A Disaster Doesn't Have to Be a Disaster

An Evidence-Based Triage Method That "Takes the Guesswork Out of Triage"

By Mick Navin, MS, & Bob Waddell II, EMT-P

You just arrived at a multiple-casualty incident, and there are victims lying everywhere. Whom do you send first? If you take the patient who seems to be in the worst condition, will he even make it to the hospital? Maybe you should put him on a helicopter, but you'll waste a valuable resource if he doesn't make it to the hospital alive. How will that affect the survival chances of all the others? If you don't send the worst first, he will surely die from your decision. But if you do, even if he can be saved, how many medical resources will it take, and what happens to the patients left untreated? How many will get worse before they are transported and treated? What is the best order among all of these immediates? You know from experience some of these delayeds will get worse; some will even crash. Do you send some of those? What if you put someone on the helicopter, the trauma team is ready and waiting, and that patient really did not need it? How can you possibly make all the right decisions and make the best use of helicopters, ambulances, trauma centers and other hospitals? How can you save as many of these patients as possible?

Triage is a complex issue, as it involves using all of your resources effectively to save as many lives as possible. Currently, the only support for making life-and-death decisions are "red" and "yellow" triage tags. Given medical advances, this seems archaic. It does not provide the help that is needed, leads to inconsistent and inaccurate triaging and may result in unnecessary deaths.[1] Color-tagging methods are subjective. They are not based on empirical data, they are not scalable, and their goal of "doing the greatest good for the greatest number" is not measurable or reproducible. All of the unanswerable questions posed in the above scenario are a product of an imprecise and ineffective triage system.

A new triage method may be the solution to these problems. The patent-pending Sacco Triage Method (STM) is an evidence-based, outcome-driven triage method.[2] It is simple and precise, scalable and reproducible, and it will significantly increase survivorship in mass- or multiple-casualty incidents. It also supports routine patient tracking and outcome evaluation. Using a simple physiological score that predicts survival and deterioration—a score that is used every day on every trauma patient—patients are triaged to maximize expected survivors in consideration of the timing and availability of transport and treatment resources.

Trauma Patient Scoring

Sacco et. al. showed that a scene score based on respiratory rate (R), pulse rate (P) and best motor response (M) could accurately predict a patient's survivability for blunt and penetrating trauma.[2] The Sacco Score is computed by summing coded values of each measure. For example, if a patient has an accelerated respiratory rate of 40 breaths per minute, a pulse of 130 beats per minute, and can raise his arm when asked, his Sacco Score would be 9 (i.e., 2+3+4). This patient would be red-tagged under the widely used START (Simple Triage and Rapid Treatment) method simply due to his rapid respiratory rate, even though the survival probability for a patient with a score of 9 is 90%.[2] We generically call the score used to assess trauma victims the Sacco Score, allowing for adjustments beyond RPM that might include age, insult and injury.

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Table I: Sacco Score					
Coded values	0	1	2	3	4
Respiratory rate (R)	0	1–9	36+	25–35	10–24
Pulse rate (P)	0	1–40	41–60	121+	61–120
Motor response (M) from pain	None	Extension/ flexion	Withdraws from pain	Localizes pain	Obeys commands

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As you can see in *Table I*, Sacco Scores can range from 0 (zeroes in each measure) to 12 (fours in each measure). The corresponding survival probabilities are not shown here, as they are not explicitly used in the field, but the underlying research is used to drive triage decisions.[2]

It is interesting to note that red-tagged immediates in START and START-like methods can have scores that range from 1 to 11, with corresponding survival probability that ranges to 97%. This does not isolate immediates as START is designed to do, but it does support the contention of one paramedic in Pennsylvania, who stated that "there are reds, and there are REDS!"[1] Further, yellow-tagged delayeds can have scores that range from 6 to 12. The wide overlap in survival probability between "immediates" and "delayeds" has led many to question the medical validity of START. The American College of Surgeons has tried to compensate for these inaccuracies by previously suggesting that a 50% over-triage rate is desirable, but more recently questioning whether this level of over-triage may be "life threatening in a disaster." Surely there is a need for more precision in triage.[1,4]

