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Loyola Burn Service Resident Responsibilities

Loyola’s Burn Center was the thirteenth in the nation to be approved by the American College of Surgeons and the American Burn Association and the first in Illinois. It admits over 700 in-patient admissions per year and has nearly 5,000 clinic visits. It is a regional referral center for patients suffering burns, chemical injuries, major soft tissue injuries or infection, inhalation injuries, frostbite and skin sloughing rashes (i.e. toxic epidermal necrolysis syndrome). The unit is known not only for its excellence in patient care but also as the clinical arm of the Burn & Shock Trauma Research Institute. The Burn & Shock Trauma Research Institute is a multi-disciplinary research institute with physician clinical scientists and Ph.D.’s who have extensive NIH grant funding, have graduated over 100 research fellows and have an extensive record of peer-reviewed publications. Members of both the clinical and research unit are renowned for their work and have served as president of the American Burn Association, Trustees of the American Burn Association, Chair of NIH study sessions, editorial board members, and actively participate in national and international organizations.

As a resident or student joining this group, we welcome you to this proud tradition. All of you at one time or another will represent our program and it is important that you understand the responsibilities and the behavior that we expect. The most important thing is to recognize that we are a resource for many patients and institutions; you must always be ready to help them with critically injured and ill patients seeking our services. In that regard, prompt and courteous responses to all requests for help are the expectation. Outlined below are the responsibilities and expectations for each of you so that we have a clear delineation of the work and a smooth line of communication. We seek to have your time with us be as productive as possible and for you to learn as much as you can during your time with us. We hope that you will find not only that this unit serves to be an excellent experience in your learning on how to care for critically injured burned patients, but also that you come away with a model of organization and approach that supports multi-disciplinary care of patients.
**Burn Chief (PGY 3):**

The Chief Surgical Resident in the Burn Unit at all times must recognize their leadership responsibility and that they set the tone for how the service works. The Chief Burn Resident has direct lines of communication to the attending at all times. In those cases where the attending is not immediately available the Chief Resident must recognize that they speak not only for themselves but also for the entire team. How they conduct themselves both in the Unit and with referring physicians and institutions is critical. Specific responsibilities for the Burn Chief Resident include:

1. Responsible for scheduling operative cases (OR block times: Tuesday, Thursday and Friday).

2. Responsible for organizing and communicating service to see patients each day before rounds. This requires updating the communication board in the Nurse’s Lounge daily.

3. Chief should be aware of all calls/admissions made from transferring/referring physicians. Attending on-call will be notified of all accepted transfers.

4. ICU Responsibilities: am rounds with team, make daily treatment plans, run list with team, may need to delegate procedure responsibilities.

5. Clinic Responsibilities: Burn Chief will attend all attending clinics on Monday & Wednesday unless there are emergencies in Unit or cases scheduled. Dr Liu has clinic on Monday afternoons, Dr Sanford has clinic on Wednesday mornings and Dr Baldea has clinic on Wednesday afternoons.

6. The Burn Chief Resident will be a part of the evaluation process of junior residents and medical students rotating through the Burn Center. It is important that the Chief be mindful of this during the course of each rotation so they can provide effective and thoughtful feedback during the evaluation process.
**Burn Mid-Level/Visiting Residents (PGY 2): 4-week rotation Day & Night rotation**

As one of the residents rotating from U of I- Peoria and Mt Sinai, you will actively participate in the care of burn patients. You are encouraged to see all aspects of the unit’s function so that your educational experience will represent the full spectrum of activities that occur at our center.

**Specific responsibilities include:**

1. The very first thing you must do is get your Loyola ID and computer access code. You must not share computer access with another resident; that will only get all of us in trouble.

2. ICU Patient Care: Pre-round on service patients (ICU), enter notes, initiate therapy for abnormal electrolyte values prior to attending rounds at 7:00 am daily (except Wednesdays when rounds are at 6:00 am).

3. Mid-level resident will share acting-senior responsibilities during times that Burn Chief is not physically in unit. Responsibilities include overseeing procedures done by interns and medical students; verify that daily patient treatment plans are indeed implemented (computer entered orders carried out, medications renewed/adjusted, etc.)

4. Maintain good communication with Burn Chief Resident regarding status of unit, patients, and issues requiring attention.

5. Attend clinic as needed depending on call schedule.

6. Encouraged to participate in operative cases once the clinical work is completed.
**Burn Intern Loyola (PGY 1): 4-week rotation Day & Night rotation**

As the Loyola surgical intern in the unit, you will likely spend the majority of your time in the Burn Intensive Care Unit. This should be an excellent opportunity for you to improve your skills in the day-in and day-out management of critically ill ICU patients. This opportunity should further allow you to refine your patient management and allow you to expand your clinical reasoning. As a Loyola resident who understands the uniqueness of our various systems, it is expected that you will work with the visiting residents to quickly orientate them to our hospital along with that of the Burn Chief Resident. You will also have day-in and day-out responsibilities for the students and it is expected that you will thoughtfully observe their performance so that you can contribute to their end of rotation evaluation.

**Specific responsibilities include:**

1. ICU patient care: pre-round on service patients (ICU), enter notes, initiate therapy for abnormal electrolyte values prior to attending rounds at 7:00 am daily (except Wednesdays at 6:00 am).

2. Responsible for discharges and discharge dictations of all floor and unit patients.

3. Responsible for daily ICU and floor patient care, ICU procedures (lines, chest tubes, bronchoscopies, etc.) with supervisions from senior residents/attending. Again, must maintain continuous and open lines of communication with mid-level and chief about issues regarding patient care.

4. Attend clinic if unit census and workload allows.

5. Encouraged to participate in operative cases once the clinical work is completed.
**Burn Sub-intern Loyola (MS4): 4-week rotation**

As the sub-intern rotating in the Burn Center, you will likely be doing this to fulfill your intensive care unit obligation. Your responsibilities and objectives are specified by the curriculum design for this rotation in addition to those of the unit. We hope that this will be a fruitful and productive time for you. We are anxious to work with you and are most pleased that you have selected the Burn Center to perform your rotation. In addition to the objectives and responsibilities as outlined within the SSOM curriculum the following specific expectations apply to your Burn Center rotation:

1. **ICU patient care:** pre-round on service patients (ICU/floor), enter notes, formulate plan to discuss during attending rounds at 7am daily (except Wednesdays at 6am). Abnormal laboratory values should be reported to residents prior to rounds.

2. **Formulate and follow-up with treatment plan of assigned patients; resident has to be made aware and co-sign computer entered orders. Procedures can be done with supervision from senior level resident.**

3. **Attend attending clinics.**

4. **Encouraged to participate in operative cases.**

**Burn Medical Students (MS3): 4-week rotation**

During the four-week rotation in the Burn Unit, it is likely that you will see a broad range of problems and emotional challenges. Our patients are some of the most critically ill individuals in the hospital and often the mechanism of their injury represents some of the most tragic aspects of human life. Your experiences will allow you to see the intricacies of demanding critical care and expose you to the challenges of critically burned children. We hope that you will see not only the care that we deliver but also the multi-disciplinary approach that we employ by which to deliver effective yet compassionate care in the most difficult of situations. We welcome your participation and your inquiry and we hope your time with us will not only be challenging but productive. In addition to the objectives and responsibilities as outlined within the SSOM curriculum, following are specific expectations during your burn center rotation:

1. **Patient care:** pre-round on 1 ICU patient and 2 floor patients. Write notes, formulate plan to discuss during attending rounds at 7am daily (except Wednesdays at 6am). Abnormal laboratory values should be reported to residents prior to rounds.

2. **Attend attending clinics.**

3. **Scrub in all operative cases.**
Most Burn service admissions are transfers from outside facilities. These calls usually come to the Burn Center. One of the Burn nurses (usually the charge nurse) takes the information regarding the transfer for inpatient or outpatient referrals. These transfers are initiated based upon referral criteria developed by the American Burn Association transfer criteria as listed in the table below.

<table>
<thead>
<tr>
<th><strong>AMERICAN BURN ASSOCIATION CRITERIA FOR BURN CENTER REFERRAL</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Second and Third Degree Burns:</strong>  &gt; 10% TBSA</td>
</tr>
<tr>
<td><strong>Third Degree Burns</strong></td>
</tr>
<tr>
<td><strong>Special Care Areas:</strong> Burns of the face, hands, feet, genitalia, perineum, or major joints.</td>
</tr>
<tr>
<td><strong>Electrical Burns</strong></td>
</tr>
<tr>
<td><strong>Chemical Burns</strong></td>
</tr>
<tr>
<td><strong>Inhalation Injury</strong></td>
</tr>
<tr>
<td><strong>Burn Patients with Comorbidities Complicating Care</strong></td>
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<tr>
<td><strong>Burn Patients with Concurrent Trauma</strong></td>
</tr>
<tr>
<td><strong>Burn Injury Secondary to Suspected Abuse</strong></td>
</tr>
<tr>
<td><strong>Patients Requiring Burn Related Care</strong></td>
</tr>
<tr>
<td>Frostbite injury, toxic epidermal necrolysis, necrotizing fasciitis or large soft tissue injuries, and any other patient deemed to need major wound care.</td>
</tr>
</tbody>
</table>

The charge nurse taking the transfer call can accept the burn for admission and should to prevent any delay, especially in large body surface area burns or inhalation injury patients. If the physician is present on the unit, the nurse may have them talk to the transferring hospital and this should happen with all sick or complicated patients. Burn transfers go directly to the Burn Unit or 7N (burn ward) unless directed to do otherwise by the attending, such as for Trauma clearance. Soft tissue patients (i.e. possible necrotizing soft tissue infection) and skin sloughing rashes (i.e. SJS/TEN) must be approved by the on call attending prior to acceptance.
The layout of our unit allows us certain flexibility to move patients out of the ICU for new Burn admissions and this must be done in an expeditious manner. When the service is very busy we need to have a plan as to who would move out next if we need beds. There are some rules you need to be aware of when making these decisions, which always need to be done as a team with nursing. The burn staff cannot go to other floors to perform specialized wound care such as post-op dressing take down, wound debridement, etc. Overflow burn step-down patients can go to 7 West or 7 South. Patients with isolated inhalation injury can overflow to 4 ICU. Pediatrics can handle children with minor burns.

Transfer calls not requiring admission can be referred to the outpatient clinic for follow up. Please obtain their phone number so we can call them and schedule an appointment and see if they have any questions or concerns. The clinic is open Monday through Friday from 7:00am to 3:30pm. Patients can also be seen in the clinic for their initial evaluation or follow up if they fit into the clinic hours. Use your clinical judgment on off hours and weekends. Patients should not be transferred to the Burn Unit for an evaluation and then sent home like it is a clinic appointment. The patient can be admitted for a 23-hour observation and must be seen by an attending prior to discharge in the morning. It is also not a good practice to transfer a patient from one emergency room to another for evaluation. One main reason is that most insurance companies won’t pay for two emergency room admissions for the same problem and then the patient is left with the expense and that is poor customer service. Again, a 23-hour admission may be necessary for this patient, if burn clinic follow up in 1-2 days is not satisfactory. This decision is one you can make with the Chief and attending.

Remember to be kind and courteous to referring providers. These transfers are why we are such a successful Burn Center.
Introduction

The following comments are a collection of random thoughts and are your introduction to the Burn Center. Unfortunately, unless you read them immediately after your arrival as a burn team member you may only learn the pearls after some less than perfect plan has already been put into action!

Each segment starts with a comment about the philosophy behind the plan we use.... making the assumption that we usually have some sort of reason for doing what we do. Please note that as in all of medicine there are a lot of things that are done just because our ancestors told us to do it that way. I have tried to write this booklet in conversational English rather than the usual stuffy dull formal prose found in texts and articles, so don’t be surprised to see a few slang words or phrases. It is designed to form your orientation package to the Burn Center. Since all students and residents rotate at different times, it becomes unimaginably boring (not to mention impossible) to try to orient each new person verbally. Therefore, consider this your physician orientation package to be read carefully and then to be used as a basis for questions or other things you don’t understand.

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>am burn clinic: Paula Petersen</td>
<td>Burn/Trauma Clinic</td>
</tr>
<tr>
<td></td>
<td>pm burn clinic: Dr. Liu</td>
<td></td>
</tr>
<tr>
<td>Tuesday</td>
<td>am burn clinic: Paula Petersen</td>
<td>Burn/Trauma Clinic</td>
</tr>
<tr>
<td>Wednesday</td>
<td>am burn clinic: Dr. Sanford</td>
<td>Burn/Trauma Clinic</td>
</tr>
<tr>
<td></td>
<td>pm burn clinic: Dr. Baldea</td>
<td></td>
</tr>
<tr>
<td>Thursday</td>
<td>am burn clinic: Paula Petersen</td>
<td>Burn/Trauma Clinic</td>
</tr>
<tr>
<td></td>
<td>pm burn clinic: Paula Petersen</td>
<td></td>
</tr>
<tr>
<td>Friday</td>
<td>am burn clinic: Paula Petersen</td>
<td>Burn/Trauma Clinic</td>
</tr>
<tr>
<td></td>
<td>pm burn clinic: Paula Petersen</td>
<td></td>
</tr>
<tr>
<td>Daily</td>
<td>07:00-08:30 am</td>
<td>Patient Rounds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BICU (except Wednesday at 06:00 due to grand rounds)</td>
</tr>
<tr>
<td>Monthly</td>
<td>9am every third Wednesday</td>
<td>QI Meeting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Burn Conference Room</td>
</tr>
</tbody>
</table>

Links of Hope Support Group: 2nd Tuesday of the month.
Burn Research Group: 1st and 3rd Mondays of each month
Burns ORs Tuesday, Thursday, and Fridays
Opening of Wounds

Wounds are open for inspection by the burn team each day. This varies depending on the technique of management or closure being used. In general, wounds are not opened at other times unless a special circumstance dictates, i.e., question of clinical necessity. Mark the white board in the break room if you wish to see a patient’s wounds the next day. If multiple requests are made for the same day it may be necessary to spread them out throughout the day. The priorities for service to see are new admissions not viewed by attending yet, patients needing to make a decision for OR (cases must be booked by 09:00 am the day before the case, the Burn OR days are Tuesday, Thursday and Friday), post-operative service dressing take downs and then any other serial wound checks.

