# The Art of Trauma Intensive Care

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Here are the relevant points with some references.
The ”Choosing Wisely” guidelines are also included.

## Transfusion

Any change in the hemodynamics of a trauma patient (tachycardia, hypotension), is hypovolemia until proven otherwise. And hypovolemia in a trauma patient is bleeding until proven otherwise.
Whenever a trauma patient needs volume resuscitation - use blood products. The ratio should be as close as possible to 1:1:1 (RBC:Plasma:Platelets).
Labs will not help you much during this phase.
The hemoglobin level doesn't change in acute bleeding.
Routine coagulation tests (INR, APTT) does not correlate with coagulation or blood loss (unless the patient is on Warfarin or Heparin). I avoid checking these. If taken very early, before major bleeding (i.e. in the ED), it might pick up patients with bleeding disorders, but this is very rare.
The only coagulation parameter I care about is Fibrinogen level. Try to keep it above 2 g/L. Give Fibrinogen concentrate or cryoprecipitate. (1 Cryo = approx 250mg Fibrinogen)
If, however, you have access to a real-time coagulation test like TEG or ROTEM, it can help guide your use of blood products to target specific issues, such as fibrinolysis
Once the patient is stable again, go ahead and check the hemoglobin (not the coagulation profile!).

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*Holcomb, J. B., Tilley, B. C., Baraniuk, S., Fox, E. E., Wade, C. E., Podbielski, J. M., … van Belle, G. (2015). Transfusion of Plasma, Platelets, and Red Blood Cells in a 1:1:1 vs a 1:1:2 Ratio and Mortality in Patients With Severe Trauma. Jama, 313, 471. https://doi.org/10.1001/jama.2015.12*

## Nutrition

ASPEN (American Society for Parenteral and Enteral Nutrition) published their latest guidelines in 2016. Here are some highlights:

- Use simple calculations to estimate calorie need (if you don't have access to indirect calorimetry): 25-30 kcal/kg/day.

I like to keep it simple. Standard feeding formula is 1kcal/mL. That means if I set the rate at 1mL/kg/hour I will reach the goal.

- Calculate protein requirements separately, and add supplemental protein as necessary: 1.5-2g/kg/day.

This is important for wound healing.

- Use standard feeding formulas.

Very low evidence to suggest benefit from specific formulas.
For renal failure - use standard formulas and the same protein target (1.5-2g/kg/day). Only change formulation if significant electrolyte imbalance.
For CRRT - increase protein to 2.5g/kg/day.

- Avoid stopping the feeding for procedures unless necessary.

Fasting for surgery is mostly meant to avoid aspiration during airway management. If the patient is already intubated, do we need to hold the feeding six hours before surgery? I say no. You need to discuss this within your unit.

- Don’t use gastric residuals as monitoring for feeding intolerance.

Unless there is obvious signs, like vomiting or abdominal distension, continue the feeding.

*McClave, S. A., Taylor, B. E., Martindale, R. G., Warren, M. M., Johnson, D. R., Braunschweig, C., … Compher, C. (2016). Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.). Journal of Parenteral and Enteral Nutrition, 40(2), 159–211. https://doi.org/10.1177/0148607115621863*

# Fluid management

Our bodies consist mostly of water (60-70%)
To maintain balance, we need an intake of 25-30mL/kg/day.
Now, how did the water get in your body?
Most likely through the GI tract and not IV.
The same should be true for our patients, whenever possible. The venous system was never designed to be the direct recipient of water or other fluids.
Always consider giving fluid replacement enterally whenever possible.

Sometimes (or maybe most of the time), we have to give IV fluids to our patients. Maybe because they are not tolerating feeding, or because they are fasting for surgery.

We then need to consider which fluid, or fluids, to give.
Many physicians spend very little time thinking about the content of the commonly used IV fluids and how they relate to patient physiology.

If I could convince you to do one thing today, it would be to lock away every bag of so-called normal saline that you have in your units. Let me explain why.
Consider again the basal requirements of our bodies. Apart from water, we need around 1mmol/kg/day of sodium (probably much less), that is about 80 mmol/day for a person of my stature. Now consider that a liter of ”normal” saline contains 154 mmol of Sodium. If I receive two liters of saline, that is the equivalent of four times my basal requirement. The surplus puts stress on the kidneys to increase the sodium excretion, and since the renal tubules can only concentrate the urine to about 1400 mosm/L, this means around 200mL of water is used only to get rid of the extra sodium.
Now maybe you find it less surprising that all your patients are hypernatremic after a week in the ICU.

(Of course, replacement of abnormal losses should be done with appropriate fluids.)

# Acid - Base

The pH of our plasma is determined mostly by the strong ion difference, SID, which is roughly the difference in concentration between sodium and chloride ions. The normal value is around 34 mmol/L. Together with the two other independent variables - PCO2 and weak acids (mainly albumin), this lands us at a nice and cozy pH of 7.4.
Now, again consider ”normal” saline. Its SID is zero. In fact, if you check the label on the bag, it says the pH is around 5.5. No wonder then, that we find our patients acidotic after resuscitation with five liters of saline.