Sacco Triage Methods

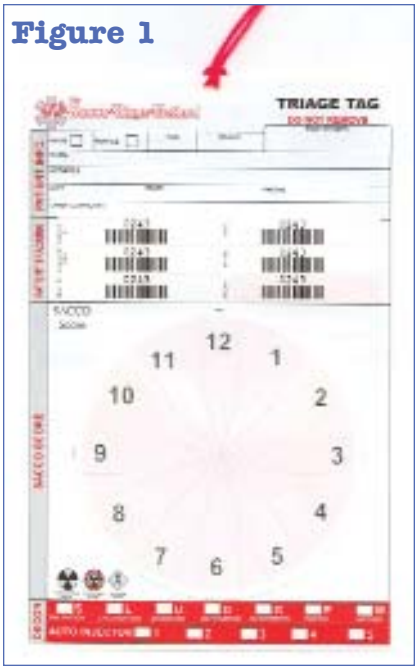
With the computation of the Sacco Score as background, application of the Sacco Triage Method to a multiple- or mass-casualty incident can be presented as a five-step process:

- Step 1. Scoring and tagging victims
- Step 2. Grouping of victims at the scene
- Step 3. Determining the optimal triage strategy
- Step 4. Implementing the triage strategy
- Step 5. Managing resources
- Alternative to Steps 3–5: Applying a rule-based triage protocol (used in absence or failure of communication or technology).

Step 1: Scoring and tagging victims

The first EMS crew arriving on the scene assumes the role of Triage. The triage officer and subsequent emergency responders begin assessing and scoring victims, using triage tags to attach the score to the victim. As shown in *Figure 1*, peeling back appropriate

Figure 1



stickers reveals scores on the tags. The familiarity of the clock face and orientation of the tag enables providers to see the score at a glance. Scores can be computed manually from memory (recall that paramedics and EMTs will be routinely scoring every trauma patient), from a pocket reference card (see *Figure 2*), or through software on PDA devices. Scores are accumulated automatically through the PDA, or by sticking the peeled-off labels onto a provided "accumulator card" that is included in the triage tag pack.

Once a victim is tagged, his score on the tag is not typically changed, as compensation for deterioration is built into STM and is based on the initial Sacco Score and on expected care at the scene. When victims are reassessed, their scores can be recorded on the back of the tag. The tag score is only changed in response to specific interventions (e.g., chest decompression, opening of an airway) where dramatic and immediate patient improvement is expected and an increase in the Sacco Score is recorded. The peel-off sticker for the new score is removed from the tag and inserted over the original score, showing only the new score, while tracking the impact of the intervention.

Step 2: Grouping of victims at the scene

Once scored, victims are organized at the scene into RPM groups that have similar physiological characteristics (see *Table II*).

The commonality within these groups of survivability and expected deterioration enable better use of scene medical resources. The groupings also organize victims at the scene. While it is true that simulations show the highest priority victims are most often within the middle group, the groupings themselves do not predetermine triage strategy, as this is dependent on size of the incident and availability of resources.

It should be noted that victims with scores of 10, 11 and 12 are screened by EMS to determine if they require trauma care. Those screened are treated as "walking wounded"

Figure 2

	CODED VALUES	0	1	2	3	4
R	Breaths per minute	0	1 - 9	36+	25 - 35	10 - 24
P	Beats per minute	0	1 - 40	41 - 60	121+	61 - 120
M	Response to stimulus	None	extension/ flexion	withdraws	localizes	obeys commands

SACCO SCORE: Measure R, P, and M and sum the corresponding coded values.

or "ambulatory" and assigned to hospitals not otherwise receiving trauma victims. Likewise, victims with scores of 0 can be characterized as expired and excluded.