Attire

Proper attire in the Burn Center is fresh scrubs. These should be Loyola scrubs changed daily and are not to be worn from home. You may not wear anything from home over scrubs except scrub gowns provided in the unit. Masks are required for viewing any open wounds. You must wear gloves when touching patients, and wash hands before and after patient contact. There is waterless soap available outside of each patient’s door. You may use gel or soap and water but must do so before and after EVERY patient contact. The gel soap is the preferred method.

You should know that anything that is within the patient’s environment, i.e. bed, nightstand, etc. can be colonized with bacteria. If you lean or sit on the furniture, then you can serve to transfer the bacteria to the next patient. So, BE CAREFUL!

Also, if you are going to do any procedure on the patient, you should gown to prevent contaminating your clothing. This is a MUST and WILL BE MONITORED!

You must wear gowns, gloves and masks before entering all rooms in ICU.

On the step-down unit follow isolation signs if applicable.
Burn Center Infection Control Guidelines

Attire

1. Clean scrubs must be worn in the Burn Center and changed daily.
2. Personnel having direct physical contact must gown accordingly when there is a risk of soiling scrubs (impervious gown/mask/gloves).
3. Impervious gowns should be worn over scrubs along with additional protective attire available in each patient room when required.
4. A buttoned white lab coat must be worn when leaving the Burn Center. It may not be worn in the ICU.
5. Professional dress other than scrubs may be worn in the Burn unit in the hallway, nurse’s station, patient/staff lounge, and ICU ante room; gowns are required over clothes in the ICU patient rooms.
6. Impervious gowns and masks must be worn for all invasive procedures performed and changed after procedure completion.

Hand washing/Gloves

1. Handwashing is required before and after each patient contact and should include the forearms. Use hand washing gel or soap and water.
2. Gloves should be worn for direct patient contact with the patient and their environment; hands must be washed after removal of gloves.
3. Clean gloves are used whenever handling patients or their dressing; each patient has their own box of clean gloves. (Patients do not share gloves.)
4. Handwashing is mandatory after using the bathroom.
5. If you do not wash your hands, anticipate that someone will direct you to do so.
6. The only time hand gel is not acceptable is if a patient has C-diff, or other resistant organisms such as Aspergillus & ESBL; in these scenarios, you must wash hands with soap and water after contact (signs are posted when this is necessary).

Universal Precautions

1. Universal precautions must be followed at all times, there are no exceptions, even for off service and non-burn patients.
2. Masks are worn at all times in the ICU, whenever wounds are exposed, and in the tub room.
3. Paper gowns may not substitute when an impervious gown is indicated.
4. Masks should never be worn around the neck or under the chin.
5. Gown, gloves and mask are the standard in the ICU and if you are opening a wound on the floor or in the ICU.
MRSA Screening

All patients admitted must be screened for MRSA with a nasal swab. This includes pediatric patients too!!! Orders are included in the burn admission order sets.

There is a nurse-driven decolonization protocol if the patient tests positive. They will receive topical intranasal mupirocin BID for 5 days and daily chlorhexidine baths throughout their ICU stay.

Guidelines For Invasive Procedures

Peripheral IVs, even if they are started through the burn are sufficient. We do not use the saphenous vein because the incidence of phlebitis and subsequent suppurative infection is very high. Central lines may be needed with burns > than 20% TBSA or in patients with severe smoke inhalation, or in the elderly patient with pre-existing cardiac problems.

♦ Catheters should be inserted using aseptic technique.
♦ Catheters should be inserted in a new site as seen in the following requirements
♦ Peripheral Intravascular Catheters
♦ Cannulas inserted during emergency without optimal technique must be changed within 24 hours.

General Issues

1. Complete barrier precautions will be utilized for all invasive procedures, including arterial lines.
   ♦ Surgical Cap
   ♦ Sterile Masks
   ♦ Gowns
   ♦ Sterile gloves
   ♦ Broad sterile draping, i.e. the head of the bed for subclavian and internal jugular lines. Use a disposable laparotomy sheet.

2. Minimize the number of “sticks” if at all possible.
   (2) per clinician

3. Order of preference for sites: internal jugular >> subclavian > femoral (with attending approval only). All internal jugular and femoral lines should be placed with ultrasound guidance.

4. All lines should be sutured in multiple locations to prevent falling out.
Changes

1. ALL lines placed prior to patient arrival in the Burn Center need to be replaced if still needed within 24 hours of admission to the ICU.

2. All lines are changed every 7 days. If a line is extended past 7 days, the attending must be notified and a notation must be made in progress note as to why line is extended.

3. If access is limited, lines may be changed over a wire for a routine change, with attending approval. This is not acceptable in:
   - Patients with suspected line sepsis
   - Patients with insertion site erythema

4. All groin lines placed in the ICU should be removed within 24 hours or consult with attending.

In Septic Patients

1. If a line infection is suspected (erythema, tenderness, induration, purulence), the line should be removed and cultured.

2. If the patient appears infected, but the source is unclear:
   - Obtain blood cultures from the line at both the proximal and distal ports, and send for QUANTITATIVE CULTURE (>1000 colonies-remove line)

3. Patients with bacteremia or fungemia should have all lines removed and cultured.

Bronchoscopy

The Burn Center Bronchoscopy cart is in the ICU. The Bronch cart must be sprayed with cavicide between uses and each bronchoscope must be cleaned and taken to materials for processing after use. See cart for cleaning instructions. BAL (bronchoalveolar lavage) is sent on all admissions that are intubated prior to arrival.

Bedside Tracheostomies

The Burn Center performs some Tracheostomies at the bedside. There is an equipment list available of all the items needed for the procedure.

Escharotomies

Escharotomies are performed at the bedside in the Burn ICU, often with conscious sedation. The Burn Center has an electrocautery unit, so it is not necessary to go to the operating room.
Our philosophy is that people put into action only those things which they are absolutely sure are correct; for everything else, make a plan but check with your senior helper before instituting it. You will never get into trouble by asking before doing. You will get into trouble by instituting an incorrect plan without the advice of your senior helper.

The Senior is the Chief Resident. This means he/she knows everything or at least knows where to find the answer. The Chief Resident is expected to know everything important about the service (by the way, “important” is by his/her definition, not yours). The Chief Resident must know what is going on at all times in order to provide optimal care to patients.
## People Who Can Help You

Here follows a list of Burn Team Members who can be of great help to you. When you have questions they will always be happy to hear from you and will answer your questions with enthusiasm.

### BURN TEAM

<table>
<thead>
<tr>
<th>TITLE</th>
<th>NAME</th>
<th>EXTENSION</th>
<th>PAGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistant Professor/Burn Director</td>
<td>Anthony Baldea, MD</td>
<td>7-2467</td>
<td>643-0949</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>Yuk Ming Liu, MD</td>
<td>7-2811</td>
<td>643-0840</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>Arthur Sanford, MD</td>
<td>7-2898</td>
<td>643-8048</td>
</tr>
<tr>
<td>Acute Care Nurse Practitioner</td>
<td>Paula Petersen, RN, MSN</td>
<td>6-4849</td>
<td>643-0642</td>
</tr>
<tr>
<td>Nurse Manager</td>
<td>Jeanie Leggett, RN, BSN</td>
<td>6-3529</td>
<td>643-1660</td>
</tr>
<tr>
<td>Assistant Nurse Manager</td>
<td>Sandra Dominguez, RN, BSN</td>
<td>6-3529</td>
<td>643-1638</td>
</tr>
<tr>
<td>Clinic Nurses</td>
<td>Diana Percival, RN, BSN</td>
<td>6-8022</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Courteney Christensen, RN, BSN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurse Educator</td>
<td>Julie Liberio, RN, MSN</td>
<td>6-5076</td>
<td></td>
</tr>
<tr>
<td>Occupational Therapist</td>
<td>Eugenia Gavrilos, OT</td>
<td>6-8800</td>
<td>643-1690</td>
</tr>
<tr>
<td>Physical Therapist</td>
<td></td>
<td>6-8800</td>
<td></td>
</tr>
<tr>
<td>Case Manager</td>
<td></td>
<td>6-8800</td>
<td></td>
</tr>
<tr>
<td>Pharmacist</td>
<td>Sarah Zavala, PharmD, BCPS, BCCCP</td>
<td>6-8184</td>
<td>643-1690</td>
</tr>
<tr>
<td>Dietitian</td>
<td>Jen Larson, RD, LDN</td>
<td>6-8659</td>
<td>643-2358</td>
</tr>
<tr>
<td>Social Worker</td>
<td>Kelly McElligott, LCSW</td>
<td>6-8739</td>
<td>643-2497</td>
</tr>
<tr>
<td>Psychologist</td>
<td>Elizabeth Simmons, PsyD</td>
<td>6-6200</td>
<td>643-9451</td>
</tr>
</tbody>
</table>
Important Definitions

Skin
Skin is the body’s envelope; it keeps bad things out and the precious bodily fluids in. The skin is the prime regulator of body temperature and permits working, walking, and love making. You can live without half of your liver, kidneys, lungs, or for that matter, without most of your GI tract and probably considerably less than half your brain, but you need just about all of your skin. The skin is made up of two equally important layers.

Epidermis
Epidermis is the outer most layer of rapidly reproducing epithelial cells; it creates a permanent outer cover for normal skin and for all wounds when wound healing takes place. Epidermis is made up of about four different layers that are of interest primarily to the dermatologist and histologist teaching first year medical students. I’m sure you remember this vital information, but all four layers are usually cooked in the burn patient, so we need not think about them further, except to remember that our pigment cells (melanocytes) live in the deepest of the layers, the basal layer. The epidermis varies in thickness from 0.2mm on the eyelid to several millimeters in callouses of the hand or foot. The epidermis extends into the dermis by way of the skin appendages; hair follicles, sebaceous glands and apocrine sweat glands. Some of the apocrine glands in the axilla and groin actually extend all the way down into the fat. When the sheet-like cover of the epidermis is burned away, the resultant wound can only heal by lateral overgrowth of the epithelial cells living in the skin appendages. After the dead dermis comes off (by daily debridement), the cells from one appendage grow out of the appendage and spread along the raw dermal surface to meet the cells coming out of another appendage. When they are migrating, they produce the characteristic appearance of epidermal “buds” or epidermal “pearls”. Epidermal buds appear as white dots in a red background of granulating dermis. The red dots that sometimes appear on white wounds are known as “fat domes” which are bits of granulating fat peeking through dermis that is devoid of appendages. These red vs. white dots are frequently a point of confusion; if the naive observer thinks that the red dots are epidermal pearls, he will think that a wound that really won’t heal is actually healing nicely and he may erroneously report such in the chart or to the attending. The deeper the burn, the fewer the remaining skin appendages and the farther they are apart. Thus, the deeper the burn, the farther the epithelial cells have to migrate and the longer it takes the wound to heal. Furthermore, the deeper the burn the more the dead dermis that must come off before epithelial migration begins. Epithelial cells migrate under a variety of stimuli, but the total distance they can spread is about one centimeter, growing at a rate of about a millimeter a day. Thus a round wound, two centimeters in diameter, will heal in approximately 10 days. When a wound is larger than two centimeters, if the wound edges can contract, it heals by wound contraction. If the wound edges cannot contract (as over the tibia or on the heel) the wound becomes a chronic ulcer. If the edges can approximate themselves (as over a joint) the wound will close by contraction but may leave the patient with a contracture. To repeat: wounds heal at least, in part, by contraction which may lead to a limitation of motion (a contracture) across a joint.

Dermis
The dermis is the stromal tissue that supports the epidermis and the skin appendages. There are no specialized native “dermal cells.” The dermis is composed of highly structured and organized collagen, wandering cells, blood vessels elastic fibers, and a glue-like substance, glucose-amino-glycan (GAG), which is also known as “ground substance”. The dermis has no regenerative
capacity and heals by scar formation (see below). Dermal thickness varies from less than 0.5mm on the eyelid to 3-4mm on the back.

**Scar**

There are whole books written about scars and scarring. People seem to think they know what scar tissue is, but they definitely don’t know why scar tissue sometimes overgrows and becomes ugly, or why it eventually matures, or why some people scar badly and others don’t seem to scar at all. A scar is made up of disordered rather than highly structured collagen, has an improper number of elastic fibers, and has a different ratio of GAG to collagen than normal skin. Scars mature over many months. They never become non-scars, but they do soften, lose their intense red inflammatory response, and they may flatten.

