

Optimizing Trauma
and Critical Care in
Resource-Limited
Settings: Strategies for
Efficiency and
Outcomes

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Disclosures

- None



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Quote

- *It always seems impossible until it is done.*
- -Nelson Mandela

How do you
make possible
the
Impossible?

Education

Planning

Execution



A Highly Reliable Organization (HRO)

HRO is an organization that operates in complex, high-risk environments and consistently avoids failures despite the potential for catastrophic events. The principles of an HRO focus on maintaining safety, efficiency, and reliability, even in situations of uncertainty or potential danger. The core principles include:

1. **Preoccupation with Failure:** HROs constantly focus on small problems and near-misses, viewing them as opportunities to learn and prevent larger failures. The idea is to be highly sensitive to deviations from normal operations, no matter how small, and act quickly.
2. **Reluctance to Simplify:** HROs avoid oversimplification of processes. They acknowledge that complexity exists and work to understand it fully. This includes creating procedures that handle the nuances of situations rather than assuming everything will fit neatly into a one-size-fits-all approach.

A Highly Reliable Organization (HRO)

3. **Sensitivity to Operations:** HROs are continuously aware of their operations and are attuned to the operational environment. This involves maintaining situational awareness and ensuring that people at all levels, particularly those closest to the work, can respond to changing circumstances in real-time.
4. **Commitment to Resilience:** HROs prepare for the unexpected by building the capacity to recover quickly from disruptions. They invest in training, systems, and practices that ensure they can respond to errors, failures, or unforeseen events without a complete breakdown of operations.



A Highly Reliable Organization (HRO)

5. **Deference to Expertise:** In HROs, decision-making is often decentralized, with authority given to those who have the most expertise and the best understanding of the situation, regardless of their rank. This promotes quick and informed decisions in critical moments.

6. **Continuous Improvement:** HROs embrace a culture of constant learning and refinement. They consistently analyze their performance, identify areas of improvement, and implement changes to enhance their reliability and reduce risks.



Evaluating Systems that Function in resource deficient environments

- Who does this the best?
 - Military
 - Given a mission and told to figure it out
 - Follow concepts of HRO
 - Continual reevaluation
 - Continual education and training
 - Recognize what the problems are and enact a plan to fix them

Utstein Formula for Survival

Trauma remains a leading cause of death worldwide, particularly in low-resource environments. According to the World Health Organization (WHO), injuries account for over 5 million deaths annually, with more than 90% occurring in low- and middle-income countries (LMICs) (WHO, 2021). Optimizing trauma and critical care in these settings is imperative to improve survival outcomes.

This guideline employs the **Utstein Formula for Survival**, which states:

Survival = Medical Science × Educational Efficiency × Local Implementation
(Nielsen et al., 2010)

This framework emphasizes that improved outcomes depend not only on medical knowledge but also on how well that knowledge is taught and applied in the local environment.

