Beginning with the 2014 version of the Resources for Optimal Care of the Injured Patient (Orange Book), **US trauma centers of all levels must have a massive transfusion protocol developed collaboratively between the trauma program and the blood bank.**

There was no further guidance given, and each trauma center was left to implement this in any way they wished. Obviously, this created a high degree of variability between trauma centers, and sometimes within the trauma hospital itself as different flavors were developed for different services.

There is so much to write about, I'm splitting the topic across two issues. This one will address the nuts and bolts of the massive transfusion protocol (MTP). I'll describe how to build your own "best" protocol and suggest reasonable ways to activate it. I will also detail the analyses that must take place after **every** activation to ensure that it's working properly. **In the next issue**, I'll dig into the product ratio debate to help you achieve the best range for you, and I'll review using real-time coagulation monitoring (TEG / ROTEM) to help fine tune the process. Finally, I'll say a few words about the newest, greatest thing (and I'm serious here): **whole blood**.

How To Build Your MTP

Your massive transfusion protocol is a complex set of processes that touch many, many areas within your hospital. There are five basic components to any MTP, so let's dig into them one by one. They are:

- Universality
- Activation
- Logistics
- Deactivation
- Analysis

Let's scrutinize each one a little deeper.

Universality. This means that there should be **one and only one MTP in your hospital**. I've seen some hospitals that have one MTP for trauma, one for cardiothoracic surgery, one for OB, one for GI. Yes, each of those services deals with patients who are suffering from blood loss. **But it's the same blood that your trauma patients lose!** There's no need to create a protocol for each, with different ratios, extra drugs, etc. This can and will create confusion in the blood bank which may lead to serious errors.

Activation. This consists of two parts: how do we decide to activate, and then how does everyone involved find out that the MTP is actually being activated? I'll discuss activation criteria in the next section. But what about the notification process? Phone call? Order in the electronic medical record (EMR)? Smoke signals?

The most reliable method is a good, old-fashioned phone call. Do not use the EMR except for documentation purposes. Unless there is a very reliable system in the blood bank that translates the order into an annoying alarm or flashing lights, don't rely on this.

Then decide upon the minimum amount of information that the blood bank needs to begin preparing blood products. This usually consists of a name or temporary patient identifier, sex, and location of activation. Ensure that an ID or transfusion band is affixed to the patient so that wrong blood products are not given in multiple patient events.

Logistics. This includes details such as who will be delivering the blood, what actually goes in each cooler, what ratios should be used, limitations imposed by the use of frozen plasma, and documentation. I'll talk about ratios and FFP next month.

The **runners** who travel between blood bank and the patient need to be selected carefully. Blood bank tech? Not ideal because they've got more important work to do. ED or OR tech? Maybe, as long as you've got a reliable pool. Student or resident? Probably not, because they may not know their way to the blood bank, which are typically placed in the farthest corner of the basement as possible.

Documentation is critically important, both in the trauma bay and the blood bank. Trauma activations, especially ones requiring MTP, are very fast moving and complex. Two sets of documentation are crucial: accurate records of blood product administration on the trauma flow sheet, and documentation of just about everything else in the blood bank. A specific timestamp that records the exact time of activation of MTP is a big plus.

What about **coolers**? I've seen everything used from uninsulated plastic buckets, picnic coolers, and pneumatic tube containers to large rolling refrigeration units. **The choice of container really boils down to cost vs waste.** The cheaper it is, the less insulated it is, the more likely that blood products will be discarded due to high temperature if not transfused. The best blend of cost vs utility seems to be the good, old-fashioned picnic cooler. It's very portable, reasonably cheap, and can be tested for temperature maintenance. Just be sure to secure a pouch to the outside to keep platelets at room temperature to maintain full functionality.