At unpredictable times and for unknown reasons, tissue collagenase quit molding the scars and at some point the scars stop changing. This takes a variable length of time, but almost never less than a year. In some patients the inflammatory process may continue for up to two years and it may go even longer if there is continued break down of the epidermis over the original scar. The recurrent ulceration and healing of the epidermis maintains the intense inflammatory response for many months or even years. The process culminates in a rare but highly malignant burn scar squamous carcinoma known as a Marjolin’s ulcer. This only occurs in neglected unhealed scars not in the ones we usually make. The more inflammation in a wound the greater the potential for ugly scarring. It seems logical that the sooner you get a burn covered with the patient’s own skin, the less the intensity of the inflammatory response. That’s one major reason we try to primarily excise and graft burns as soon as we can after the burn occurs, although we have not yet been able to prove that it makes any difference. Hypertrophic scars are scars that are raised above the surface of the wound (exuberant not just wrinkled) but these kinds of scars remain confined to the wound itself and are different from keloids which are essentially tumors with scar tissue that invades beyond the margin of the original wound.

**Pressure and Scars**

Pressure applied to healed wounds does not prevent scarring but there is some clinical end experimental evidence that pressure flattens the scar tissue, and perhaps makes the long term results more acceptable. We generally treat patients who have skin grafts and those whose burns have taken longer to heal with pressure bandages of two types - compression garments (expensive) or Tubigrip (tubular elastic bandages) in several sizes that are less expensive than compression garments.

If pressure is applied to the scars, we suggest it be applied 23 hours/day and continue until (1) there is evidence that the patient will have flat scars without further use, (2) the scars become mature, or (3) the patient demonstrates that he won’t wear it anyway.

**Experimental Animals and Hypertrophic Scars**

One reason that there isn’t any experimental data on hypertrophic scars is that there are no animals other than humans that develop hypertrophic scars. The eagle is reported to scar, but it seems unlikely that that particular line of research will ever get very far.

**Steroids and Scars**

Triamcinolone injected directly into a raised scar is supposed to help the scar atrophy.

**First Degree Burns**

A first-degree burn extends only into the epidermis. Such burns never blister, they are painful, and they get better in 3-4 days without scarring. A few days after the pain goes away sheets of dead epidermal cells come off (peeling) as the dead epidermis desquamates. Burns initially appearing as first degree may blister within 12 hours, in which case they are not really first degree
after all but superficial dermal burns. Severe sunburn with blistering is a superficial dermal burn. Blistered sunburn is treated like any superficial dermal burn using biologic dressings, etc.

First degree burns are not calculated in burn diagrams or in overall total percent burn of a patient with more serious burns. First degree burns are treated with a soothing lotion (such as aloe vera) and plenty of pain medication (narcotics are OK).

**Dermal Burns: (Partial Thickness)**

Dermal burns extend through the epidermis and into the dermis. Superficial dermal burns extend only through the upper dermis (called the papillary dermis) and will heal within 1-3 weeks. They are usually uniformly pink, moist and painful. If left alone, they heal without scarring or functional impairment. Deep dermal burns extend into the reticular (deeper layers) of the dermis. Deep dermal burns are white, or mottled white when initially cleaned. They are usually fairly dry instead of moist, not very painful, and pin prick may be interpreted as pressure. They are often hard to tell from full thickness burns, but since they will usually be excised and grafted anyway, the distinction between deep dermal and full thickness burn is not too important in most patients.

Left to their own devices, deep dermal burns will heal in 3-8 weeks if they don’t become infected. Unfortunately, when they heal spontaneously, they are likely to do so with severe scarring and with significant loss of function. We try to excise and graft non-healing deep dermal burns to avoid scarring and functional impairment. The trick is to tell the difference between wounds that will heal in 2-3 weeks without scarring, and those that won’t. Unfortunately, that is not always an easy chore.

**Full Thickness Burns**

Full thickness burns extend all the way through the dermis into the subcutaneous fat. Because all of the skin appendages are burned away, such burns can only heal by epithelial migration from the periphery and by wound contraction.

Since these burns will eventually need to be grafted anyway, we excise and graft such burns early before they become infected, and also to shorten the patient’s hospital stay. Fourth degree burns are full thickness burns that extend through skin into the fat, muscle, tendon or bone. Decubiti, electrical, molten metal, and flame burns where the victim is trapped, or unconscious (or super-drunk), and some immersion scalds are potentially fourth degree burns.

**Burn Diagrams**

The body can be fairly accurately divided into known percentage areas of the total body surface... these are represented in the computer and are called the Burn man diagram. Every patient admitted to the Burn Service with an acute burn needs a burn diagram. Be sure that you use the initial burn diagram for the admission drawing. If the burn is not obviously shallow, color the burned area “indeterminate or deep” and you will usually be correct. Please update as more skin debrides.

**Eschar**

Eschar is pronounced “es-kar,” not “es-sshar.” Eschar is dead dermis that remains attached to the wound bed. Eschar is not the coagulated serum, bits of desiccated cream or other debris left on the wound after cleansing. That stuff can be called crusts, scabs, or whatever you want, but not eschar.

**Pseudo- or Neo-eschar**

Desiccation denatures the collagen or exposed dermis leaving new dead dermis on the surface. This newly dead tissue is pseudo-eschar. Pseudo-eschar sacrifices more dermis, making the wound deeper. Pseudo-eschar will typically lift with time; often times, we will use collagenase (Santyl) to help mechanically debride the pseudo-eschar from wounds. Eschar will not lift with Santyl.
The once or twice daily debridement and wound cleansing takes place in the Hydrotherapy room or the patient’s shower, or for those on a ventilator, in their bed.

**Initial Care and ICU Issues**

**Philosophy**

To maintain circulating volume in the simplest, safest, and cheapest manner. The goal is to have at 48 hours an alert patient who is not in cardiac, pulmonary, or renal failure. Capillary permeability is caused by a number of acute inflammatory mediators released by cellular destruction. When you hit your thumb with a hammer it hurts, it swells and it gets hot. A burn does the same thing; the symptoms are limited to the area of the burn itself as long as the total burn is less than about 25% TBSA. When the burn is larger than that, the local reactions become systemic ones. Capillaries everywhere become permeable to molecules up to 500,000 Daltons. Fortunately, the leak probably begins to seal at about 12 hours. The deeper the burn the more the acute inflammatory mediators that are made and the worse the capillary leak. Smoke inhalation aggravates the capillary leak in the lungs, which will significantly increase the fluid requirements during resuscitation. Most patients (including children) with burns less than 15% TBSA can be resuscitated orally. Kids get Pedialyte, adults get juices. If IVs have already been placed before you see the patient, leave them in, but don’t start new ones until you are sure the patient won’t tolerate oral fluids. For bigger burns (>20% TBSA), the Parkland formula is used (lactated ringers solution in a dose of 2-4ml/kg/% burn with half given in the first eight hours). For children up to age three or so, normal daily maintenance fluids are given in addition to the Parkland formula.

Urine output of 30ml/hr is fine for adults; for kids 1.0-/Kg/hr is OK. The formula predicts an estimate of how much fluid the patient will require. The patient’s actual physiological response to injury and resuscitation will guide the hourly fluid rate. There is a Burn Resuscitation Order Set with a nurse-driven protocol that delineates the steps for hourly fluid resuscitation. This protocol should be followed unless directed otherwise by the attending on call.
Burn Resuscitation: ABC’S and Complications

During the first 24-48 hours post-burn, massive fluid shifts along with critical changes in the vasculature occur, which adversely affect the severely burned patient. These changes are mediated by a variety of factors (histamine, prostaglandins, serotonin and vasoactive amines), which allow for changes in vascular permeability and allow for the massive burn wound edema seen at 8-24 hours post-burn. The end result is changes in the microvasculature with disruption of the normal capillary barriers with resultant depletion of the intravascular volume and marked increase in the extracellular fluid. Edema fluid, with its rich composition of electrolytes and proteins, contributes to the enormous fluid losses seen in the acute burn period. Severe “third space” losses contribute to a myriad of complications. Ultimately, hypovolemia becomes apparent with the lack of adequate volume resuscitation.

In burns, many complications can arise early in the care of the severely burned patient. Although complications can arise at any time during the burn patients’ hospitalization, a large body of complications can occur during the acute resuscitative phase. It is these complications which will be reviewed in the following text.

If one were to consider a burn an extension of traumatic disease, the ABC’s of resuscitations must be strictly adhered to. With this, the airway of the burned patient becomes the most important single focus upon arrival of the patient to a Burn Center. Patients with massive burns receive massive amounts of fluid in the first 24-48 hours post-burn. As with the massive edema that occurs in and around the burn wound itself, edema also greatly affects the glottis, epiglottis and the vocal cords. The edema can become severe enough around these vital airway structures so as to prohibit intubation in cases where airway protection was delayed. This can invariably lead to patient demise or the necessity of a surgical airway (with possibility of massive neck edema being present). Hence, delay in recognition of the need for airway protection can allow for an adverse outcome in the critically ill burn patient.

If we continue to follow the ABC’s of resuscitation, the breath sounds of the acutely burned patient are of next most importance. Continuous reassessment of patient breath sounds must occur in order to avoid numerous complications. Despite the initial appearance of some patients who seem to have a stable airway, extreme caution must be exercised in these patients as they may develop airway edema which could preclude intubation. With the massive resuscitations this subgroup of patients receive, burn wound edema not only affects the burn wound, it affects the airways (both directly and indirectly). In instances where an inhalation injury has occurred along with the burn, lung stiffness can occur and impose a decrement in the ability to ventilate and oxygenate the patient. Along with this, protein rich fluid “pours” into the lung and allows for the development of a further decrement in pulmonary function. Furthermore, edema of the chest wall can worsen airway pressures so as to effectively inhibit any ventilation. It is in these instances that the astute Burn Surgeon proceeds with chest wall escharotomies to re-establish a more tolerable peak inspiratory pressure and allow for more effective ventilation. Without recognizing this complication, hypercarbia, worsening acidosis and the risk of pneumothorax place the critically ill burn patient in grave danger.

The circulation portion of our ABC’s of resuscitation deal mostly with the massive resuscitation that occurs during the initial 48 hours post-burn. It is during this time period that under-resuscitation may occur, leading to hypovolemic shock and acute renal failure. During this phase, we must account for many organ systems. First and foremost, the total body surface area burned will dictate approximately how much intravenous fluid will be administered over the ensuing 24-48 hours. A simple and well known formula is the Parkland formula, which is:
(%TBSA Burn) x (weight in kg) x 4 \rightarrow \text{this calculates the approximate 24 hour need of the patient.}

One-half of the total is given in the first eight hours, with the remainder being administered over the ensuing 16 hours. Note, this is only a guide to therapy, as adequate urine output (our basic determinant of end-organ perfusion) is the goal of resuscitation therapy. Other formulas exist, but the above equation is a simple guide to relay to the community practitioner who is transferring a patient to a Burn Center. Without this guide, severe under-resuscitation may occur, allowing for the sequelae of hypovolemic shock (renal failure, myocardial infarction in the patient with cardiac disease and ultimately death). Lactated Ringer’s solution (or any other isotonic solution) is the resuscitation fluid of choice, during acute burn resuscitation. When patients are not making adequate urine output on crystalloid resuscitation alone, albumin is added. Boluses of crystalloids should be avoided, as these may also worsen tissue edema prohibit adequate restoration of the intravascular space. \textit{All of this is delineated on the fluid resuscitation protocol.}

Over-resuscitation of the burn patient also presents its own inherent complications, mostly in the form of worsening edema. The massive edema which can occur, leads to the development of the following:

1. Compartment syndrome of the extremities (with the urgent need for escharotomies and possibly fasciotomies),
2. The development of abdominal compartment syndrome (with resultant difficulty in ventilating the patient, diminishing urine output, and the need for laparotomy to relieve the intra-abdominal pressure). (Note that abdominal compartment syndrome constitutes the symptomatology along with elevated intra-abdominal pressures) and
3. Increasing ventilator requirements secondary to worsening pulmonary interstitial edema with persistent increase in peak inspiratory pressures, hypercarbia, and worsening respiratory acidosis, (all which confound an already severe metabolic acidosis). In these patients, one may need to relieve an abdominal compartment syndrome and perform chest wall escharotomies to improve the overall ventilation/oxygenation of the patient. Also control of airway pressure is critical to prevent inhalation induced lung damage and may require a change in the mode of ventilatory support.

While on the subject of circulation, one must not neglect the need for intravenous access in the severely burned patient. In most instances of large burns, it becomes a daunting task to find peripheral intravenous access. Along with this, it is preferable to place an intravenous catheter at a site distant to a burned extremity. Given this, central intravenous access becomes the “gold-standard” method to obtain access in the severely burned patient. As with everything else early on in the acute phase of burn resuscitation, this too can be a difficult task. In some instances, the catheter must be placed through burned skin. This increases the risk of catheter related infection, but not acutely. What can pose a threat early on is the risk of major vascular injury (both via insertion-related injury and the possible limb threat that can occur by vessel occlusion or thrombosis) and pneumothorax. Pneumothorax can ultimately lead to demise of the patient in whom it is already difficult to ventilate (who has already developed increase peak airway pressures and requires increased PEEP). Adding pneumothorax to the above, (along with the massive edema, an abdominal compartment syndrome, a delay in diagnosis of the pneumothorax, and the need for chest wall escharotomies) leads to an almost uniformly fatal result.