Note that the acidosis is due to low SID, which is present in all unbalanced solutions, including water.

For reference: http://www.acidbase.org

What is the solution (pun intended)? First of all, think about the basal requirements of the patients. Check the labs and the ABG, and choose your fluid accordingly.

If your patient is acidotic due to reduced SID, give a fluid with a higher difference between Na and Cl, for example dextrose with Sodium bicarbonate - also called "Chloride free Sodium".
Use balanced solutions, e.g. Lactated Ringer's, whenever possible.
Also - don't forget that the patient needs other electrolytes, too. The basal requirement of K is about half that of Na, i.e. 0.5 mmol/kg/day. So again - don't be surprised if you cause hypokalemia by giving potassium-free solutions all day...

And don't drown your patients. Fluid overload is an independent predictor of bad outcomes. Maybe you had no choice during the resuscitation phase, and had to give a lot of fluids resulting in a positive balance. When the patient is stable, you have to take that water back - deresuscitation. Rule of thumb - two consecutive days with negative fluid balance within the first week in ICU.

## Sedation

Always monitor sedation using a validated scale. I recommend RASS.
Deep sedation (-3 and below), even during the first four hours after intubation, is an independent predictor for extended ventilator time and mortality.

*Shehabi, Y., Bellomo, R., Reade, M. C., Bailey, M., Bass, F., Howe, B., … Weisbrodt, L. (2012). Early intensive care sedation predicts long-term mortality in ventilated critically ill patients. American Journal of Respiratory and Critical Care Medicine, 186(8), 724–731. https://doi.org/10.1164/rccm.201203-0522OC*

Start with analgesia, e.g Fentanyl. Then add a little more analgesia. Then consider hypnotics.

Protocolised sedation, with a set RASS target, is as good or better than daily sedation vacation.

*Hughes, C. G., Girard, T. D., & Pandharipande, P. P. (2013). Daily sedation interruption versus targeted light sedation strategies in ICU patients. Critical Care Medicine, 41(9 Suppl 1), S39-45. https://doi.org/10.1097/CCM.0b013e3182a168c5*

Don't use bensodiazepines! They lead to longer ICU stay, longer time on the ventilator, and increased delirium (Fraser et al)

*Fraser, G. L., Devlin, J. W., Worby, C. P., Alhazzani, W., Barr, J., Dasta, J. F., … Spencer, F. A. (2013). Benzodiazepine versus nonbenzodiazepine-based sedation for mechanically ventilated, critically ill adults: a systematic review and meta-analysis of randomized trials. Critical Care Medicine, 41(9 Suppl 1), S30-8. https://doi.org/10.1097/CCM.0b013e3182a16898*

Delirium is a common problem in ICU, and is associated with worse outcomes. Avoid delirium by using minimal sedation with focus on analgesia, and support a natural sleep pattern.
Keep lights on daytime, off at night.
Minimise handling and procedures during the night.
Offer earplugs and eye covers.
Consider medication to promote good sleep (Zopiclone, Melatonin).

*Girard, T. D., Pandharipande, P. P., & Ely, E. W. (2008). Delirium in the intensive care unit. Critical Care (London, England), 12 Suppl 3, S3. https://doi.org/10.1186/cc6149*

*Cavallazzi, R., Saad, M., & Marik, P. E. (2012). Delirium in the ICU: an overview. Ann Intensive Care, 2(1), 49. https://doi.org/10.1186/2110-5820-2-49*

Choosing Wisely®

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# Five Things Physicians and Patients Should Question

1

## Don't order diagnostic tests at regular intervals (such as every day), but rather in response to specific clinical questions.

Many diagnostic studies (including chest radiographs, arterial blood gases, blood chemistries and counts and electrocardiograms) are ordered at regular intervals (e.g., daily). Compared with a practice of ordering tests only to help answer clinical questions, or when doing so will affect management, the routine ordering of tests increases health care costs, does not benefit patients and may in fact harm them. Potential harms include anemia due to unnecessary phlebotomy, which may necessitate risky and costly transfusion, and the aggressive work-up of incidental and non-pathological results found on routine studies.

2

## Don't transfuse red blood cells in hemodynamically stable, non-bleeding ICU patients with a hemoglobin concentration greater than 7 g/dL.

Most red blood cell transfusions in the ICU are for benign anemia rather than acute bleeding that causes hemodynamic compromise. For all patient populations in which it has been studied, transfusing red blood cells at a threshold of 7 g/dL is associated with similar or improved survival, fewer complications and reduced costs compared to higher transfusion triggers. More aggressive transfusion may also limit the availability of a scarce resource. It is possible that different thresholds may be appropriate in patients with acute coronary syndromes, although most observational studies suggest harms of aggressive transfusion even among such patients.