Here's a sample MTP cooler that's ready for use. The platelets are in the pouch on the left. Note the reminder to prompt the team to give TXA if not contraindicated.
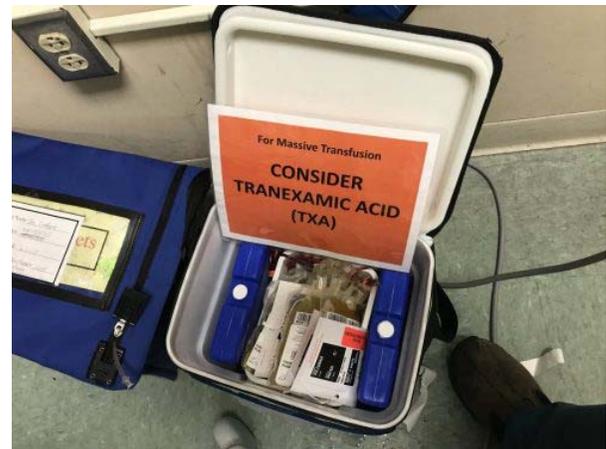
Who actually runs the MTP? In some ways, it should run itself. Coolers get delivered, products get transfused. However, some decision making is needed to decide how long to continue and whether any tweaking of product ratios needs to happen. In the emergency department, the surgeon or emergency physician can do this. But once a trauma patient arrives in the OR, that is no longer the case. The emergency physician was left behind in the ED and the surgeon is up to her elbows in trouble. What about the anesthesiologist? Nope, he or she is busy keeping the patient safely asleep, regulating rapid infusions, and actually administering the blood.

Most of the time, however, these two physicians actually end up running the MTP while multi-tasking at their other job. Unfortunately, this can lead to errors and delays. **One best practice to consider**: a highly trained trauma resuscitation nurse or advanced practice provider (APP) can run the MTP from the sidelines. They travel with the patient from ED to OR, managing the MTP the entire time. This offloads responsibility from busier people.

Deactivation. There are two components to this: recognizing that high volume blood products are no longer needed, and communicating this with the blood bank. As bleeding comes under surgical control, and CBC and clotting parameters (and maybe TEG/ROTEM) normalize, the pace of transfusion slows, and ultimately stops. Until this happens, the MTP must stay active. Even a low level of product need should be met with coolers stocked with the appropriate ratios of products.

There are two ways to stop the MTP: the surgeon or surrogate calls the blood bank (when no more blood products are to be used), or the blood bank calls the surgeon after the next cooler has been waiting for pickup for a

finite period of time. This is typically about 30 minutes. It is extremely helpful if the exact deactivation time is recorded in the electronic medical record. However, this information can be obtained from the blood bank.

Analysis. It's all over, and now the real fun begins. For most trauma centers, the blood bank maintains extensive data about every aspect of each MTP event. They record what units were released and when, when they were returned, which ones were used, were they at a safe temperature on return or were they wasted, and much, much more! Typically, one of the blood bank supervisors or a pathologist then compiles and reviews this data. What happens next varies by hospital.

Ideally, the information from **every MTP activation** gets passed on to the trauma program. Presentation at your transfusion committee is fine, but this data is most suitable for presentation at the operations committee. And **if significant variances are present** (e.g. product ratios way off) then it should probably also be discussed at your multidisciplinary trauma PI committee.

There are relatively few standard tools out there that allow the display of MTP data in an easily digestible form. Here are some of the key points that must be reviewed by the trauma PI program:

- Demographics
- Components used (for ratio analysis)
- Lab values (INR, TEG, Hgb, etc)
- Logistics
- Waste

I am aware of two tools, the Broxton form and an MTP audit tool from the Australian National Blood Authority. The Broxton tool covers all the basics and includes some additional data points that cover activation criteria, TXA administration, and administration of uncrossmatched blood. The Australian tool is much more robust with more data points that make a lot of sense. I've published a copy of this tool on the next page. If you want to download it, enter this URL in your web browser, taking care to enter upper and lower case letters as they appear:

http://bit.ly/2FzwSgS

MTP Activation Triggers

What criteria should trigger your massive transfusion protocol? Sometimes, it's obvious. The EMS report indicates that your incoming patient is in shock. Or there was notable blood loss at the scene. Or they have a mangled extremity and will need blood products in the OR, if not sooner.

But sometimes the need for ongoing and large quantities of blood sneaks up on you. The patient is doing well but has an unexplained pressure dip. And it happens again. You give one of your uncrossmatched units of blood. It happens again. At some point, you come to the realization that you've given six units of blood and no plasma or other products! Ouch!

