years. This represents more than 90% of the burn hospital admissions in Washington State. Some patients in Idaho and Montana go to Salt Lake City or Minneapolis, and some patients in Alaska are cared for in Fairbanks. Our mean burn size is about 13% TBSA and our mean length of stay is 12 days. Our average census is about 28 patients, with 6 in the intensive care unit and 22 in the step-down unit. Our two general surgeons rotate call, with each covering at least a month at a time. In addition to full plastic surgery coverage, our full-time staff includes 160 nurses, six therapists, and one each social worker, nutritionist, recreational therapist, and psychologist. This would seem good economy of scale. The load is neither so large as to overwhelm our 350-bed hospital nor so small as to lose our dedicated full-time staff. Furthermore, without other hospitals "skimming" insured patients, we care for all socioeconomic groups, and we actually make a small profit for the hospital. Through this evolution we believe the patients in our region receive optimal care at reasonable cost—whether the managed care environment will agree with us remains to be seen.

John Settle has devoted considerable time to the concept of regionalization in Great Britain and has reached a similar conclusion that optimal resources include one burn center for 5 to 5.5 million population. In Europe the regionalization concept also appears fairly well developed, at least as represented by International Society for Burn Injuries membership in the European countries. It would be of interest for the International Society for Burn Injuries national representatives to make similar calculations to see how closely these figures match reality in countries around the world.

Using all of these statistics, there are probably nearly three times as many burn care facilities listed as might be deemed optimal. It is possible that the verification process will be helpful in determining which centers fulfill a regional concept and which ones fall below the rigorous standards expected by the verification committees. It is likely that centers that feel they are likely to fail the process have and will continue to forego verification. Although the era of managed care in the United States is clearly beginning to ration care, it does not ration malpractice liability, and any sort of imperfect result puts the hospital and physicians at risk of lawsuits. The establishment of verified "Centers of Excellence" that will provide optimal care in a cost-effective manner is most likely to ensure the continued advances necessary in burn care. There have been recent complaints within the burn community that burn centers are closing. Perhaps this is not such a bad event if it promotes improved economy of scale and quality of care in the remaining ones.

Burn care was the first to develop multidisciplinary representation in its national and international organizations. Perhaps it can also be on the forefront in the concept of regionalization.

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An outcome analysis of patients transferred to a regional burn center: Transfer status does not impact survival

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Abstract

Background: Optimal burn care is provided at specialized burn centers. Given the geographic location of these centers, many burn patients receive initial treatment at local emergency departments prior to transfer. The purpose of this study was to determine whether patients transferred from other facilities have worse outcomes than those admitted directly from the field.
Study design: A retrospective cohort study was performed comparing the outcomes of patients admitted to our burn center directly from the field with patients requiring transfer from a preliminary care facility. The outcomes of interest were mortality, length of stay, length of stay/TBSA burned, number of operations and hospital charges. Poisson regression or Cox proportional hazards model was used to evaluate differences in outcomes after adjusting for potential confounders.
Results: From 2000 to 2003 a total of 1877 patients were admitted to our burn center and 953 (51%) were transferred from a preliminary care facility. No difference ($p < 0.05$) was found in length of stay, number of operations, hospital charges and mortality between the two cohorts.
Conclusions: This study demonstrates that patients transferred to a regional burn center from local hospitals have equivalent mortality, length of stay and hospital charges as those admitted directly from the field.

Keywords: Burn; Transfer; Outcomes

1. Introduction

Advances in resuscitation and surgical management have significantly improved survival following severe burn. The provision of optimal burn care is a resource-intensive endeavor, requiring specialized tools and equipment as well as a specialized team of caregivers [1,2]. These resources can typically be provided only at dedicated burn centers. In the United States, there are 132 self-designated burn care facilities [3]—about one facility for over 2.1 million people, and worldwide the ratio may be even lower. Therefore, many burn patients must receive initial care at a local hospital prior to transport to a specialized burn center.

In virtually all reports in the trauma literature, patients initially treated at smaller suburban or rural hospitals prior to transport to regional trauma centers have increased intensive care unit or hospital length of stay, increased number of complications, hospital charges, or mortality [4–12]. However, few studies examined the outcome of burn patients first treated in the emergency department of these transferring hospitals (hereafter referred to as *preliminary care centers*) and then transferred to burn centers.