The very young and the very old pose interesting challenges during all resuscitative phases of the patient’s hospitalization. In the very young, the patient cannot be resuscitated by the Parkland formula (or any formula) alone. This subgroup of patients must also have maintenance fluids administered so as to prevent under-resuscitation. In addition, children must have their glucose
monitored as they have a higher risk for hypoglycemia. In the elderly, coronary artery and pulmonary disease, along with other co-morbidities, confound an already difficult resuscitation. Early non-response to resuscitation (with poor urine output and progressive cardiogenic and hypovolemic shock) leads to myocardial infarction and acute oliguric renal failure. Once this occurs, the elderly patient has an enormous risk for the development of an adverse outcome. Hence, early determination of a poor response to resuscitation, along with the use of more invasive hemodynamic monitoring, can guide therapy in these instances and allow for optimization of patient hemodynamics. Aggressive pulmonary toilet along with early mobilization of the non-intubated patient allows for decreased morbidity. Once intubated, the elderly patient is at enormous risk of prolonged ventilation, along with the possible need for tracheostomy. Ultimately, one must have an overall heightened awareness in the elderly patient to avoid any of a myriad of complications that may occur.

As eluded to above, certain instances exist where patients may require excessive resuscitation (in extreme excess of calculated Parkland formula). These instances are many and include the following:

1. Delay in resuscitation- must attempt to “catch-up” with resuscitation
2. Missed injuries- concomitant trauma with risk of bleeding from distant sites
3. Alcohol/illicit drug use- diuretic effect worsens shock
4. Patient with escharotomies and deeper injuries- increases insensible losses, risk of bleeding
5. Massive electrical injuries- injuries under-estimated
6. Severe inhalation injury- patients need overall increased resuscitation (up to 40% more fluid)
7. Hyperglycemia/mannitol administration- with potential osmotic diuresis

In all of the above instances, if one fails to identify the confounding factor, under-resuscitation may occur, again placing the patient at risk of progressive hypovolemic shock. By identifying any of the above factors, one may adjust fluids appropriately to ensure adequate urine output and tissue perfusion.

After the initial 24 hours of resuscitation, especially in massive resuscitations, electrolyte derangements may occur. Hypernatremia, hyperchloremia, along with hyperkalemia (in the patient with delayed resuscitation and the development of renal failure) can make fluid administration a challenge. With this in mind, frequent laboratory assessment of the patient electrolytes will aid in correcting the abnormalities. Once abnormalities have been identified, fluids can be adjusted appropriately. Along with this, once the initial 24 hours of resuscitation have been completed, colloid administration can begin as the capillary membranes have sealed. The greater risk at this point is not restoring the plasma oncotic pressure with resultant accentuation of edema.
STEP ONE: Adult Fluid Resuscitation: Patient weight _____ kg, Burn size: _____ %, Parkland Estimate: _____

STEP TWO: Start LR at calculated rate: _____ ml/hr.
Measure VS and urine output every hour and bladder pressures Q 4hrs.

Vitals stable: HR < 140 and MAP > 60
- UOP < 15ml
  - Increase IVFs by 20% or 100 ml/hr (whichever is greater)
- UOP 15-29ml
  - Increase IVFs by 10% or 100 ml/hr (whichever is greater)
- UOP 30-50ml
  - Keep IVFs at current rate
- UOP > 50ml
  - Decrease IVFs by 10% or 100 ml/hr (whichever is greater)
- UOP > 200ml
  - Decrease IV rate every hour by 10% or 100 ml/hr, whichever is greater. Be sure to assess patient’s blood sugar, BP, HR before decreasing IV rate. Consult with MD/NP for any questions.

CALL MD/NP, start vasopressin (0.04 u/min)

REPEAT STEP TWO EVERY HOUR, if successful go back to original calculated IV rate

SUCCESSFUL RESUSCITATION
24 hr post injury fluid resuscitation is COMPLETE

STEP THREE (failed)
CALL MD/NP, start Albumin Protocol (see page 2)

FAILING RESUSCITATION
UOP < 15ml/hr for 2 hrs despite an increase in IVFs or if at 150% of Parkland prediction

IF patient again develops oliguria or unstable vitals during the Albumin Protocol
CALL MD/NP and increase IVFs (LR) by 10%
**ALBUMIN PROTOCOL**

To be initiated if patient is failing fluid resuscitation (UOP < 15ml/hr for 2 hrs or unstable VS) or has complications related to edema. If inadequate improvement after 3 hours, should consider Plasma exchange.

**REMEMBER** to continue to measure urine output hourly. If greater than 50 ml/hr, Decrease IV rate by 10% or 100 ml/hr, whichever is greater.

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**Failing Fluid Resuscitation Rescue**

5% Albumin is started at 1/3 current rate of LR and LR is decreased to 2/3 current rate. (Example: LR at 900ml/hr should be changed to LR at 600ml/hr and 5% albumin at 300ml/hr)

Repeat step two until patient maintains calculated resuscitation rate with UOP > 30ml/hr and MAP > 60

When combined LR and Albumin rates reach the calculated resuscitation rate, change to LR for 2hrs

If UOP is maintained for 2hrs on LR and patient is > 24 hours post injury, fluid resuscitation is COMPLETE. Change to D5 0.45%NS w/ 20mEq KCl at calculated maintenance rate (per MD/NP order)

**Inadequate Albumin**

If patient’s oliguria or unstable vitals have not responded to 3 hours of albumin protocol, CALL ATTENDING.
Loyola University Burn Center

Fluid Resuscitation Worksheet

(For TBSA >20%)

Patient Label

Wt. _____ _____ Time Initiated __________

**Parkland Formula**  
4ml / % of Burn/KG = ________________ = 24 hr requirement

1st 8 hrs = ______________ ml ___________ ml/hr

Next 16 hrs = _____________ ml _______________ ml/hr

**Maintenance Fluid – to be determined by MD/NP**

100 ml/kg - 1st 10 kg  
100 x 10 kg = 1000 ml

100 x 10 kg = _____________ ml

50 ml/kg - 2nd 10kg  
50 x 10 kg = 500 ml

50 x 10 kg = _____________ ml

25ml/kg - Remainder of kg wt.  
25 x ? kg = ____ ml

25 x ? kg = ______________ ml

24 hr Fluid Requirement = __________ ml

Hourly rate = ___________ ml/hr

**Albumin Protocol**

Once Albumin Protocol is started, give 5% albumin at 1/3 the current LR rate and LR at 2/3 the rate.

Current LR rate divided by 3 will equal your starting rate of Albumin  
(Example: LR at 900 ml/hr ÷ 3 = 300 ml/hr of Albumin, LR decreased to 600 ml/hr)

1/3 Albumin __________ ml/hr

2/3 LR ______________ ml/hr

P Petersen RN, ACNP & J Liberio RN, MSN 5/2013
Abdominal Compartment Syndrome

Patients who are burned are at risk for the development of abdominal compartment syndrome. Although this is a rare complication, its consequences can be devastating. Most importantly, evaluation of abdominal compartment syndrome is not just the measurement of elevated bladder pressure (signifying intra-abdominal hypertension, greater than 25 cm H2O), but includes the clinical symptoms to match the elevated abdominal pressures. First of all, the measurement of the abdominal pressure is a pressure which is measured indirectly. Measurement occurs by connection of a pressure transducer to a clamped Foley catheter. If the measurement of the bladder pressure (and hence the abdominal pressure) is greater than 25 cm H2O, this is one of many variables that should lead the burn team member to have heightened awareness of the possibility of abdominal compartment syndrome. More importantly, though, the patient of note must have a constellation of clinical symptoms which further validate the onset of abdominal compartment syndrome. The symptoms, which accompany the elevated bladder pressures, include the following:

1. Difficulty in patient ventilation secondary to ineffective diaphragmatic excursion. Peak airway pressures are often elevated, and there will be a resultant hypercapnia and hypoxia with difficulty ventilating.

2. Decreased urine output secondary to diminished cardiac output and impaired renal perfusion (which is secondary to vena cava compression and decreased venous return)

3. Abdominal distention/rigidity

4. Resultant tachycardia.

In most instances, one may find a patient with an elevated bladder pressure, but with none of the above symptoms. Again it is the symptoms, along with the elevated pressures, that mandate intervention. In such instances, when one has a definitive diagnosis of abdominal compartment syndrome, immediate operative decompression of the abdomen along with placement of some sort of prosthetic (vicryl mesh, silo constructed of iv bags, etc.) coverage will allow for patient improvement and reduction in overall patient mortality by 40%.
Inhalation Injury

Carbon Monoxide (CO)
Any patient suspected of having CO intoxication and/or inhalation (injury) should immediately receive Humidified 100% oxygen by mask until the CO level is < 10%. Normal levels of CO are <5% in non-smokers, and up to 10% in smokers. Once the CO level is < 10%, 100% FiO₂ is maintained for an additional 6 hours to ensure tissue washout of CO. Appropriate clinical judgment should be used in chronic lung disease patients in whom hypoxia is the primary respiratory stimulant.

Thermal Airway Damage
There is no such thing as a pulmonary burn unless patients inhale live steam or explosive gases. However, the upper airway can be burned. Patients at greatest risk are those in explosions (propane, gasoline, etc.) who have face and upper torso burns. Other patients at risk include those who were unconscious in the fire. Look in the patient’s mouth. If the mucosa looks dry and red or has blisters, the patient will probably need to be intubated. The way to tell when to extubate adults is to deflate the cuff and see if they can breathe around the tube after a day or so. This is called checking for a cuff leak.

Pressure Leak Test in the Pediatric Burn/Inhalation Injury Patient
One important criteria prior to extubating any patient is to assure airway patency. The adult intubated patients cuff leaks are assessed by simply deflating the endotracheal cuff balloon and listening for gross leakage with volume loss (>120ml less than set tidal volume), while pediatric intubated patients are measured by pressure leaks. In the staff’s experience, pediatric patients with a leak occurring at a pressure of <25 cwp fulfills the pre-extubation criteria and will likely extubate successfully.

Procedure
1. The RT assembles the equipment needed, such as: a pediatric laerdal manual resuscitator and a pressure manomenter with the bag connected to the flowmeter with a 100% oxygen gas source.
2. The patient is then disconnected from the ventilator and the ETT is attached to the manual resuscitator with hand ventilations started.
3. A stethoscope is then placed on the lateral neck for auscultation of leak.
4. Hand ventilations are modified to gentler squeezing of the bag while observing the rise of the manomenter needle. When the needle holds at a certain pressure, and a
sound like a squeak or gurgle is detected through auscultation, the number on the manometer is then noted as the pressure leak.

5. This number is then relayed to the RN and Burn Service. This is also charted on the back of the Respiratory Ventilator Sheet.

Note: Before initiating a pressure leak test, the patient needs to be suctioned via ETT, nasally and orally to achieve accurate results.

Compressed Vol = Compressibility Factor *(Peak Pressure – PEEP)
Compressibility Factor = Exhaled Tidal Vol / (Peak Pressure – PEEP)

Inhalation Injury

Patients with the combination of carboxyhemoglobin levels > 10%, history of a closed space fire and production of carbonaceous sputum have a very high chance of needing ventilator support if they have associated burns. Singed nasal and facial hairs is not always synonymous with a smoke inhalation injury. The key to diagnosing an inhalation injury relies on the mechanism of injury (prolonged exposure to smoke in an enclosed space) in association with some clinical findings (i.e. carbonaceous sputum, hoarseness, and stridor). With associated burns, the mortality rate for any given burn is doubled with smoke inhalation. We follow patients with blood gases. Never use steroids. One double-blinded study showed twice the mortality and three times the infectious complication rate in patients who received steroids. In the presence of smoke inhalation, resuscitation should progress normally, but slightly on the dry side. Patients with smoke inhalation will almost always require more fluids than patients with the same size burns without smoke inhalation.

Inhalation injury has three distinct phases each of which has its own set of problems with distinct symptoms and signs. Each has a distinct treatment.

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**Nebulized Heparin Protocol for the Inhalation Injury Patient**

Dosage: Adults: 10,000 units given Q4 hours for 72 hours  
Peds: 5,000 units given Q4 hours for 72 hours  
(with option to extend protocol if the patient is still producing carbonaceous sputum)

No suctioning after heparin given for one hour unless absolutely indicated

Alternated with:

Adults: acetylcysteine 20% in 4ml and albuterol 2.5 mg q4 hours for 72 hours  
Peds: acetylcysteine 20% in 2ml and albuterol 2.5mg q4 hours for 72 hours

Note: Patient will be receiving nebulized treatments Q2 hours for the duration of protocol.

Patients will be receiving treatment or suctioning every hour around the clock. They remain on protocol for 72 hours and may be extended if indicated.
Inhalation Injury Cyanide Antidote: Cyanokit (Hydroxocobalamin)

This is given for severe inhalation injury Grade III or IV in addition to Nebulized Heparin Protocol if the patient demonstrates a metabolic acidosis with anion gap, elevated lactate, altered mental status, and suspicion for cyanide poisoning. It should be given within 6 hours of inhalation injury.

   Children: Hydroxocobalamin 70mg/kg IV x 1 (Max single dose of 5gm)
   May repeat the above dose once if necessary.

   Adults: Hydroxocobalamin 5gm IV x 1
   May repeat the above dose once if necessary.

Expected or common side effects: red urine, flushing, HTN, nausea, diarrhea.

The RCP Rotator’s Guide to the Burn Unit

Because of the unique approach to Burn Management, this guide should help you follow the Unit’s Protocol and know your role in the Team.