Many trauma centers have adopted MTP criteria like:

- More than 4 units given over 4 hours
- More that 10 units to be given over 24 hours
- Loss of half a blood volume over 24 hours

I call these the "psychic power" criteria, because one must be prescient to know this just shortly after the patient arrives. **Don't include criteria like these at your center!**

Instead **use some sort of objective criteria.** A simple one is the use of any of your blood refrigerator products or emergency release blood, or a calculated score such as the ABC score or shock index (SI).

ABC score is the Assessment of Blood Consumption score and gives one point each for a heart rate > 120, SBP < 90, positive FAST, penetrating mechanism. ACS score $\geq$ 2 was predictive of requiring MTP with sensitivity and specificity of about 85%. Overtriage was about 15%.

Shock index (SI) is defined as the heart rate divided by the SBP. Normal values are in the range of 0.5 to 0.7. Need for MTP was found to increase to 2x for SI of 0.9, x4 with an SI of 1.1, and x7 with SI 1.3.

A 2017 paper compared these two systems retrospectively on 645 trauma activations over a 5-year period. They found that they both worked well with the following results:

Shock index $\geq$ 1 – 68% sensitive 81% specific

ABC $\geq$ 2 – 47% sensitive, 90% specific

Bottom line: Unfortunately, I think the series are too small to determine superiority. Just pick the one you are most comfortable with and use it!

Coming next month: Part 2, which will cover ideal ratios, TEG, TXA, and more!

Massive Transfusion Protocol
Clinical Audit Tool

Your Logo

Audit Information

Facility Name:		Date of Audit:	
Clinical unit/ward MTP initiated:		Date of MTP Activation:	
		Time of MTP activation:	
		Time of MTP deactivation:	

*If times are not known, enter 'unknown' in box

1. Does the organisation use a MTP that includes the dose, timing and ratio of blood component therapy   1. [   ]

Patient Demographics

Patient identification/medical record number:		Patient gender:
Consultant/treating specialist:		Patient age (years):
Clinical Speciality:		Reason for admission:

Type of case:
- Thoracic trauma
- Abdominal trauma
- Pelvic trauma
- Multiple long bone trauma
- Obstetric haemorrhage
- Gastrointestinal bleeding
- Vascular surgery
- Surgical bleeding
- Other

2. Did the patient have a pre-existing bleeding risk?   2. [   ]

Numerical Outcomes

Number of RBC units:		Lowest Hb this episode: g/L
Number of platelet units:		Lowest platelet count this episode: Count x 10⁹/L
Number of FFP units:		Highest INR this episode:
Number of cryoprecipitate units:		Highest APTT this episode:
*1 unit apheresis = 2 units whole blood		Lowest fibrinogen this episode: g/L

Other: [   ] [   ]
    (product)   (units)

*Episode is defined as the time between activation and deactivation of the MTP

Cell salvage volume reinfused: [   ]
    mL

Lowest platelet count: Count x 10⁹/L

MTP Audit Details

3. Was the MTP activated appropriately according to your organisation's definition (in accordance with local policy)?   3. [   ]
4. Were RBCs released prior to activation?   4. [   ]
   If so, how many?   [   ]
5. Was the patient's identity known at the time of activation?   5. [   ]
6. Was the lab notified of massive blood loss (if known)?   6. [   ]
7. Was a haematologist/transfusion specialist notified?   7. [   ]
8. Was early baseline pathology performed (within 15 minutes of MTP activation)?   8. [   ]
   (Full Blood Count, Coagulation screen (PT,INR, APTT, Fibrinogen), biochemistry, arterial blood gases)
9. Was ongoing pathology performed (every 30 - 60 minutes)?   9. [   ]
   (Full Blood Count, Coagulation screen, ionised calcium, arterial blood gases)
10. Was the patient's temperature documented early and frequently?   10. [   ]
   (within 15 minutes of MTP activation and every 15 minutes thereafter)
11. Was the lab notified of MTP cessation?   11. [   ]

Additional Measures

12. What was implemented to stop bleeding?
- Surgical Management
- Angiography
- Other

13. Was intraoperative cell salvage used?   13. [   ]
14. Was tranexamic acid administered?   14. [   ]
15. Was Factor VIIa administered?   15. [   ]
16. What was the outcome for trauma patients?   16. [   ]
17. What was the outcome for non-trauma patients?   17. [   ]

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