Clearly, the quality of burn care provided at preliminary care centers depends on both the human and physical resources available. In fact, errors by inexperienced physicians in the estimation of burn size and depth – two

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critical elements of patient assessment – occur quite commonly at referring centers [13–19].

The University of Washington Burn Center is the regional burn center for the states of Washington, Alaska, Montana and Idaho [1], and, therefore, severely burned and critically ill people are commonly transported hundreds to thousands of miles to receive definitive care at the Center. Nearly half of the over 500 patients admitted to our burn center annually are initially treated at another facility, and about 25% of burn patients are transferred from a facility over 90 miles away. The purpose of this study was to determine the impact of preliminary care and the delay in time to receipt of definitive care on the outcome of patients with severe burns.

2. Methods

2.1. Study overview

This is a retrospective cohort study where the exposure of interest is the receipt of preliminary care prior to transfer to a regional burn center. In essence, we are evaluating the outcomes of a cohort of patients transferred from referring hospitals to those transported directly from the field. The cohort includes all patients who were treated at the University of Washington Burn Center from 2000 to 2003. The outcomes of interest were mortality, length of stay, length of stay/total body surface area (TBSA) burned, number of operations and hospital charges. The study was conducted with the approval of the University of Washington Human Subjects Division.

2.2. Patients

The transfer cohort was comprised of any patient who received care at another medical center prior to transfer to our regional burn center with the exclusion of those transferred more than 48 h following injury. Treatment at preliminary care facilities typically consists of stabilization and triage as there is rarely an intent to provide definitive care. Patients transferred later than 48 h may have been admitted for provision of definitive rather than preliminary care and, therefore, subsequent transfer may occur because of complications that arose. This could confound the relationship between transfer status and outcome.

All other patients were considered to have been transported directly from the field. Patients in the direct admit cohort admitted more than 48 h following injury were similarly excluded because they are typically admitted at that point for surgery, for complications related to the burn injury (infection) or inability to manage wound care at home which could similarly confound our analysis. In addition, all patients admitted to the burn center with a diagnosis of toxic epidermal necrolysis were excluded from analysis.

Transferred patients were identified from the hospital's Transfer Center patient logs. Demographic and outcome data were obtained through our burn center registry.

2.3. Outcomes

The outcomes of interest for both cohorts were mortality, total length of hospital stay, total length of hospital stay/TBSA, number of operations and hospital charges. Hospital charges include charges incurred at our burn center but do not include charges accrued at the preliminary care facility or associated with patient transport.

2.4. Potential confounders

We considered the possibility that patients were referred to a regional burn center because health care providers at the referring facility felt they had risk factors for adverse outcomes. These risk factors would have confounded the effects of transfer status on outcome. To adjust for these potential differences, we considered the effect of the following potential confounders: TBSA, inhalation injury (diagnosed based on history and physical evaluation), age, gender and insurance status. Insurance status was used as a surrogate for socioeconomic status [20].

2.5. Statistical methods and data analysis

Means and standard deviations were calculated for all variables. Differences between groups were calculated using a two-tailed *t*-test test or Kruskal Wallis test for continuous variables and chi-squared or Fisher's exact test where appropriate for discrete variables. Patients who died prior to discharge were excluded from the length of stay and hospital charge analysis. Mortality and hospital charges were analyzed using a generalized linear model with a Poisson distribution after adjusting for potential confounders TBSA, inhalation injury, age, gender and insurance status [21,22]. The effect of transfer status on outcome is presented as either relative rates or increases, along with 95% confidence intervals. Cox proportional hazard analysis was performed to measure the impact of transfer status on length of stay.

3. Results

From 2000 to 2003, 1877 patients were admitted to the UW Burn Center. Following exclusion of patients admitted more than 48 h following injury and patients admitted with TEN, 1853 patients remained for analysis. About 949 (51%) of these patients were transferred to the burn center from a preliminary care facility. The geographic origin of all

Table 1
State of origin of admitted patients

State	Number of patients	% Patients
Alaska	45	2.4
Idaho	36	1.9
Montana	37	2.0
Washington	1735	93.6

Table 2
Injury characteristics for transferred and direct admit cohorts

	Transferred ($n = 949$)	Direct ($n = 904$)	P-value
Age	29.2	32.0	0.003
Average total body surface area	11.4	9.6	0.001
Burn etiology (%)			0.001
Flame	43.2	36.5	
Scald	23.9	25.3	
Flash	15.8	12.6	
Contact	5.7	9.6	
Grease	5.6	7.7	
Chemical	2.1	3.5	
Electrical	2.0	1.4	
Other	1.6	3.0	
Male (%)	72.9	68.3	0.03
Inhalation injury (%)	4.9	3.9	0.36

patients is shown in Table 1. The majority of patients were from the state of Washington (93.6%), with the remainder of patients coming from the states of Alaska, Montana and Idaho.