Step 3: Determining the optimal triage strategy

Based on the number and physiological distribution of victims at the scene and scene characteristics, along with the availability, timing, proximity and capability of transport and treatment resources, the optimal triage strategy is defined through the application of incident command software that maximizes the expected number of survivors.[2] This requires data from the scene, and planned or updated data on transport and treatment resource availability. For purposes of this discussion, we will assume that a central dispatch facility will receive scene and resource information and run the incident command software on a standard personal or laptop computer.

The triage officer will communicate information to a central dispatch center:

- Number of victims with each Sacco Score
- Estimate of the ambulance processing rate at the scene (e.g., number of traffic lanes available)
- Number of available landing sites for helicopters.

While live on the phone, the dispatcher enters this information into the incident command software, which immediately produces the optimal triage strategy. The strategy assigns victims in priority order by score to specific treatment facilities and indicates transport mode. This is conveyed to the triage officer, as in this sample dialogue:

- Take two "sixes" via ambulance to Community Hospital
- Take a "five" and a "six" via ambulance to Mercy Trauma Center
- Take two "fours" via helicopter to University Trauma Center.

This triage plan is recorded at the scene by the triage officer on the left side of a Triage Command Log (as shown in *Figure 3*). The triage officer enters a sequential vehicle number, the Sacco Scores of assigned victims and the designated hospital. In the interest of time during a large incident, a maximum of one page of dispatch (seven vehicles) is relayed to the triage officer.

The entire communication exchange, including inputting of scores, determining the optimal triage strategy and communicating the strategy back to the scene, will take typically less than one minute (and rarely more than two). Large-scale incidents require periodic communication, as do scene modifications during implementation of the plan, as shown below.

Table II: Victim Grouping

Group	RPM Range	Characteristics
1	0–4	Survival probability less than 35%; expect rapid deterioration
2	5–8	Savable but transitional patients; on slippery slope of deterioration
3	9–12	Survival probability greater than 90%; expect slow deterioration

Step 4: Scene implementation of strategy (concurrent with Step 5)

The triage plan is on the left side of the Triage Command Log; the actual dispatch is recorded on the right in the same way assignments are typically recorded at MCI scenes, on what is now often called the "transport log." Deviations from the plan, while not encouraged, as this can be proven to reduce overall survivorship, are nonetheless necessary under chaotic scene circumstances (e.g., parents insisting on accompanying their child to the trauma center). These changes are simply noted and communicated to central dispatch upon the next communication. Subsequent communications are necessary when scene characteristics change, when additional victims are found or scored, or in large incidents simply to receive more dispatch triage assignments.

During subsequent communications, the dispatcher will lock in scene dispatches that have already been made and will rerun the