**Surgical Scrubs** are *mandatory* when assigned to Burns. This is in compliance with Infection Control and also required for transports to the OR which usually occur on Tuesdays, Thursdays and sometimes Friday. You can get your scrubs in the break room and change in the locker room. There are some lockers in the Men’s Locker room that are vacant in which you can temporarily put your clothes in for the shift. Just remember to take any valuables with you. Lab coats are not allowed in the ICU, so you can hang them in the room on the left just through the double doors entrance.
**Daily Rounds** start promptly at 7:00 a.m. Burns is run by a multi-disciplinary team and respiratory therapists are part of that team. We are expected to attend rounds since most of the management plans are discussed at the beginning of the shift. If you are also covering the floor, or have an assignment somewhere else you can of course leave rounds for stat calls. On Wednesdays, rounds start an hour earlier due to resident conferences. Since all practitioners are aware of the SBAR (Situation, Background, Assessment and Recommendation) hand-offs in reporting, information should also include parameters in the management of the patient. For example: If a patient is on PC mode, try to stay within the parameters discussed on rounds. However, if in the middle of the night the patient needs to be on a different mode, have the resident on-call (which could be the plastics resident) get in touch with the Burn Chief before the change.

**Vent Mini Checks** can be done during rounding. Please note the patient’s spontaneous tidal volumes, rate, effective tidal volumes (peds) and plateau pressures. These parameters are often discussed on rounds. Take note of the ETT position. There are several factors that can make the tube trombone in and out, such as: edema from all the fluids introduced as part of resuscitation, edema loss when the patient diureses, tape slippage due to saliva or secretions (peds patients in particular), loose trach ties, and agitation.

**Infection Control** is high priority in the BICU. Please follow the color coded guidelines stickers on the door to each room. Make sure you dispose of the gowns, mask and gloves, wash hands or use the gel before coming out of the room. Infection Control Guidelines may sound redundant, but the BICU is closely monitored by all the staff.

**Securing Airways** is done differently because of the nature of the injury, topical antibiotics and amount of facial edema from the fluid resuscitation. Instead of taping the tube, we use “Trach Ties” to secure the airway and ETT position is measured at the teeth not the lips. The nurse is usually responsible for tying while the therapist stabilizes the airway. We use tape for patients without any facial burns and their injury is mostly inhalation. Depending on the degree of resuscitation, there might be several ETT position changes during the first 5 days of being intubated and daily X-rays are done at this time for placement. When you round with the Team everyone will get to see the X-rays and know if position changes are required. When an unstable
patient needs to be turned due to dressing changes, RCPs are needed to stabilize the airway, especially the pediatric patient.

**Transporting Ventilated Patients** to the Operating Room and back happens on Tuesdays, Thursdays, and Friday.

**Procedures**

**Tracheostomies** are sometimes done at the bedside. As the team starts to prepare for the procedure, it’s a good idea to position yourself by the head of the bed before it gets sealed off by a sterile field. You will need scissors and a 10 cc syringe for cutting the ties and deflating the cuff when extubating as the surgeon inserts the trach. If this is your first bedside trach experience, just inform the surgeon so they can tell you what needs to be done. After the trach is secure please use the vent circuit holder that is specified for the Burn Unit, it is located in the RC Dept. bottom drawer of the CDC. The flexible part of the holder prevents the fresh trach from too much torque and avoids accidental decannulation.

**Bronchoscopies** are essential in determining the degree of inhalation injury. The RCP needs to be present for the procedure in case of any ventilator changes. The O2 needs to be increased to 100% prior to starting. During the bronchoscopy, an initial BAL specimen is obtained by the service. You will be surprised to find out that lungs are often already contaminated very early on in the patient’s pulmonary insult. Subsequent BALs may be needed if patient’s temperature goes to 39 Celsius with increase in sputum production, viscosity and changes in color. After the initial bronchoscopy, the next BALs are done by the RCP.

**Checking Cuff Leaks** in Adults prior to extubating is done just like in any other unit, while checking cuff leaks in a pediatric patient is done by pressure with a pressure manometer and an ambu bag. There is a more detailed description of how this is done in the Department’s Policy and Procedure Manual, and on the Burn Unit’s Resident Manual.

- Adults: Listening for gross leakage and Vt loss of at least 110 ml.
- Pediatric: Pressure Leak < 25 is a judgment call while < 20 is ideal

**Steroids** are routinely **not given** prior to extubating because of the negative effect with healing in the burn patient, but they are given judiciously in certain cases and this is the attending physician’s decision.

**Preferred Modes of Ventilation** in the Burn Unit are SIMV, Assist Control, Pressure Control and Pressure Support. Initially, when an intubated patient is admitted we start off with SIMV. If the patient burns are circumferential around the chest, the switch to Pressure Control Mode happens quickly. On occasion, the surgeon will require you stand by the ventilator and monitor exhaled Vts while they do escharotomies on PC mode. Hybrid modes of ventilation such as SIMV\PC\PS and PRVC are common on the pediatric patient. We also paralyze patients on PC ventilation. All intubated pediatric patients will need to have an end tidal co2 monitor on initial set-up.

**Extubations** can be difficult in the Burn Unit. The only procedure different than the weaning protocol is that the patient needs to be on the PST for 1 to 2 hours rather than the standard 30 minutes trial prior to being extubated. It is standard protocol to keep the ventilator on standby at least 8 hours post-extubation, however, if you feel that the patient’s respiratory status is unstable, then inform the service that you will require a standby for 24 hours order. Sometimes trached patients may need to be on the ventilator for sedation and procedures by the bedside even after
they have been considered weaned. **All extubated patients will be placed on the Burn extubation protocol.**

**Respiratory Equipment** such as parameter kits are stored inside the Omnicell. Please return them in the Omnicell (bottom shelf) prior to the end of the shift.

**Heparin Protocol for Smoke Inhalation Injury** is initiated after the injury is confirmed by bronchoscopy. We may start the protocol before the bronch if there’s evidence of carbon deposits through suctioning. The protocol can be found in the Resident Burn Manual or in our Policy and Procedures Manual located in the Respiratory Care Dept.

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**Electrical Burns**

Jolts of 110-220 volts (as is seen with household injuries) - if the patient has no symptoms and has a normal ECG and rhythm strip -> home. If there are any abnormalities, admit for monitoring for 24 hours.

True electrical burns, (not just electrical flash burns) caused by over 1000 volts and up require admission, and probably should have cardiac monitoring for 24 hours. Patients with 440 volt shock are individualized, but we still have a low threshold for admission.

We see a number of patients with electrical flash burns that really don’t have electrical burns at all (as you can guess, they have flash burns resulting from an electrical discharge). The patient can usually tell you if he was shocked by electricity. The rest of the comments here deal with major electrical burns.

Check for visible myoglobin. If you can see it, treat it by maintaining a urine output of about 100cc/hr. Frequently, increasing fluids alone will accomplish this; mannitol is not routinely needed. If you can’t see it (the urine is clear light yellow), you can quit worrying about it. Don’t keep sending chemical myoglobins, because they stay positive for a longer than we feel we need to treat the patient. Serum CK levels can be checked in cases of suspected rhabdomyolysis.

There are two reasons for early operation on patients with electrical burns. If the burn is making the patient sick, manifested by persistent gross myoglobinuria or a metabolic acidosis that doesn’t abate, then the dead tissue load needs to be decreased by operative debridement. If the burn is leading to compartment syndrome, then the extremity needs emergent fasciotomy for decompression.

Resuscitative fluid requirements of the patient with an electrical burn bear no relationship to cutaneous burn size. Use vital signs, urine output, etc. as resuscitation parameters.
Stress Ulcer Prophylaxis

Our incidence of stress ulcer is very low. Our general plan is to provide continuous tube feedings or diets as early as possible in the course. Consider adding pharmacologic prophylaxis if the patient does not tolerate tube feeds.

Maintenance of Body Temperature

It is often difficult to prevent hypothermia in the large TBSA burn patient. Don’t be surprised to see the nurses “pre-warm” the patient to 38-39° or even greater prior to dressing changes to prevent hypothermia. Bair Hugger, fluid warmers, bed temperature, and vent temperature are ways to increase body temperature.

Nutritional Support

Nutrition plays an important role in recovery after a burn injury. Increased metabolism, infection and surgery, results in an increased need for protein, energy and other nutrients involved in wound healing. This increase is related to the magnitude of the injury.

The goals of early and aggressive nutrition support post burn injury include: restoration of fluid and electrolyte balance; maintaining organ structure and function; treating/preventing malnutrition; limiting protein breakdown; improving wound healing and graft retention; and maintaining weight within 10% of pre-burn weight. Achievement of these goals may shorten recovery time and length of stay in the hospital.

The burn patient with burns greater than 20% TBSA develops an increased metabolism. It starts immediately after the injury and persists until the patient is completely covered with skin. Nutritional requirements reach a maximum of about 200% of basal requirements in a 50% TBSA burn. Burn patients who can eat get "general" diet with a supplement. It is rare that an individual, especially a child, can meet his nutritional requirements voluntarily if their burn is in excess of 20-25%. Such patients should have a feeding tube placed no matter how convincing they are that they "can do it on their own". Tube feedings are given continuously and if feeds are stopped for surgery or procedures nurse will replace amount missed.

Background

Initially, patients will experience the "ebb phase" which includes hyperglycemia and hypometabolism. After about 3 days, they enter the "flow phase" of injury. During this time the patient becomes hypermetabolic. They will experience increased cardiac output, oxygen consumption, body temperature, and energy usage. The patient will begin to undergo protein and skeletal muscle catabolism. Glucose, free fatty acid release, insulin, epinephrine and norepinephrine, glucagon,
and cortisol levels will all increase. The levels of carbohydrate, protein, fat, and oxygen released increases; however, usage is poor. The breakdown of protein also will lead to an increase in urinary losses of potassium, phosphorus, and magnesium. Hormonal changes will increase lipolysis, resulting in more circulation of free fatty acids. Patients will experience hyperglycemia as a result of increased gluconeogenesis and the shift in hormone production. Aldosterone and vasopressin levels will increase, leading to conservation of water and sodium. Serum iron and zinc levels also decrease following the burn injury.

Patients are best supported with early and aggressive nutrition support. The goals include: restoration of fluid and electrolyte balance, maintaining organ structure and function, treating/preventing malnutrition, limiting protein breakdown, improving wound healing and graft retention, and maintaining weight within 10% of pre-burn weight. Achievement of these goals may shorten recovery time and length of stay in the hospital.

**Dietitian Consults**

EVERY burn patient needs a Dietitian Consult. The dietitian (Jennifer Larson MS, RD, LDN, CNSC) can be reached at x68659 or pager 708-643-2358.

**Feeding Protocol**

**Oral diet:** General diet + supplements (If hyperglycemic, add CHO restriction. If hyperkalemic, add potassium restriction)
- Ensure Plus, Ensure Max Protein, Ensure Clear—both lactose free
- Mighty Shakes—have lactose
- Novasource Renal or Nepro or Ensure Clear ok for renal/dialysis patients (however, Ensure Clear high in sugar).
- Glucerna or Ensure Max (Only comes in Chocolate) for those with very high glucose levels.

**Tube feeding:** Indicated for patients with a burn >20% TBSA or otherwise struggling with intake. Tube feedings are given continuously and if feeds are stopped for surgery or procedures nurse will replace amount missed. X-rays are required after Dobhoff placement, but not for pediatric feeding tubes. Bridles are used to minimize frequent Dobhoff replacements & x-rays.

*If hx RYGB, must use guided tube placement*

**Total Parenteral Nutrition (Central IV alimentation):** Only to be used when unable to use the gut. Check triglycerides/LFTs prior to administration of lipids.

**Initiating Nutritional Support**

1. Calculate the patient’s energy and protein needs.
2. Initiate support upon the patient’s admission to the unit as soon as it is feasible using the unit’s feeding protocol.