The baseline characteristics of the direct admit and transferred patients admitted within 48 h of injury are summarized in Table 2. Patients admitted from the field were slightly older than the transfer group (32.2 versus 29.2 years, $p = 0.004$); both groups were predominantly male (74.5% and 68.8%). Flame and scald were the most common etiologies in both cohorts. The average total body surface area burn was larger in those transferred (9.9% versus 11.3%, $p = 0.02$), while the proportion of those with inhalation injuries was comparable across the two groups (3.8% versus 4.6%, $p = 0.6$).

The hospital course of the two cohorts is summarized in Table 3. Both groups had similar number of operations and hospital charges and the length of stay per TBSA was slightly higher in the direct cohort. The overall mortality of the direct admit and transfer groups was 4.0% and 4.6%, respectively ($p = 0.49$). These rates include all patients who died following admission to the burn center regardless of whether resuscitation was attempted. Survival curves for the two cohorts are shown in Fig. 1. More patients in the direct admit cohort died within the first 72 h following admission than in the transfer cohort (21 versus 19, $p = 0.26$) and the overall mortality rate after 72 h following admission was 1.7% and 2.7% ($p = 0.15$) for the direct and transfer cohorts, respectively. The mortality rate for patients with larger burns (over 30% TBSA) was 35% and 36% for the direct and transfer cohort groups, respectively ($p = 0.95$).

Average length of stay per TBSA was shorter in the transfer cohort than in the direct cohort (1.9 days/TBSA versus 2.2 days/TBSA, $p = 0.001$). However, when adjusted for potential confounders transfer status did not significantly impact length of stay (Table 4).

Disposition status is summarized in Table 3. The majority of patients in both cohorts returned home following discharge. A small number of patients (6) from the transfer cohort were discharged to another acute care facility and a similar number of patients in both groups were discharged to a skilled nursing facility.

3.1. Outcome analysis

A multivariate Poisson regression analysis was performed to evaluate the effect of transfer status after adjusting for the effects of several important confounders (Table 5). After adjusting for age, TBSA, gender, inhalation injury, insurance status the relative risk of mortality was similar for patients transferred from a preliminary care facility [RR of death: 1.36 (95% CI 0.82–2.24)] compared to those transported directly to the regional burn center. Non-commercial insurance status, inhalation injury and burn size were associated with a higher relative risk of mortality.

Greater hospital charges were associated with older age, larger burn size as well as inhalation injury but were not impacted by transfer status (Table 6).

4. Discussion

Trauma patients cared for at preliminary care facilities prior to transport to a Level I trauma center have worse

Table 3
Outcomes of transferred vs. direct patients

	Transferred	Direct	P-value
Length of stay (days, mean ± S.D.)	13.7 ± 61.7	12.2 ± 32.7	0.06
Length of stay/TBSA (mean days/TBSA, ± S.D.)	1.9 ± 19.8	2.2 ± 10.5	0.001
Number of operations (mean ± S.D.)	0.48 ± 1.1	0.55 ± 1.5	0.83
Hospital charges (mean ± S.D.)	$28615 ± $118016	$23931 ± $104168	0.30
Mortality (%)	4.6	4.0	0.49
Disposition			0.37
Home[a]	876 (97%)	841 (97%)	
Skilled nursing facility	21 (2.3%)	20 (2.3%)	
Other acute care	6 (0.7%)	3 (0.3%)	
Against medical advice/unknown	1 (0.1%)	5 (0.6%)	

[a] Includes patient/family home, shelter, jail.