Figure 3

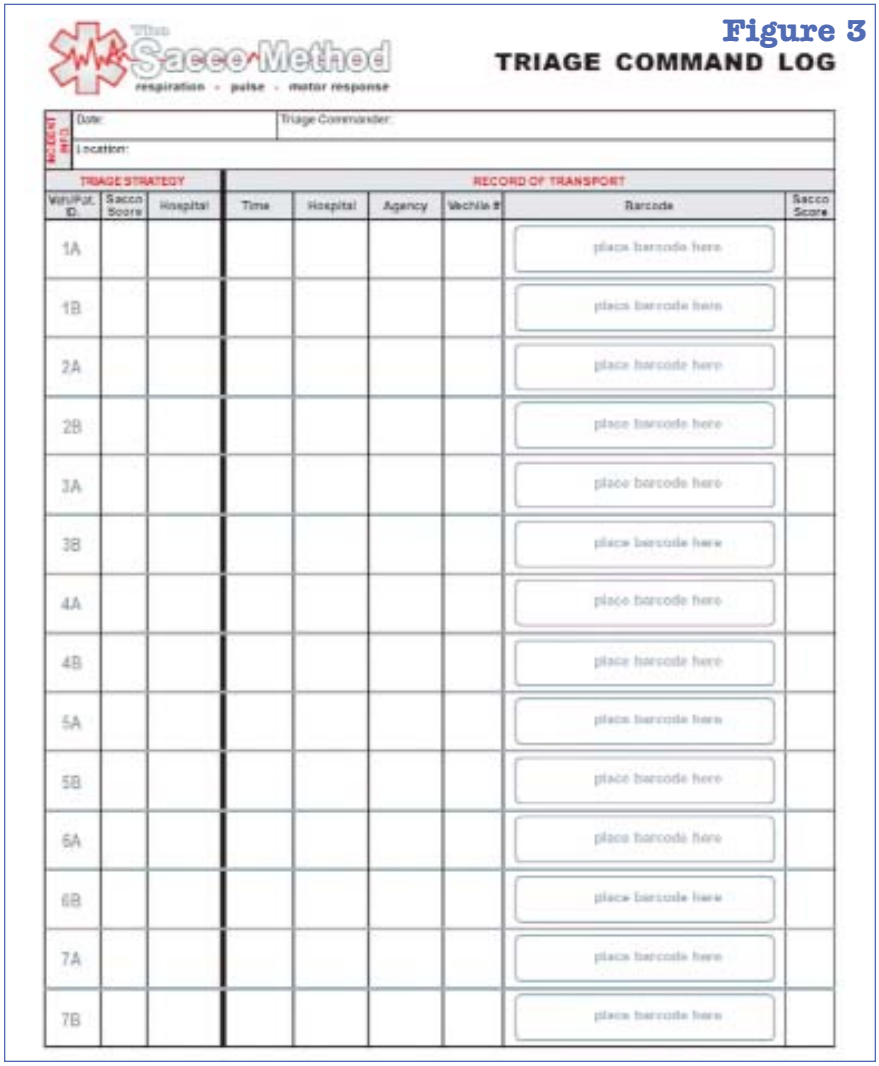
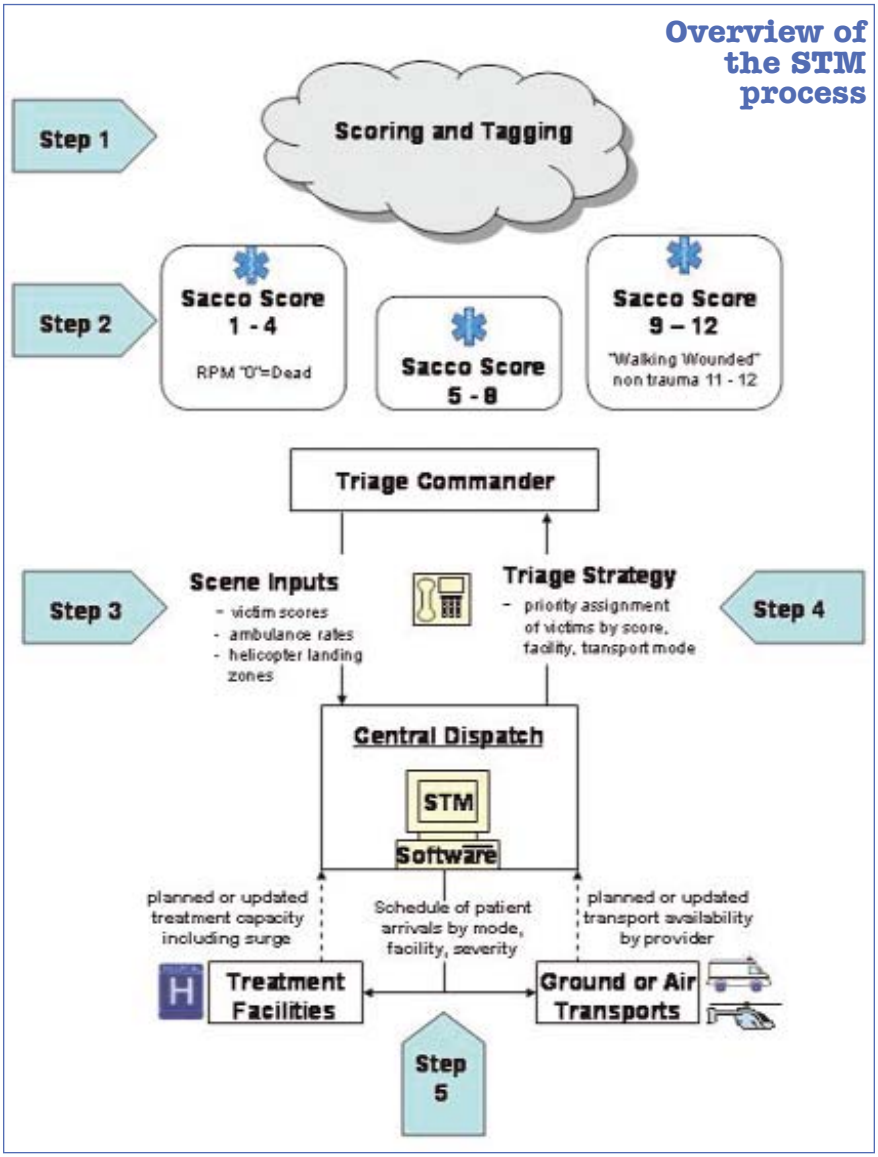