**Calculating Energy Requirements for Adult Patients**

At the Loyola Burn Center, the following formulas are used for calculating the energy needs of the patient. The aim is to provide > 85% of estimated nutritional needs. Achievement of these goals may shorten recovery time and length of stay in the hospital.
Xie Formula: Energy Expenditure=$(1000 \text{ kcal } \times \text{ BSA} [\text{m}^2])+(25\% \text{TBSA})$
- BSA is body surface area (Mostellar equation): square root of (height (cm) x weight (kg)/3600)

Adult Energy Needs for SJS: 25-35 kcal/kg
Adult Energy Needs for TENS: 30-35 kcal/kg
Adult Energy Needs for NSTI: 30-40 kcal/kg

***Weight Adjustment for Overweight (SJS/TEN/NSTI):
Obese patients > 125% of Ideal Body Weight (IBW): use adjusted weight to calculate kilocalories and protein needs. Adjusted weight = [(Actual Weight - IBW) x (.25)] + IBW

Protein Requirements in Adults (use IBW or Adj BW for obese pts):
- <20% burn 1.5-2 g/kg
- >20% burn 2-2.5 g/kg; may go up to 3 g/kg or more for severe burns/wounds

Calculation of Energy Needs for Pediatric Patients
Galveston equation for Pediatric Burn patients.
0–1 year: 2100(body surface area)+ 1000(body surface area × TBSA)
1–11 year: 1800(body surface area)+ 1300(body surface area × TBSA)
12–18 years: 1500(body surface area)+ 1500(body surface area × TBSA)

Pediatric Protein Requirements
See RDA table x 1.2 for burns <10%, use below for burns>10%

<table>
<thead>
<tr>
<th>Age</th>
<th>G protein/kg for &gt;20% TBSA</th>
<th>G protein/kg for &lt;20% TBSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6 years</td>
<td>3-4.5</td>
<td>1.5-2.5</td>
</tr>
<tr>
<td>6 years and older</td>
<td>2.5-3</td>
<td>1.5-2</td>
</tr>
</tbody>
</table>

Other Injuries: For children <3 years of age use RDA

<table>
<thead>
<tr>
<th>RDA TABLE</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Calories/Kg</td>
<td>Grams Protein/kg</td>
</tr>
<tr>
<td>0-0.5</td>
<td>108</td>
<td>2.2</td>
</tr>
<tr>
<td>0.5-1</td>
<td>98</td>
<td>1.6</td>
</tr>
<tr>
<td>1-3</td>
<td>102</td>
<td>1.2</td>
</tr>
</tbody>
</table>
For children >3 year, energy needs are estimated using BMR table plus a factor

Add an injury and activity factor to BMR:
- ≤10% TBSA Burn: BMR x 1.5-1.7
- 10-30% TBSA Burn: BMR x 1.6-1.8
- >30% TBSA Burn: 1.8-2.0

<table>
<thead>
<tr>
<th>Age</th>
<th>Kcal/kg/day</th>
<th>Age</th>
<th>Kcal/kg/day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>1</td>
<td>56.4</td>
<td>57.0</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>54.3</td>
<td>53.65</td>
<td>12</td>
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<tr>
<td>3</td>
<td>53.0</td>
<td>53.5</td>
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<td>4</td>
<td>51.0</td>
<td>50.8</td>
<td>14</td>
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<tr>
<td>5</td>
<td>50.9</td>
<td>48.63</td>
<td>15</td>
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<tr>
<td>6</td>
<td>47.4</td>
<td>46.72</td>
<td>16</td>
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<td>7</td>
<td>44.7</td>
<td>44.8</td>
<td>17</td>
</tr>
<tr>
<td>8</td>
<td>42.0</td>
<td>41.5</td>
<td>18</td>
</tr>
<tr>
<td>9</td>
<td>39.1</td>
<td>40.3</td>
<td>19</td>
</tr>
<tr>
<td>10</td>
<td>37.1</td>
<td>38.3</td>
<td>20</td>
</tr>
</tbody>
</table>
Tube Feeding Protocol

How to Write TF Order (see formulary card for formula selection)
Order tube feed formula in 12 hour amounts. Example: “Novasource Renal Full Strength continuous 60 ml/hr or 720 ml q 12 hours to run continuous over 24 hours. RN may increase hourly rate to replace formula not given when tube feeds are held.” Please write order in this format.

Standard tube feeding formulas do not always meet the patient’s needs; in this case a combination of feedings can be used. Some examples are listed below.

Selection of formula:
- **Osmolite 1 cal**-typically for children >1 year w/ burn and those with inhalation injury only
- **Promote 1 cal**-Standard formula, high protein
- **Pivot 1.5**-high protein, fluid concentrated. **Has fish oil, watch for fish allergies.**
- **Novasource Renal**-used in renal failure
- **Vital 1.5**, **Vital HP** are available for semi-elemental needs

*Note, Glucerna is NOT recommended for ICU patients. Increased risk of ileus in ICU patients.

NEW Admit or Feeding After Prolonged NPO Status > 24 Hours:
**Adults 15 and Older**: Start at 50/hr. for 2 hours, check residual. If < 500, increase by 50cc’s every 4 hours until goal rate achieved. Check residuals every 4 hours. (**use clinical judgement, if at risk for refeeding syndrome, go slower**)

**Pediatric Ages 0 to 14**: Titrate rate up every 2 hours starting at 50% of base rate (if goal of 80 ml/hr, start at 40). Increase by 25% of total base rate every 2 hours until goal rate achieved. Check residuals every 2 hours until goal rate achieved, then check every 4 hours.

***Note, residuals are only checked for patients with a burn >20% TBSA***

BE SURE PATIENTS HAVE TOTAL FLUID ORDER! IF TF OFF, FLUIDS SHOULD BE ON.

Infusion Adjustments for OR Time
Nurse may increase hourly rate to maximum rate of formula in order to replace amount not given when tube feeds are held. Infusion rate could be increased to twice the current rate or maximum hourly amount allowed. Day before surgery, *at 16:00*, increase rate to twice the current rate or the maximum amount allowed. Remember to warm patient 1 hour pre-op to improve post-op feeding. After surgery the nurse receiving patient will calculate total amount of formula missed and determine amount needed to replace it. Paper work sheet is available at nurses’ stations to calculate amount. Begin feeding post-op at full rate. *It is not necessary to titrate up after surgery if patient is hemodynamically stable and normothermic.*

Maximum Hourly Infusion Amounts:
- Adult: 200/hour
- Pediatric: Age 0 to 6 - 100/hour    Age 7 to 14 – 150/hour
- For Bariatric patients, page dietitian to determine if appropriate for increased rate

Checking Residuals/High Residuals (**In patients with >20% TBSA burn**)
Definition of High Residual Amounts:
- Adult: 500cc’s
- Pediatric Ages 0 to 14: 2.5x current rate

High Residual Instructions: Adult Ages 15 and Older:
If residual > 500cc’s discard. Do not replace high residual amount. Continue to infuse at current rate for 2 hours.
- Recheck in 2 hours: If residual < 500, infuse at base rate. If residual > 500, discard and notify MD. Decrease rate to 25cc/hour. Obtain total fluid order to increase IV fluids to keep total fluid volume unchanged.
- Recheck in 4 hours: If residual < 500, increase rate by 50cc’s every 4 hours until goal rate achieved. If residual > 400 discard and notify MD.

High Residual Instructions: Children Ages 7 to 14:
If residual exceeds 2.5x current rate discard. Do not replace high residual amount. Continue to infuse at current rate for 2 hours.
- Recheck in 2 hours: If residual < 2.5x current rate, infuse at base rate. If residual > 2.5x hourly rate, discard and notify MD. Decrease rate to 25cc/hour. Obtain total fluid order to increase IV fluids to keep total fluid volume unchanged.
- Recheck in 4 hours: If residual < 2.5x current rate, increase rate by 20cc’s every 4 hours until goal rate achieved. If residual > 2.5x current rate discard and notify MD.

High Residual Instructions: Children Ages 0 to 6:
- If residual > 2.5x current rate discard. Do not replace high residual amount. Continue to infuse at current rate for 2 hours.
- Recheck in 2 hours: If residual < 2.5x current rate, infuse at base rate. If residual > 2.5x current rate, discard and notify MD. Decrease rate to 1cc/kg/hour for 4 hours. Obtain total fluid order to increase IV fluids to keep total fluid volume unchanged.
- Recheck in 4 hours: If residual < 2.5x current rate, increase by 1cc/kg/hr every 4 hours until goal rate achieved. If residual > 2.5x current rate notify MD.

Refeeding Residuals
Re-Feeding Residual when amount is not high residual: slowly re-feeding gastric contents is ideal to avoid electrolyte imbalance.
- Exception: If residual is very thick and chunky and nurse determines that it may clog feeding tube, discard residual and replace same amount with fresh formula. Emesis: Do not attempt to replace amount of emesis and Notify MD.

Un-Clogging Feeding Tubes

Equipment:
- (1) 20ml syringe
- (2) 10ml syringes
MD orders from Pharmacy:
- Pancrelipase 6000 (Viokase) Capsules – 2
- Sodium Bicarbonate 650mg Tablet – 1

Procedure:
1. Withdraw as much formula as possible from the tube and discard.
2. Irrigate feeding tube with 10mls warm coffee or Coke and clamp tube for 15 minutes. If still clogged, use two 10ml syringes simultaneously to instill irrigation via infusion port and medication port. This requires two nurses to alternately instill and pull back solution to dislodge clog.

*Be careful to avoid splashing each other.

3. If unsuccessful, obtain Pancrelipase 6000 capsules (2) and Sodium Bicarbonate tablet (1) from Pharmacy.

4. Crush tablet and mix with capsule powder. Add 20ml lukewarm water and stir until fully mixed.

5. Draw up mixture into 20ml syringe and instill using gentle pressure.

6. Clamp tube for 15 to 30 minutes.

7. Draw up 20ml lukewarm water and irrigate tube gently.

8. If unable to unclog the tube notify service to replace tube.

DO NOT re-insert wire used to initially place tube due to risk of perforation and it will be uncomfortable for patient.

**Calorie Counts**

Order calorie count if there is a questionable oral intake, slow wound healing and for patients who need to be weaned off tube feedings.

**Ordering Labs**

A BMP with iCa, Mg, Phos, and CBC is ordered as deemed necessary by the physician. Order Transferrin, Prealbumin and LFTs every Monday for all patients with > 20% TBSA burn and on tube feedings. Vitamin D is ordered on all BICU patients and as requested by RD.

**Vitamin and Mineral Supplementation**

Cholecalciferol preferred, but may use ergocalciferol for ease of administration. Recheck q 8 weeks.

<table>
<thead>
<tr>
<th>Vitamin D Level</th>
<th>Peds 0 – &lt;6 months</th>
<th>Peds 6 mo- &lt;1 year</th>
<th>Peds 1 yr – 3 yrs</th>
<th>Peds 4 yr – 8 yrs</th>
<th>Peds &gt; 8 yrs</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-30</td>
<td>400 IU daily</td>
<td>400 IU daily</td>
<td>400 IU daily</td>
<td>400 IU daily</td>
<td>400 IU daily</td>
<td>1000 IU daily</td>
</tr>
<tr>
<td>12-20</td>
<td>1000 IU daily</td>
<td>1000 IU daily</td>
<td>1000 IU daily</td>
<td>1000 IU daily</td>
<td>2000 IU daily</td>
<td>2000 IU daily</td>
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<tr>
<td>&lt;12</td>
<td>1000 IU daily</td>
<td>1500 IU daily</td>
<td>2500 IU daily</td>
<td>3000 IU daily</td>
<td>4000 IU daily</td>
<td>8000 IU daily Or 50,000 IU weekly</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vitamin/Supplement</th>
<th>Adult Dose</th>
<th>Peds Dose</th>
<th>Infant Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVI</td>
<td>Standard adult</td>
<td>Standard peds</td>
<td>Standard infant</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>500 mg BID</td>
<td>250 mg vitamin C/day for patients ≤1 year.</td>
<td>500 mg/day &gt;1 year</td>
</tr>
</tbody>
</table>

*Only if burn >10%*
Zinc  | 110 mg BID >20% burn  
If renal, 110 mg/day  
.5-1 mg/kg for burns >20% up to max of 25 mg/day (elemental or 110 mg daily zinc sulfate)  

Mg Oxide  | 25 mg/kg/day for 20-40% TBSA  
35 mg/day for >40% TBSA  

Oxandrolone  | 10 mg BID >20% TBSA  
If renal, 5 mg BID >20% TBSA  
0.1 mg/kg BID in children >6 months of age >20% TBSA  
n/a  

Standard guidelines are listed above. Other vitamins and minerals as B1, B6, B12, folic acid, Na+, K+, Mg+, etc. to be given as needed.

[Do not order Oxandrolone if patient has hypercalcemia, liver disease, cancer, or in pregnant and lactating woman]

Some Points to Remember

♦ Calorie needs increase with an increase in % TBSA burn. However, the Xie equation maxes out at 70% burn. For a 80% TBSA you still calculate with 70% in the equation.

♦ For patients with acute renal failure and not on dialysis, it is no longer recommended to give less protein. Continue to provide adequate protein for healing. Patient's receiving HD can be calculated at 1.2-1.5 g/kg IBW and if on RRT or CRRT 1.5-2 g/kg IBW.

♦ Use full strength supplements for tube feedings preferably. Free water boluses can be given if patients need more free water. Dilution of tube feed to ½ - ¾ strength without increasing the feeding rate appropriately will result in underfeeding the patient.

♦ When changing the feeding from a 1 cal to 1½ or 2 cal formula, or vice versa, please make sure the rate/hour is adjusted in order to avoid underfeeding or overfeeding the patient.
Escharotomies

Usually only circumferential full thickness burns require escharotomies. The chief resident will always participate in doing them; an attending physician must be present. An electrocautery is available in the Burn Unit to do them. Trunks need escharotomy only with very deep burns. We do not perform escharotomies on fingers. Extremities need escharotomy fairly frequently. Do not cut all the way down to the muscle fascia. The incision should go only through the eschar that is constricting, generally to the subcutaneous fat. Major bleeding vessels can be coagulated with the electrocautery or suture ligation. The procedure is performed in the ICU with moderate/conscious sedation. Although the eschar is insensitive, coagulating subcutaneous bleeders are very painful - another reason to avoid going too deep. Oozing can often be stopped with application of pressure or thrombin spray.

Laboratory Work

In addition to this, you have laboratory charges, respiratory therapy and related items. Order what lab stuff you really need, but keep in mind that all patients don’t need total blood work every few hours (or even every day). Typically, labs are stopped for patients will small burn injuries when they are confirmed to tolerate a diet, they are no longer requiring IVF and their electrolytes/CBC have no anticipated disturbances.

Ambulation

Burn patients do not get to lounge in bed. They should be up and exercising if they are not attached to a ventilator. If they are attached to a ventilator, they should still be exercising if not up.