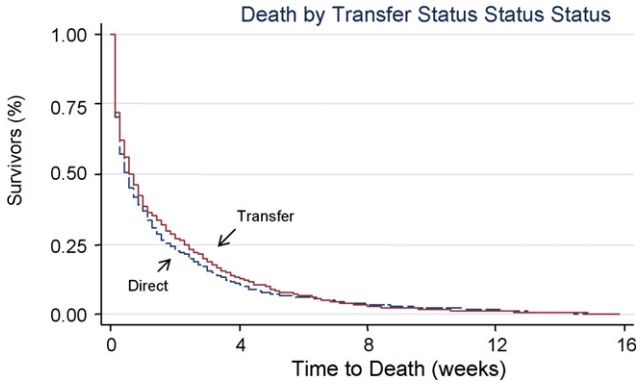

Fig. 1. Time to death for direct and transfer cohorts.

Table 4
Impact of transfer status on LOS: multivariate analysis

	Relative increase in length of stay
Transfer status	1.05 (0.96–1.2)
Age	
0–19	Reference
20–39	1.2 (1.1–1.4)
40–59	1.3 (1.2–1.5)
≥60	0.97 (0.79–1.2)
TBSA	
0–9	Reference
10–19	2.3 (2.0–2.5)
20–39	4.2 (3.5–5.1)
40–59	2.3 (1.6–3.3)
≥60	0.55 (0.31–0.96)
Female gender[a]	0.96 (0.87–1.1)
Payer status (non-commercial[b])	1.2 (1.0–1.3)
Inhalation injury	0.5 (0.39–0.72)

As determined by Cox proportional hazards.
[a] Reference to male gender.
[b] Reference to commercial insurance.

Table 5
Impact of transfer status on outcome: multivariate analyses

	Relative risk of death	Relative increase in charges[a]
Transfer status	0.97 (0.89–1.06)	0.99 (0.99–0.99)
Non-commercial insurance	1.59 (0.82–3.1)	1.10 (1.06–1.07)
Age		
0–19	Reference	Reference
20–39	1.84 (0.63–5.40)	1.90 (1.90–1.91)
40–59	4.42 (1.67–11.7)	1.99 (1.93–1.94)
≥60	9.99 (3.67–27.2)	2.74 (2.73–2.74)
TBSA (per 10% increase)	1.49 (1.37–1.62)	1.98 (1.97–1.98)
Female gender	1.31 (0.82–2.09)	1.38 (1.38–1.38)
Inhalation injury	2.43 (1.47–4.19)	1.18 (1.16–1.16)

[a] Excluding deaths.

outcomes than patients admitted directly from the field [4–12]. The outcome of burn patients initially managed at preliminary care hospitals has not been yet been evaluated to the same extent. As a significant proportion of severely burned patients receive care at these centers, the impact of this early care and delays to definitive care needs evaluation to better organize the preliminary care of burn patients within a region. The purpose of this study was to compare the outcome of burn patients transferred from preliminary care centers with those admitted directly from the field.

The cohort of transferred burn patients had a lower age, larger burn size and higher incidence of inhalation injury. In spite of these differences there was no significant difference in median or adjusted average length of stay, number of operations and hospital charges between the two cohorts. Whereas transferred patients had a slightly higher mortality rate (4.6% versus 4.0%), this difference was not statistically significant. However, there was a higher rate of mortality for the direct cohort of patients within the first 72 h of admission (58% versus 43%). This could potentially result from the fact that patients who are severely injured and unlikely to survive did not get transferred. There was virtually no difference in mortality rate for patients with larger burns (over 30% TBSA).

The disposition status between the two cohorts was also similar. The majority of patients returned to their own home following discharge and a smaller number of patients were discharged to skilled nursing facilities or extended care facilities. A higher number of patients from the transfer cohort were discharged to other acute care facilities (6 versus 3) closer to their homes for the remainder of their hospital course. While this early discharge from our burn center could bias the length of stay results, the overall number of patients transferred to other acute care facilities was quite small.

Provision of optimal burn care is a resource-intensive endeavour that requires an experienced team of physicians, nurses, therapists, and psychologists. The American Burn Association has developed a list of clinical criteria to identify patients that would most benefit from the resources offered by a dedicated burn center (http://www.ameriburn.org/). However, patients who do not meet the ABA criteria may also benefit from burn specialty resources. Given the geographic distribution of burn centers, many patients will be initially evaluated and treated at a facility close to the place of injury. Therefore, physicians with little burn experience may be responsible for important aspects of early post-injury care including airway assessment, estimate of burn extent and depth and initiation of fluid resuscitation.