3

## Don't use parenteral nutrition in adequately nourished critically ill patients within the first seven days of an ICU stay.

For patients who are adequately nourished prior to ICU admission, parenteral nutrition initiated within the first seven days of an ICU stay has been associated with harm, or at best no benefit, in terms of survival and length of stay in the ICU. Early parenteral nutrition is also associated with unnecessary costs. These findings are true even among patients who cannot tolerate enteral nutrition. Evidence is mixed regarding the effects of early parenteral nutrition on nosocomial infections. For patients who are severely malnourished directly prior to their ICU admission, there may be benefits to earlier parenteral nutrition.

4

## Don't deeply sedate mechanically ventilated patients without a specific indication and without daily attempts to lighten sedation.

Many mechanically ventilated ICU patients are deeply sedated as a routine practice despite evidence that using less sedation reduces the duration of mechanical ventilation and ICU and hospital length of stay. Several protocol-based approaches can safely limit deep sedation, including the explicit titration of sedation to the lightest effective level, the preferential administration of analgesic medications prior to initiating anxiolytics and the performance of daily interruptions of sedation in appropriately selected patients receiving continuous sedative infusions. Although combining these approaches may not improve outcomes compared to one approach alone, each has been shown to improve patient outcomes compared with approaches that provide deeper sedation for ventilated patients.

5

## Don't continue life support for patients at high risk for death or severely impaired functional recovery without offering patients and their families the alternative of care focused entirely on comfort.

Patients and their families often value the avoidance of prolonged dependence on life support. However, many of these patients receive aggressive life-sustaining therapies, in part due to clinicians' failures to elicit patients' values and goals, and to provide patient-centered recommendations. Routinely engaging high-risk patients and their surrogate decision makers in discussions about the option of foregoing life-sustaining therapies may promote patients' and families' values, improve the quality of dying and reduce family distress and bereavement. Even among patients pursuing life-sustaining therapy, initiating palliative care simultaneously with ongoing disease-focused therapy may be beneficial.

These items are provided solely for informational purposes and are not intended as a substitute for consultation with a medical professional. Patients with any specific questions about the items on this list or their individual situation should consult their physician.

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# How This List Was Created

This document was prepared as an initiative of the Critical Care Societies Collaborative, which includes the American Association of Critical-Care Nurses, the American College of Chest Physicians, the American Thoracic Society and the Society of Critical Care Medicine. Each of these four societies was invited to nominate up to three members to join the taskforce. The final taskforce included 10 members representing all four societies and the disciplines of internal medicine, surgery, anesthesiology, emergency medicine and critical care nursing. Taskforce members initially proposed 58 items for consideration. The taskforce evaluated each item on five criteria (evidence, prevalence, cost, relevance, innovation), and agreed to narrow the list to 16 items. The taskforce debated the conceptual merits of these 16, and selected nine in which to pursue in-depth evidence reviews and consultations with external content experts. Taskforce members then independently scored each item on a scale from 1-9, rating each item on its overall impact as well as on each of the five criteria. The five items with the best mean overall scores were retained in the "penultimate" list. The taskforce then reviewed and edited the wording of items on the penultimate list, and submitted it to the four societies' executive committees. The executive committees sought feedback from additional experts in the field, debated the items and provided written comments to the taskforce. The taskforce deliberated and incorporated these suggestions where appropriate to create the final list, resolving any conflicts through discussion. All four societies endorsed the final list.

Members of the taskforce were: Scott D. Halpern, MD, PhD (Chair), Deborah Becker, PhD, RN, J. Randall Curtis, MD, MPH, Robert Fowler, MD, Robert Hyzy, MD, Jeremy M. Kahn, MD, MSc, Lewis Kaplan, MD, Nishi Rawat, MD, Curtis Sessler, MD and Hannah Wunsch, MD, MSc.

The disclosure and conflict of interest policies for the American Association of Critical Care Nurses, the American College of Chest Physicians, the American Thoracic Society and the Society of Critical Care Medicine can be found at www.accn.org, www.chestnet.org, www.thoracic.org and www.sccm.org respectively.

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*About the Collaborative Societies*

The Critical Care Societies Collaborative (CCSC) was established in 2000 as a partnership among the four major professional and scientific societies whose members care for America's critically ill and injured. These societies are: the American Association of Critical-Care Nurses (AACN), the American College of Chest Physicians (ACCP), the American Thoracic Society (ATS) and the Society of Critical Care Medicine (SCCM). The CCSC leverages its collective and multi-professional expertise through communication, education, research and advocacy efforts. The CCSC speaks with a unified voice representing more than 150,000 critical care professionals to bring important issues to the forefront in public policy and in the health care arena.

To learn more about the American Association of Critical-Care Nurses, the American College of Chest Physicians, the American Thoracic Society and the Society of Critical Care Medicine, please visit www.accn.org, www.chestnet.org, www.thoracic.org and www.sccm.org respectively.

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