Prophylactic Antibiotics

Studies from burn centers have laid to rest the idea that patients with burns should be given anti-*Streptoccal* antibiotics (penicillin) for the first few days following a burn. The topical agents we use are quite effective against Gram positive organisms and there is no need for additional ones. We do treat patients peri-operatively with anti-*Staphylococcal* antibiotics at the time of excision and grafting.

Wound Treatments

Unexcised Burn Wounds

Philosophy

The wound treatment should permit healing, prevent infection, and provide comfort. But first a word about desiccation.

Some societies with few resources must treat burns by leaving them open to the air to allow them to desiccate. Although they can’t afford dressings or salves, they know that a completely dry wound discourages bacterial growth. Unfortunately, the crusts (scabs) of dried serum that form on the surface of the burn usually crack and the cracks provide an entrance for bacteria to reach the wound.

Furthermore, the dry crusts are uncomfortable, significantly limit exercise and ROM (range of motion) and they definitely delay wound healing since the crusts must come off before the epithelial cells can migrate. We never allow wounds to desiccate. This means they must be covered with something. Choices include the following:
1. **Blisters**

Blisters form at the dermal-epidermal interface. The roof of the blister is dead epidermis. Dead epidermis is not durable and usually offers little protection for the underlying dermis. When blisters break the fluid leaks out and the dermis dessicates. Blister fluid is a nearly perfect culture medium, although it does contain a few inflammatory mediators. We will occasionally leave blisters of the palms, fingers or feet intact if they are small, do not limit motion and are unlikely to break by themselves.

2. **Biologic Dressings**

Biologic dressings cover the wound, protecting it from air currents while covering the raw nerve endings. Thus, they make the burn nearly pain free. When biologic dressings adhere to the wound, they provide an ideal warm, moist, bacterial free environment, which are the requisites for rapid re-epithelization. Unfortunately, biologic dressings can only be placed on a viable bed. If the burn extends very far into the dermis, a layer of tightly adherent dead dermis called eschar results. Dermal thickness varies according to age and area of the body. Skin reaches its adult thickness at about age five, but it atrophies in the aged. Dermis on the back may be up to 4-5mm thick, while eyelids are 0.5mm or less.

Xenograft (pig skin) or allograft (human cadaver skin) can be used selectively on patients.

3. **Antibacterial Ointments and Creams**

For burns of all sizes and depth, the most common practice is to apply some sort of antimicrobial agent directly to the burn.

a) **Silver Sulfadiazene**

Silver sulfadiazene (Silvadene, SSD) is a commonly used agent. It is soothing on application, has a broad antimicrobial spectrum, has virtually no systemic effects (except possibly allergy) and is easy to use. About a third of patients with significant burns will get leukopenic during the first post burn week when SSD is used. WBCs can fall to about 1000. The fall in WBC is probably only an accentuation of the margination process (WBCs going to the injury site and sticking to the capillary walls) instead of any sort of suppression of WBC production. The leukopenia is self-limited and requires no change in therapy. Patients with sulfa-drug allergies are not usually allergic to SSD because the silver molecule is attached to the usually antigenic portion of the sulfadiazine molecule. If the patient gives a history of sulfa-drug allergy, try a little test patch of SSD; if the patient is truly allergic to silver sulfadiazine, it will hurt on application (instead of feeling soothing) or it will cause a local rash. Anaphylaxis is exceedingly uncommon with the use of topical SSD. Application of SSD results in the formation of a pseudo-eschar that must be fully cleaned off with each dressing. SSD also has a cytotoxic effect on epidermal cells that results in delayed wound healing and closure.

b) **Sulfamylon (Mafenide)**

Mafenide cream or solution is less commonly used for routine application to burns because it is painful on application and, when used over large areas, causes a severe systemic metabolic acidosis through carbonic anhydrase inhibition. On the other hand it has a broad antibacterial spectrum and it does penetrate into the eschar and cartilage. It is most useful on burns of the ear to prevent the development of chondritis. Mafenide solution is commonly used for post-operative grafts. Mafenide solution does not penetrate cartilage.

c) **Bacitracin**

Bacitracin is an over the counter clear topical antibiotic ointment that has strong coverage for gram positive organisms. It is mainly used for superficial partial thickness burns. It does not
cover pseudomonas or MRSA. Deeper injuries will be colonized by a broader spectrum of bacteria, so bacitracin is typically not used in this setting. The main side effect of bacitracin is that prolonged use (especially in healed wounds) can lead to a fungal rash. Treatment is discontinuation of the bacitracin. It is generally cost effective and well tolerated otherwise.

d) **Bacitracin/Polymyxin/Neomycin**

Triple antibiotic ointment has a broader coverage, including most gram-negative organisms. Is an over the counter medication (Neosporin).

e) **Mupirocin (Bactroban)**

Has coverage for MRSA with known MRSA infections. Generally is well tolerated, and is prescription only.
<table>
<thead>
<tr>
<th>Topical Compound</th>
<th>Consistency/ Size</th>
<th>Action</th>
<th>Dressing</th>
<th>Wound Indication</th>
<th>Side Effects/ Contraindications</th>
</tr>
</thead>
</table>
| Acticoat               | Silver impregnated gauze   | Silver natural antimicrobial, same as silver nitrate G+, G- antifungal | Available in rolls, 8x8 or 16x16. Stays in place for 2-5 days | ✓ TENS  
 ✓ Sulfa allergy  
 ✓ Minimizes dressing changes | ✓ High cost  
 ✓ Painful and bloody dressing changes |
| Bacitracin             | Ointment 30 g tube 454 g jar | Antimicrobial (G+ > G-)       | Apply to wound veil or Exudry     | ✓ Superficial and partial thickness burns  
 ✓ Healing burns | ✓ Can promote yeast with prolonged use |
| Bactroban Mupirocin 2% | Ointment or Cream 22 g tube | Antimicrobial (G+ only) Used for MRSA and VRE | Apply to wound veil or Exudry | ✓ Wound not responsive to SSD/to Bacitracin |
| Dakins (sodium hypochlorite) | 273 ml bottles  
 Full-strength = 0.5%  
 Half-strength = 0.25%  
 Quarter-strength = 0.125%  
 One-eighth-strength = 0.062% | Antibacterial, antifungal | Soaked kerlix, burn gauze, or exudry. Can use during bath. | ✓ Infected wounds, MDR organisms  
 ✓ Wounds with biofilm  
 ✓ Typically alternated with baci/poly solution | |
| Doxepin (Zonalon)     | 3% tube 60 g               | Anti-pruritic                 | Healed skin OTA                   | ✓ For itching  
 ✓ Drowsiness  
 ✓ Nonformulary | |
| Gentamicin             | 0.1% Cream 0.1% ointment 15 g tube | Antimicrobial | Directly on wound cover with gauze | ✓ Infected wound  
 ✓ Wound not responsive to traditional topicals | ✓ Pseudomonas converge |
| Dermaide Aloe          | Cream 120 g jar            | ✓ no antimicrobial action  
 ✓ moisturizing agent           | Healed or superficially open skin, OTA | ✓ healing burn |
| Mepilex AG             | Silver foam                | Siver natural antimicrobial, same as silver nitrate G+, G- antifungal | Partial thickness burns & donor sites. May remain for up to 7 days | ✓ Minimizes trauma and dressing changes  
 ✓ Decreased pain | ✓ High Cost |
| bacitracin/polymyxin irrigation | 1 liter bottle | Antimicrobial | Soaked kerlix, burn gauze, or Exudry | ✓ Post-op  
 ✓ Grafts  
 ✓ MDR organisms | |
| Bacitracin/polymyxin/amphotericin irrigation | 1 liter bottle | Antimicrobial, antifungal | Soaked kerlix, burn gauze, or Exudry | ✓ Fungal/mold growth |
Santyl (Collagenase)  Gel 15, 30 gram  Enzymatic debrider of dead collagen  Directly on wound cover with coarse mesh gauze of Silvadene dressing  ✓ Deep partial thickness burn  ✓ May be used to decide if STSG is needed  ✓ Painful on application  ✓ High cost

Silver Sulfadiazine (Silvadene/SSD)  1% cream 20 g tube 454 g jar  Broad Antimicrobial, antifungal, anti-Pseudomonas eschar penetration  Impregnated in burn gauze or kerlix  ✓ Partial thickness  ✓ Full thickness  ✓ Generally soothing on application  ✓ Messy dressings  ✓ Creates pseudoeschar, may slow wound healing  ✓ Use with caution in sulfa allergy

Sulfamylon (mafenide)  11% cream 113 g tube 2.5% solution  Broad antibacterial, antifungal, anti-Pseudomonas and superior eschar penetration with cream. No eschar penetration with solution  Impregnated in Burn gauze or kerlix, cream should not stay on for longer than 12 hours at a time, alternate with silver sulfadiazine. Solution is applied in soaked Exudry  ✓ Cream is applied to full thickness burns and ears  ✓ Solution is applied to post-op grafts  ✓ Cream is painful on application  ✓ Systemic metabolic acidosis with cream, (carbonic anhydrase inhibitor)  ✓ Use caution with sulfa allergy

Triple ABX ointment (bacitracin/neomycin/polymyxin)  30 gram tube  Antimicrobial, Gram +, Gram -  Apply to gauze  ✓ Partial thickness Infected wounds  ✓ Comes in smaller quantities than Bacitracin

Lotions: Aquaphor, Cocoa butter, aloe, Vaseline intensive care, Lubriderm, Eucerin, Nivea, Neutrogena.

5. Water Application

Immediate application of cold water probably does do some good but it needs to be applied within the first few minutes after injury. It probably works by (temporarily) inhibiting thromboxane release in the tissues. Whether this does any long-term good is controversial. Obviously big burns shouldn’t be immersed in cold water for fear of systemic hypothermia. By the time the patient gets to any emergency room it is too late for cold water to be effective.

Dressings

There is always confusion about the specific details of dressing. However, if you understand the principles of dressing wounds, the details of exactly how you do it become relatively unimportant, as long as you follow the principles. Dressings are used in several circumstances and each involved different principles:

1. Dressings over Fresh Burns

All of the antibacterial agents discussed above are usually covered with a light dressing of some sort. Pig skin needs a dressing for about 24 hours to keep it from getting dislodged. By 24 hours the pig skin will usually be adherent enough to dispense with the dressing although a light dressing may be cosmetically more appealing to the patient and require less lengthy explanation to his
friends. Furthermore, even a light dressing may absorb some bumps and scrapes that could still dislodge the pig skin. A light dressing (generally just a layer of gauze and Kerlix) is also used with ointments and creams to keep the goo from sliding off. The light dressing for outpatients also protects house furnishings and the patient’s clothes from staining. All of the goos have a half-life of about 12 hours so significant wounds are generally cleansed and redressed q 12 hours. For outpatient burns however, a once a day dressing change is probably perfectly adequate.

a) 2. Dressing over Later Stage Burns

Philosophy
To preserve epidermal budding and re-epithelialization while removing debris from the wound. Dressings are not as good a method of removing debris as an operation is. By the way, granulation tissue occurs only in full-thickness wounds with exposed subcutaneous tissue.

Wet to Dry Dressings
Course mesh gauze is again applied, but to the wound surface moistened and then allowed to dry out over eight hours or so. The coarse mesh sticks to the wound surface and debrides dead and sometimes even living tissue as it is pulled off.

Wet Dressings
Course mesh is again applied, but the dressings are kept moist. This environment permits bacterial growth, and the resultant bacterial collagenase production loses some of the connections between wound debris and the wound bed. The coarse mesh gauze sticks a bit to the wound and does some mechanical debridement. Although this dressing is still painful to remove, it is more gentle than a wet to dry dressing but it is also proportionally less effective. Patients may still send you Christmas cards although if they have wet dressings put over too big an area the bacteria might win and the patient may not survive to send the cards to you. Wet dressings can be made wet with many substances. Saline is most commonly used. Dakin’s solution is the hypochlorite solution (Chlorox). It takes the green color out of pseudomonas drainage (unfortunately without hurting the red ones). It is painful when applied full or half strength; quarter strength doesn’t hurt so bad so when we use it, we use quarter strength Dakin’s solution and change the dressing twice a day. We very rarely use any wet dressing other than 5% Sulfamylon liquid, and those only for fresh skin graft dressings.

Dry Dressing
Rarely used by our burn team, except as a secondary dressing to absorb effluent from primary dressings such as Mepilex Ag.

Grafted Burn Wounds

Philosophy
The excised (or granulating) bed under a skin graft must be kept moist, warm, and bacteria free until the graft attaches itself and vascularizes.

Sheet and Meshed Autograft
Sheet autograft is the ideal wound cover. Since it already fulfills all the above criteria, no additional dressing is necessary to protect the excision bed. However, the sheet graft itself needs to be protected from mechanical dislodgement. When meshed autograft is used, the exposed interstices need to be protected, so a bulk dressing is used over the autograft.
(You will often see our service to see dressings, wrapped in Saran wrap for easy viewing and to avoid shear and friction.)

**Antimicrobial Dressings**

If wounds are already colonized at time of excision and grafting, or if they are extensive enough to be life threatening if they do become infected, we (usually) cover the meshed autograft with a dressing kept wet with an antibacterial agent.

A wet dressing never utilizes a greasy material at the wound surface because these petroleum based gauzes are water impermeable and the antibacterial agent will not get to the wound surface.