Table III: Sample Rule-Based Protocol	
Scene Characterization	**Triage Priority Order**
1. Multiple casualty; resource levels stressed **Estimate about an hour or less to clear the scene**	**4 5 6 3 2 7 1 8+**
2. Large multiple casualty or small mass casualty requiring staged resources **Estimate 1½ to 2½ hours to clear the scene**	**5 6 7 8 4 9 3 2 1 9+**
3. MCI; resources overwhelmed **Estimate 3 or more hours to clear the scene**	**6 7 8 5 9 10 4 3 2 1 11+**

computer model to account for changes at the scene or changes in resources. For example, a second incident or series of small incidents might impact a treatment facility and reduce its capacity to support this incident. The incident command software readily accommodates these changes.

Step 5: Resource management (concurrent with Step 4)

When the STM incident command software computes the triage strategy, it also produces a regional resource management plan that shows the number of transport units needed; the estimated time it will take to move all victims to treatment; the treatment facilities impacted; and the number, severity and scheduled arrival of all victims that each treatment facility will receive. Each treatment facility will know, at the onset of an incident, the number of victims they are receiving, their scheduled arrival and their severity as indicated by the RPM score. This will enable them to ramp up in staff and support in response.



Incident snapshots can also be viewed at any time to show the current state of the incident, including the number of victims remaining on scene, the number in transit, and the number in treatment and at which treatment facilities. All of this information includes victim severity. The resource management plan and all ancillary information are available in report form, but will soon be accessible via secured Web access to enable EMS, EMA or others real-time data access as appropriate.

Within the limitations of maximizing expected survivorship, the STM incident command software will balance and distribute patient loads among facilities based on standard and surge capacities to mitigate the impact on any one facility. Planned treatment capacities are available as defaults, or can be automatically or manually updated at the onset or anytime during the incident. These changes and updates are made off-line from and independent of scene communications. For each treatment facility, there are three levels of capacity:

- routine or expected capacity
- initial surge capacity and time to surge
- maximum surge capacity and time to surge.

Capacities reflect throughput—the facilities' ability to treat and process trauma patients—and do not necessarily reflect "bed" capacity. These capacities are not violated by the incident command software unless the incident size exceeds the region's available resources.

Alternative to Steps 3–5: Applying a rule-based triage protocol

In the absence or failure of effective communication or technology, a customized rule-based protocol is applied. This strategy considers survivability and broad resource levels to determine triage order, but does not require communication from the scene or a software application. The rule-based protocol provides a good but suboptimal strategy

that simulations show exceeds current capabilities.

The rule-based strategy is based on the triage officer's characterization of the incident and on a predefined priority ordering of victims. The triage officer assesses the scene, estimating the size of the incident and the time he expects it will take to clear. He then selects a triage strategy, determined *a priori* through custom simulations, that best corresponds to the incident size. Consider the rule-based protocol shown in *Table III*.