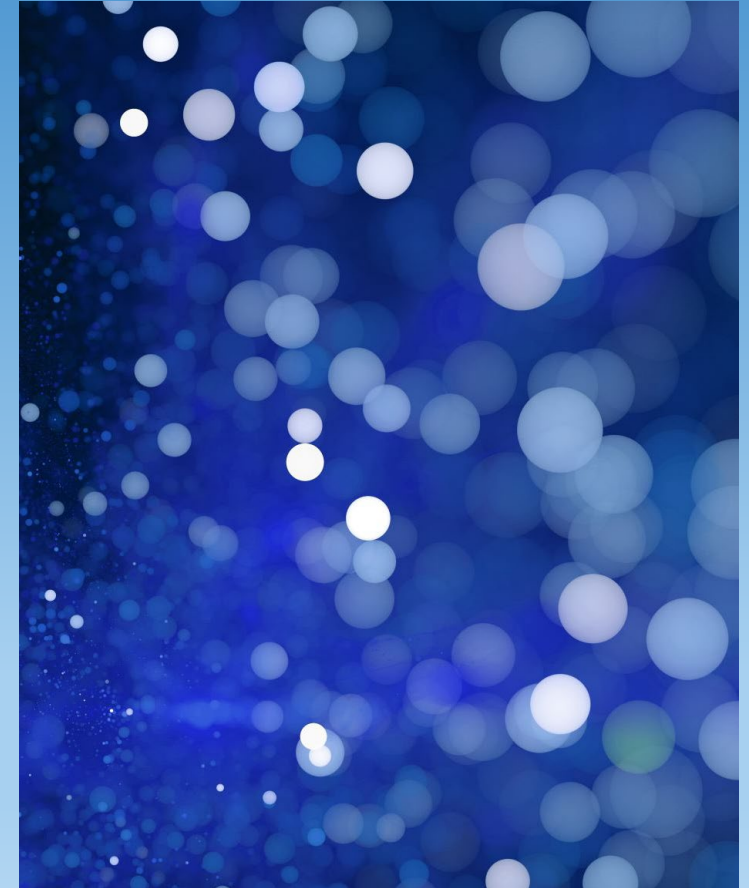


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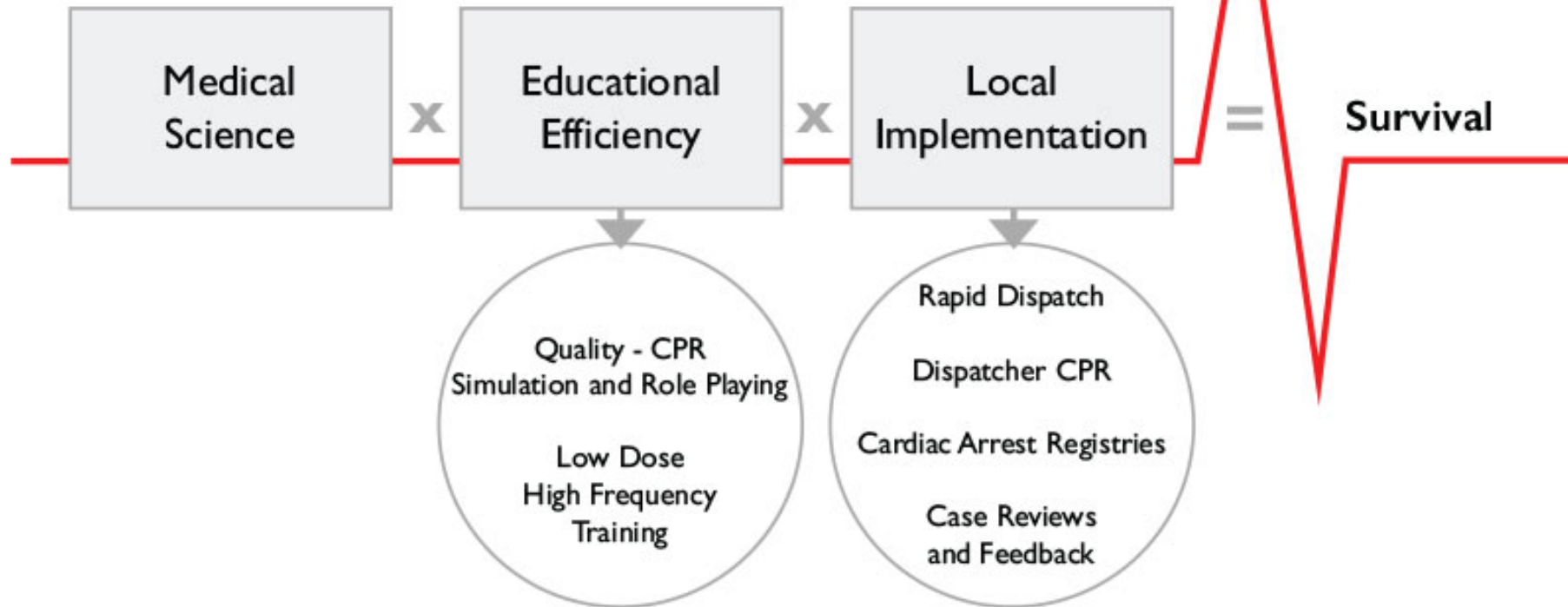
The Utstein formula of survival provides a standardized framework for trauma care, but its implementation remains challenging in low-resource settings.

Structured quality improvement initiatives, such as protocol standardization and targeted skill development, enhance system efficiency and provider competency.

Integrating these initiatives with scenario-based simulation training and telemedicine strengthens trauma care capacity and fosters global collaboration in trauma education



The Utstein Formula of Survival



In an ideal world, if each of the elements of the model were performing at 100%, 100% would survive. Realistically, however, we are more as 80%, 50% and 50% respectively. This means that survival rates would be down to 20%.

By virtue of its generic nature, the Utstein Formula for Survival carries relevance for most kinds of medical training and treatment within utilizing it in this way, it serves as an analytical tool to map strengths and weaknesses in systematic approaches to improving patient outcomes.



How to Apply
the Formula

Guideline quality
science

Efficient education
of the care givers

Well functioning
chain of survival



Identify what is needed



Biggest issue is people just say, “We can’t do it,” “Not possible here.”



Pick one thing to fix or implement



Organize a plan with a goal and work backwards from the goal



Set a process and make the change in phases



Verbalize itSay
it out loud Bring it
into Being

- Tell people what you are going to do so they can absorb what is going to happen.

Start educating and training the staff

General Rule of Thumb (Based on Research):