Inaccurate assessment of burn injuries occurs commonly at preliminary care facilities. In 1980, in one of the first reports of civilian transport of burn patients, Treat et al. reported numerous errors in the initial phases of patient management [13]. As part of their institutional protocol, a burn surgeon and burn nurse would travel to the referring hospital and assume patient management prior to the

initiation of patient transport. They found 20 out of 129 patients (16%) had unrecognized pulmonary injuries, 42 patients (32%) required alterations in their fluid resuscitation strategy and 6 patients (4.6%) required escharotomies or escharotomy revision for pulseless extremities. Despite these errors in early management, there was no analysis of the impact of these errors on ultimate patient outcome.

In a similar analysis, Wong et al. [15] reviewed the accuracy of burn size estimation and the management of fluid resuscitation by referring hospitals in Australia. In their series, burn size estimation was incorrect in 57% of patients. In addition, incorrect resuscitation fluid administration was common. More recently, Saffle et al. [14] compared the outcome of patients transported by air from other facilities with those admitted directly to the burn center and found significantly ($p < 0.01$) higher mortality (8.4% versus 2.9%) and longer length of stay (17.1 days versus 8.3 days) in the transfer cohort. However, these results were confounded by the air transport group having larger burns and more patients with inhalation injury. Saffle also examined errors in burn size estimation by referring physicians. Estimates differed in nearly half of the patients by more than 15%, leading to errors in fluid resuscitation.

Despite the previous reports in both the trauma and burn literature of worse outcomes and potential causes for worse outcomes, our study found that transfer status did not significantly impact mortality, length of stay or hospital charges in our burn patient population, despite transferred patients having a larger average total body surface area burn. The overall mortality rate of 4.4% was similar to the other recent reports of burn mortality rates [23,24]. A higher rate of patients admitted directly from the field died within the first 72 h following admission, which may reflect the fact that not all patients with potentially fatal injuries get transferred to our burn center.

In an attempt to improve the care patients receive prior to transfer to our burn center and reduce errors that may contribute to morbidity and mortality, we developed a burn stabilization protocol that is disseminated to all hospitals in our region. The protocol reviews crucial aspects of initial management of the burn patient and methods for estimating burn size and initiating resuscitation. In addition, all patient transfers are coordinated through our institutional transfer center in order to further optimize pre-burn center care. By calling a toll-free number, referring physicians review the details of the burn with the accepting burn service attending who can help estimate the extent and depth of burn and make recommendations for the initiation of fluid resuscitation. If necessary, the transfer center nurses then coordinates patient transport whether by ground or air. There are well-organized systems for aeromedical patient transport in the northwest region and quality assurance processes occur regularly for these transport services. Specialized nursing and medic teams provide patient care during transport, typically based on the physician orders formulated during the communication between the referring providers and the attending burn surgeon.

It is important to note that we did not examine errors in burn size estimation and fluid resuscitation and their potential impact as part of this study. Therefore, we cannot comment on whether the similarities between the two patient cohorts occurred in spite of errors in burn size estimation and fluid administration. Clearly, it is important to emphasize the potential impact of the early phases of fluid management. The sequelae of both underresuscitation and overresuscitation can be quite significant. Underresuscitation can lead to hypotension, organ hypoperfusion and failure and burn wound ischemia; overresuscitation can lead to abdominal and extremity compartment syndromes, ARDS and prolonged mechanical ventilation [25,26]. In addition, we did not have access to comorbidity data through our patient database. However, since age and the presence of comorbidities are highly correlated, the adjustment for age in our regression analysis should correct for any potential confounding effects due to comorbidities.

Several other baseline characteristics evaluated as part of this study including age, insurance status, gender and presence of inhalation injury were all associated with a higher risk of mortality. Larger burn size, presence of inhalation injury and age were associated with longer lengths of stay and increased hospital charges. These findings corroborate other reports of factors influencing burn survival and resource utilization [23,24,27,28]. However, as shown in Table 4, age over 60 and burn size over 60% was associated with shorter lengths of stay. This is likely attributable to the higher mortality levels in patients in these age and TBSA groups.

In conclusion, this study demonstrates that patients transferred to a regional burn center from hospitals providing preliminary care have equivalent mortality, length of stay and hospital charges as patients admitted directly to the burn center from the field. These findings support the concept that burn care for large geographic areas can be safely provided at a single regional burn center. In addition, with the growing emphasis on national disaster planning, this study provides evidence for the feasibility of a coordinated long distance triage and transport program—a critical need following a mass casualty event.

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