



Figure 3-4. Resuscitating patients with blood components means giving the individual products in some ratio. The ratio chosen is important because small changes in the ratios can affect the composition of the reconstituted blood given. However, the physiologic differences are less because the extra fluid is saline, which has limited intravascular persistence—66-75% will leave the circulation.<sup>27</sup>

RBC = Red Blood Cell; AS = additive solution; FFP = Fresh Frozen Plasma; WBD = whole-blood-derived; plts = platelets; Hct = hematocrit; INR = international normalized ratio; PTT = partial thromboplastin time.

### Blood Systems and the Support of Massive Transfusion

Blood components for transfusion in the United States are collected, processed, and distributed in a complex national system that involves both donor centers and transfusion services. Blood donor centers recruit and qualify donors, collect whole blood and specific components, process



## 70 MASSIVE TRANSFUSION

whole blood to make components, and further modify those components (eg, irradiation and washing), and label components for distribution. Government licensing of blood donor centers is based on the demonstration of quality systems that ensure that all required steps in donor qualification and manufacturing have been successfully completed before a blood unit is labeled and shipped.

Hospital transfusion services and blood banks buy blood components from licensed donor centers and modify and match them to meet the requirements of individual patients. Hospital transfusion services and blood banks are subject to standards, regulations, and laws. To ensure hospital blood banks meet standards, they are assessed by accreditation organizations such as the AABB or the College of American Pathologists (CAP) on a voluntary basis. Legally, state departments of health oversee and license all medical laboratories, blood banks included. Hospital blood banks may be listed, registered, or licensed by the FDA, depending on the amount of secondary manufacturing the local bank performs.

In this system, blood donor centers recruit the donors and make the components that they believe their hospital customers need. Hospitals purchase just the products and services they will use. Unlike the top-down national blood systems in other highly developed countries, this US blood system is largely nongovernmental, consumer-driven, and competitive. It functions on the assumption that the customers know what they need. The “customers” (eg, hospitals) are, in turn, complex organizations in their own right. The blood system interface is managed on a day-to-day basis by a transfusion service manager and transfusion service medical director responsible to hospital administrators (through a laboratory chain of command) and to the medical staff (through a transfusion committee). These front-line individuals—the transfusion service manager and medical director—are hired for, and evaluated on, their ability to meet the hospital patients’ blood needs within a budget. Within this context, blood resources are maintained locally and processes for massive transfusion are developed and supported.

Harborview Medical Center is fortunate to have an administration that understands the importance of a well-staffed and highly functioning transfusion service. Two technicians and two technologists are on duty around the clock, a staffing level distinct from levels at some larger hospitals with only a single technologist on duty in the blood bank during the night shift. The benefit of extra workers means that the transfusion service develops good procedures and follows them in a modern quality-driven process. Assessors from the AABB, the CAP, the American College of Surgeons, the State of Washington, and the Center for Medicaid Services have all said that Harborview is a “best in class” facility.

Massive transfusion is usually a stressful event—for the patient, the patient’s family, the patient care staff, and the transfusion service. In



extreme events, it can involve the donor center as well because of the need to ship additional components rapidly and the impact on regional reserves of blood. Staff involved in massive transfusion situations can feel discomfort when they do not have as much time and as many resources as they need. Others may be stressed by the sheer amount of valuable or even irreplaceable resources being used. For these and many other reasons, massive transfusion is best handled with standard operating procedures and clear lines of communication. There are many advantages and secondary benefits for the transfusion service manager and medical director if the hospital administration, staff, and medical staff are supporting an effective massive transfusion process.

Massive transfusion can be a planned event, as it was in cardiac surgery and liver transplantation in the past and as it remains in certain large cancer and orthopedic surgeries and difficult obstetric cases to this day. It can also be an unplanned event as in trauma, massive gastrointestinal bleeding, ruptured aortic aneurisms, and obstetric catastrophes. The most important aspect of dealing with these events is the planning and allocation of resources that occur beforehand. For planned massive bleeding, this preparation can and should be patient-specific. For unplanned events, there still must be a framework that defines roles and expectations in the event of a bleeding emergency. In modern usage, this is a massive transfusion protocol (MTP).

### **The Building and Structure of Massive Transfusion Protocols**

As recently as a decade ago, MTPs were rare.<sup>29</sup> The two AABB publications, *Massive Transfusion* (1994) and *Guidelines for Massive Transfusion* (2005), provide historical perspective and still-useful advice. Now MTPs are required for the accreditation of hospitals and patient care programs by The Joint Commission, the American College of Surgeons Committee on Trauma, the CAP, and the AABB. The AABB requires MTPs for the accreditation of a hospital transfusion service as well as a patient blood management program.

An MTP is a profoundly local document in that it reflects the patient care needs, available resources, interpretations of data, and opinions of local individuals and systems that must work together in a stressful emergency. It starts with a set of questions.

1. What kinds of patients do we see?
2. What are the resources available locally?
3. Are we prepared to use those resources well?
4. What might we do better with additional preparation and training?
5. What might we do better with additional resources?