An appropriate wet dressing utilizes fine or coarse mesh gauze next to the wound and then a bulky burn dressing that can be kept moist with any one of several things. Things that are used include: mafenide solution. We often used a ready-prepared composite dressing called Exudry. It works pretty well and comes in special configurations to include trunk jackets, arm and leg tapered dressings and gloves. The graft dressings are kept wet with one of the antimicrobial solutions by pouring over the grafted area (and sometimes the donor site) and by injecting solution into IV extension tubings placed strategically in the dressing.

**Dressing Changes**

Dressings protect the freshly applied grafts until they are well adherent. Grafts initially adhere to the wound surface only by a fibrin seal until new capillary growth and collagen formation begin to cement the surfaces together starting at 4-5 days.

The trick is to balance protection of the graft from mechanical trauma against progressive infection eating away the new grafts. In general we feel that 3-5 days is an OK balance. Dirty wounds or grafts next to unhealed burns may need to be changed on day one. The physician always looks at the wound at the first dressing change (service dressing takedown is POD #2) unless otherwise indicated.

**Donor Site Dressings**

**Philosophy**

The goals are the same as for a grafted site: to provide a warm, moist, clean environment for the wound, and a pain free 10 days for the patient, until the wound is healed. Mepilex AG is the donor site dressing of choice, this is applied in the operating room and kept in a bulky secondary dressing for 3 days post operatively. If the donor site is adjacent to a fresh autograft, the donor is placed in the same solution as the autograft. After POD #3 the donor dressing is changed daily or as needed based upon nursing judgement. See burn center policy regarding donor site care.
Pain, Sedation, and Delirium

Philosophy

We do not believe burn patients should have to demonstrate how tough they are. Burns hurt. Burn treatment hurts. Infants and toddlers have the same pain nerves as adults. There are several types of burn pain, and a multimodal approach should be used. Burn pain is most commonly due to inflammation, which responds to scheduled NSAIDs and scheduled acetaminophen, but will not respond to opioids. Opioids should be used for premedication prior to a dressing change, procedure, and therapy sessions. Oral agents are preferred, especially because there is a severe national shortage of parenteral opioids. For the patient's very first dressing change, it is appropriate to use IV opioids because you do not want to make them wait for the oral agents to kick in, and you can assess their requirements to plan for future orders. Not all opioids are created equal, nor are they dosed the same (morphine 2 mg does not equal hydromorphone 2 mg!). Patients respond differently to different agents and dosages, and it is not one-size-fits-all.

Equianalgesic Opioid Dosing:

<table>
<thead>
<tr>
<th>Drug</th>
<th>Parenteral (mg)</th>
<th>Oral (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>0.1</td>
<td>n/a</td>
</tr>
<tr>
<td>Hydrocodone</td>
<td>n/a</td>
<td>30</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>1.5</td>
<td>7.5</td>
</tr>
<tr>
<td>Oxycodone</td>
<td>n/a</td>
<td>20</td>
</tr>
<tr>
<td>Tramadol</td>
<td>n/a</td>
<td>120</td>
</tr>
</tbody>
</table>

Patients should have a prn option available on their MAR for each type of pain: mild pain (pain score 1-3), moderate pain (pain score 4-6), severe pain (7-10), dressing change premedication and PT/OT. Patients should also have scheduled non-opioid adjuncts to address background pain.

If a patient requires prn opioids around the clock, ensure that non-opioid agents are maximized, and consider adding a long-acting opioid such as methadone to address background pain. Methadone is a Qtc-prolonging agent and will require baseline and weekly EKGs to monitor for prolongation. Methadone may be added on to patients who are receiving continuous analgesics (i.e. fentanyl drip) to help reduce drip rates and time on the vent.

Non-pharmacologic methods should also be utilized, including deep breathing, distraction (TV, music), and other coping strategies. Our psychologist is a fantastic resource if the patient is agreeable to talking with her.

Pain Management

<table>
<thead>
<tr>
<th>Class</th>
<th>Example Medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSAID</td>
<td>Ibuprofen 400 mg PO q6h</td>
</tr>
</tbody>
</table>
Non-Opioid Acetaminophen 650 mg PO q6h

Neuropathic Pain Gabapentin 300 mg PO q8h

Opioid Oxycodone 10 mg PO q4h prn severe pain and premedication for dressing changes

Anxiolytic (associated with dressing changes or procedures) Intranasal midazolam 5 mg BID prn dressing change
Hydroxyzine 25 mg PO q6h prn anxiety

Muscle relaxant Methocarbamol 500 mg PO TID

Long acting opioid Methadone 10 mg PO q12h

**Sedation**

Sedation principles are based on the SCCM PADIS guidelines for patients who are ventilated. Sedation is assessed using RASS score, with a goal for nearly all patients of -2 to 0. The goal is to use the lowest dose needed to achieve this RASS goal. Attempts should be made daily to decrease the rate of sedation given if the patient is at goal RASS.

The choice of sedative agent is important, and non-benzodiazepines are preferred (propofol, dexmedetomidine), as they are less associated with the development of ICU delirium. Propofol is quick-acting and is useful for daily spontaneous awakening trials (SATs). Dexmedetomidine does not suppress the respiratory drive, and may be continued peri-extubation in patients who are particularly anxious. Midazolam saturates a patient's body fat, and may take a prolonged period of time (days) to clear.

**Delirium**

Delirium is known to worsen outcomes in critically ill patients, including burn patients. Delirium presentation is typically hypoactive, which is harder to identify, than the well-known hyperactive delirium. The best thing to do is prevent delirium from happening in the first place. There are many medications that are associated with increased incidence of delirium: benzodiazepines (i.e. lorazepam), anticholinergics (i.e. scopolamine), antihistamines (i.e. diphenhydramine), and more. Notably, in non-burn ICU patients, increased opioid use is associated with increased delirium, but that does not hold true in burn patients. Adequately managing our patients' pain will reduce the incidence of delirium. Much of delirium prevention is non-pharmacologic: promoting a good sleep/wake cycle (lights on in the day, minimize disturbances at night, use ear plugs/eye mask when sleeping), ensuring the patient has any hearing aids or eyeglasses, reorienting the patient, having family engaged at the bedside, and early mobility with PT/OT.

The CAM ICU is used to assess delirium in patients, and should be assessed at least once daily or if there is a significant change in the patient's behavior. If a patient screens positive, ensure non-pharm measures are in place, discontinue any medication-related causes, ensure there are no other potential medical causes (i.e. UTI in elderly) and treat as appropriate, and then consider pharmacologic management. In general, antipsychotics are used to treat delirium. Scheduled quetiapine or olanzapine have been used in some small studies. An order for prn IV haloperidol is also appropriate. Antipsychotics may prolong the Qtc, and weekly EKG monitoring should
occur. Benzodiazepines should not be used to treat delirium, as they can exacerbate it. The patient should always be assessed appropriately.

**General Issues**

On morning rounds, a nurse should accompany the doctor team. If you want to see a particular wound, tell the nurse assigned to that patient to have you paged. **THIS WILL BE THE ONLY TIME YOU MAY VIEW THE BURN WOUNDS.** Wounds will not be exposed at any other time except by request of the Attending Surgeon.
Burn wounds contract. Meshed grafts contract. Sheet grafts contract. Unused joints and muscles contract. Contraction destroys motion. Therefore, exercise (including skin and muscle stretching) is an important part of the care of virtually all burn patients. We have a fine Occupational Therapy and Physical Therapy team whose primary goal is to maximize ROM and mobility throughout the healing process. OT and PT should be ordered for every patient on admission, and activity level should always be “as tolerated” unless there is a medical reason for a patient to be on bedrest. PT and/or OT will assess all patients, and one or both disciplines will follow each patient depending on the size and location of the burn as well as other mobility issues. After skin grafting, patients may need to be on bedrest to keep graft sites immobilized. Activity is usually upgraded POD #3 or 5, or when service decides that the graft is sufficiently adherent.

Occupational Therapy assists patients in achieving their highest level of functional independence in activities of daily living, such as feeding and dressing. A patient’s range of motion may be restricted as burn wounds heal and contract, thereby limiting a patient’s independence. The Occupational Therapist provides the following services in the Burn Center:

- Achieving and maintaining full ROM of affected joints.
- Providing splints for post-operative positioning as well as optimal functional positioning.
- Assisting patients in achieving maximal ADL independence.
- Instructing patients in daily exercise routines.
- Instructing patients in relaxation techniques.
- Providing initial scar management.

Physical Therapy provides assistance for patients to maximize their level of functional independence in performing mobility skills, including: bed mobility, transfers, ambulation, and stair climbing. A patient’s posture, coordination, endurance, and safety during these activities may be affected by healing and contracture of wounds, thus requiring physical therapy intervention. The Physical Therapist in the Burn Center has the following objectives:

- Achieving and maintaining full ROM of affected joints.
- Maximizing patient safety and independence with mobility skills.
- Providing gait facilitating exercises and gait training.
- Instructing patients in proper posture during activity.
- Instructing patients in daily stretching and home exercises.
- Providing initial scar management.

In order to facilitate optimal communication, Occupational and Physical Therapy alternate attending daily morning rounds. During rounds, it is important to discuss a patient’s activity level and their pre and post-surgical needs, such as splints and activity restrictions. In order for the therapists to plan what they need to do, they need to know what you plan to do. Therefore, you should talk to and listen to OT/PT all the time, as well as making sure that any activity orders and restrictions are kept current in the chart. PT & OT also work closely with social work to assist with discharge planning.
Out-Patient and Discharge Issues

Burn MD Clinic is on Monday and Wednesday and Nurse Practitioner Clinic is Monday through Friday. Patients can be scheduled for appointments in the Burn Clinic through Central Scheduling. The clinic is open Monday through Friday. If you communicate with any outpatients please document in epic under telephone encounter. All prescription refills should go through clinic. If you do refill medications, please document in epic so we know the patient received medications from another clinician.

Discharge may be to acute rehab, long-term acute care facility, skilled nursing facility, outpatient day rehab, or home with a visiting nurse. There is a discharge video available to help patients and families prepare. Never talk to DCFS or insurance case managers. Instead refer them to utilization review and our social worker.

The burn service arranges post-discharge activities for patients sooner than five minutes before they leave the unit. In order for discharge planning to work, the nurses must know when the discharge is planned. If you let her know in plenty of time (several days), most of the work will be done for you. If you don’t, not only will you have to do the work yourself, but the patient’s planning will get screwed up. For example, before discharge, family members are taught home wound care by participating in hospital wound care; clinic visits are arranged; the OT/PT group talk to local therapists regarding follow-up therapy and so forth. If the physician decides on the spur of the moment that someone can be discharged, none of this activity can occur. The sign of a good service is that discharge planning starts on the day of admission - When is the patient going to go? Where is the patient going to? What will be his follow-up? What are his resources? etc., etc.

Emergency Department

Burn Team Consultation

The Burn Team is called for all burns. We do that for your education and so you can evaluate changes in the wound. When the patient is seen in follow up clinic, we have access to special treatment plans. Rules for ED are like rules everywhere else - if there is any doubt in your mind about what to do for a patient’s wound, ask your more senior team member. The resident is not expected to come in from home to evaluate every tiny burn, but he is expected to come in if there is a problem with it.

Wound Care in the ER

The Burn Unit nurses do not come to the ED to do wound care, and the patients in ED don’t come up to the Burn Unit for wound cleansing. The unit isn’t staffed properly for this added work and there is no mechanism for charging the patient for the time and supplies used. The resident team will be responsible for wound care in the ED.

ER Follow-up

The patient should call for a follow-up appointment in burn clinic.
Admission

Admission Write Up

The patient’s admission history and Physical Exam needs to be entered in EPIC. There is a Burn adult and peds template. A brief ER consultation note (on the ER sheet) stating that “Patient is a ______ y.o. _______ with a _____% flame/scald (etc.) burn. “Plan admission to burn service” is sufficient. Of course, if the patient is to go home, a more detailed note is required. All burn patients who are admitted require burn admission order sets.

Direct Admissions to the Burn Center

Sometimes patients will stop in the Emergency Room to rule out other traumatic injuries. If this is necessary, the stay should be extremely short (mainly for imaging workup and to ensure that there are no airway needs).

Patient Deaths

All burn patient deaths are automatic coroner cases. The Cook County Medical Examiner must be notified by the MD pronouncing the patient. Please document ME number and coroner badge number on your death note in EPIC. Soft tissue patients are not coroners’ cases unless a family requests an autopsy. Refer to the additional handout of forms and instructions for completion upon a patient’s death. All patient deaths or close to death situations must be called into Gift of Hope.
Frostbite Protocol (to be started within 12-24 hours of rewarming after discussion with Attending)

1. Initiate rapid rewarming. If after rewarming the affected areas remain cyanotic and the patient has no contraindications, tPA may be administered.

2. Start alteplase (tPA) intravenous infusion, may use peripheral IV line. Search "frostbite" in orders for the order panel.
   - Max total Dose = 100mg (bolus + infusion)
   - Bolus 0.15 mg/kg (give over 2 minutes)
   - Infusion 0.15 mg/kg (give over 6 hours)


4. Start aspirin 325 mg daily starting about 3-5 days after alteplase/heparin. No bridging is necessary.

5. Continue aspirin for 4 weeks post injury

Please refer to the "Adult tPA (alteplase) Guidelines for Frostbite" on the Order Sets and Guidelines page for more details, including a list of contraindications.