Once the triage officer estimates the size of the incident, he dispatches from the scene in the order indicated. For example, if he estimated, given the number of victims and the resources available, that it would take about an hour to clear the scene (i.e., characterization 1), he would dispatch all 4s first, then 5s, then 6s, then 3s, 2s, etc. He would continue until all victims have been removed from the scene, only deviating if victims have expired. As shown in this example, victims with Sacco Scores of 1 would likely expire, as they are not as high of a priority, unless of course the distribution of victims is such that there are many 1s and few victims of higher priority.

Note that "8" in the strategy for characterization 1 is a low priority, but is a much higher priority under characterization 2. This is interesting, as it indicates a bit about the process. Victims with Sacco Scores of 8 are expected to have minimal or no deterioration in the first hour. Therefore, they are a low priority in incidents where we expect to clear the scene within an hour. In the second characterization, where we expect the scene will take up to 2½ hours to clear, 8s become a much higher priority, as they are very viable and savable victims, but will deteriorate if they are not transported and treated.

The rule-based protocols are best determined through simulations that reflect the region's EMS capabilities, including the proximity and capabilities of treatment facilities, and the type of incidents most likely to be encountered. New York City would likely have a different set of rules and different scene characterizations than Cheyenne, WY, for example.

Once the rule-based protocols are determined, they are provided on a pocket reference card, in the ambulance disaster kit and on a PDA, as appropriate.

Benefits of the Sacco Triage Method

STM provides operational, process and outcome benefits over current triage protocols:

Triage is a complex problem of using all medical resources effectively to save as many lives as possible. Emergency providers have been saddled with the burden of "life-and-death" decisions without any real support, until now.

• Saves lives

The Sacco Triage Method produces optimal triage strategies. Simulations of large MCIs show increases in expected survivors by as much as 500% compared with current protocols. The START and START-like triage priority of sending the worst first for transport and treatment can be proven to cost lives when resources are taxed.

• Used every day, on every trauma patient

Routinely computing Sacco Scores on every trauma patient supports outcome tracking and continuum of care data collection, and ensures mass-casualty preparedness.

• Outcome-driven and measurable

The expected survivorship in every casualty incident, every drill, even routine EMS performance can be tracked.

• "Takes the guesswork out of triage"[3]

Scoring is simple and quick. A precise triage strategy provides the transport schedule and patient assignment to specific hospitals. This leads to consistent, reproducible decisions based on science. No more "playing God"!

• Promotes interoperability

Precision in scoring overcomes differences in local protocols and allows all responders to "speak the same language." The STM incident command software considers all regional resources in determining the optimal triage strategy for large incidents.

• Balances patient loads across hospitals

The STM incident command software distributes patients across trauma treatment centers within a region based on capability and proximity, not allowing the disaster to be "moved to the hospital."

• Scalable

Determines the optimal and unique triage strategy when resources are taxed or overwhelmed. Readily supports local or regional surge analyses.

• Manages/leverages resources

Maximizes human, transport and treatment resource utilization.

• Overcomes the eight scientific limitations of START

Sacco et. al. identified eight fatal scientific flaws of START, many of which are included in this list. STM overcomes all of them.[2]

Summary

So, whom do you take first? It depends—on the location of the incident, the number and severity of victims, timing and availability of resources, local and regional treatment and transport capabilities, and accessibility to patients. Triage is a complex problem of using all medical resources effectively to save as many lives as possible. Emergency providers have been saddled with the burden of "life-and-death" decisions without any real support, until now. Dr. Robert Buckman (a trauma surgeon at St. Mary Medical Center in Langhorne, PA) calls the STM the "first evidence-based triage in history." As more evidence is gathered, the method will continually improve. STM is fully operational for daily use and during MCIs for blunt and penetrating trauma. Research is already underway to enhance STM for blast, burn and chemical injuries, and age adjustments. Application of STM for hospital triage is also under development. Future publications will outline these advancements. ■

References

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❒ 2. Sacco WJ, Navin DM, Fiedler KE, et al. Precise formulation and evidence-based application of resource-constrained triage. *Acad Emerg Med* 13, August 2005.

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