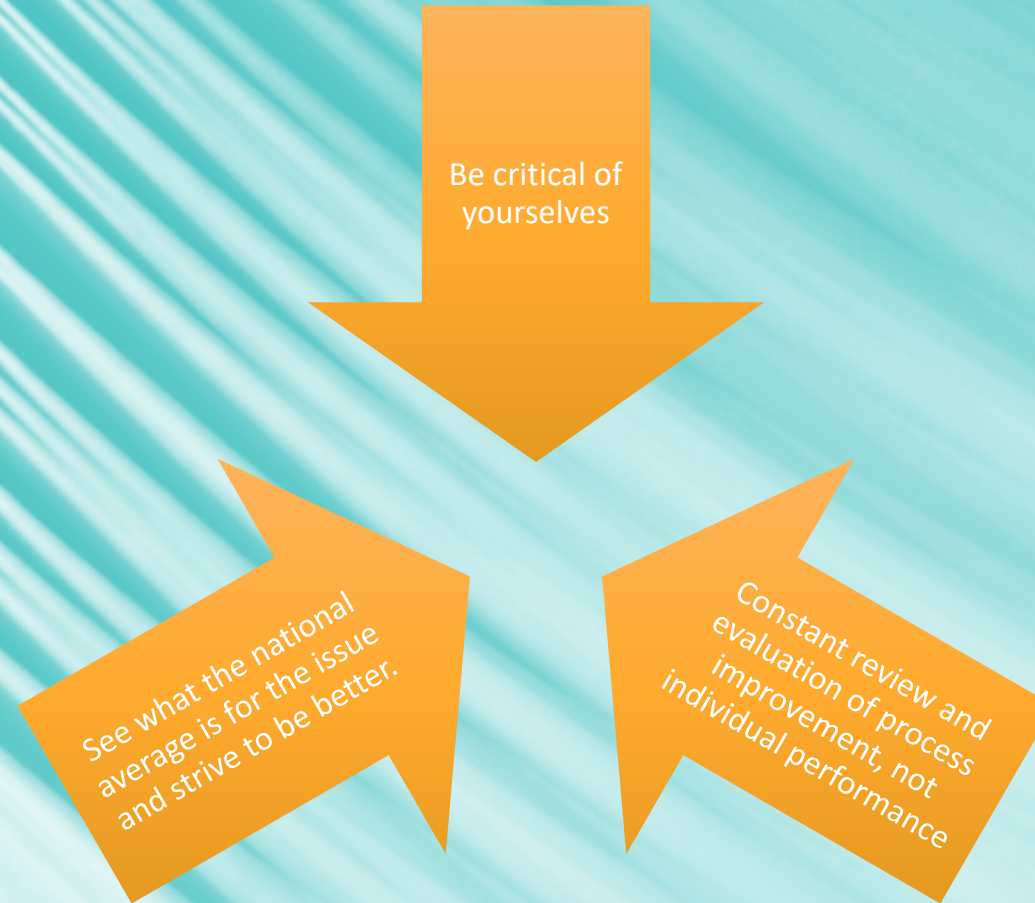
- **Tipping Point:** ~15–20% of the population (or key influencers) is often enough to create momentum for broader adoption.
- **Critical Mass:** ~25–30% may be needed for the change to feel inevitable or self-sustaining.

Set a Start Date “Go Live”

Put the mark in the sand. We are going to be trauma center on this date.....



Look at the Evidence and where things can be improved



Evaluating Systems that Function in resource deficient environments

Military systems

Metric	Value
Combat Case Fatality Rate (OEF/OIF)	9.4% (vs 15.8% in Vietnam)
Survival if reaching Role 2/3	>98%
Impact of Tourniquets (Extremity)	85–90% increase in survival
Golden Hour Evacuation	24% mortality reduction

Outcomes and Impact

Intervention	Estimated Mortality Reduction
Early TXA administration (CRASH-2)	1.5% (14.5% → 13.0%)
Organized trauma systems (MacKenzie et al.)	15–20%
Trauma training for providers (Frehywot et al.)	10–30% depending on coverage
Regional referral protocols	25% improved survival in penetrating trauma
Community responder training	10–15% mortality reduction (Sasser et al.)



Comparative Trauma Outcomes: Military vs. U.S. Civilian Systems

Metric	U.S. Military (Iraq & Afghanistan)	U.S. Civilian (NTDB)
Penetrating Trauma Survival	Over 90%	Median 67.5%
Blunt Trauma Survival	Not specifically reported	Median 78.9%
Time to Surgical Intervention	< 60 minutes for damage control surgery (Role 2)	Median 90–120 minutes
Prehospital Death Rate	< 10%	26%
Blood Product Resuscitation	1:1:1 ratio (PRBC:Plasma:Platelets)	Often PRBC-heavy
Tourniquet Use	Widespread, early application	Variable, often delayed
Evacuation Time	< 60 minutes (MEDEVAC); definitive surgery in 2–4 hrs (Role 3)	Often > 60 minutes, location-dependent
Training & Simulation	Routine, high-intensity combat scenarios	Variable, less frequent
Role 2 Surgical Capabilities	Immediate DCS within 60 mins; rapid medevac to Role 3 in 2–4 hrs	No equivalent typically in civilian systems



How to Apply this Process

The diagram consists of two blue arrow-shaped boxes pointing towards each other. The left box contains the text 'St Mary Medical Center Apple Valley'. The right box contains a list of factors: 'Located 60 miles from Nearest level 1 trauma center', '• 58-minute flying time', '• 90-minute drive time', '• 650,000 people in the area', and '• San Bernardino mountains create huge barrier and isolate the area from services'.

St Mary Medical Center Apple Valley

Located 60 miles from Nearest level 1 trauma center

- 58-minute flying time
- 90-minute drive time
- 650,000 people in the area
- San Bernardino mountains create huge barrier and isolate the area from services

Process Applied

Go Live Date set

Education campaign for hospital

- TNCC 80% of ED Nurses, 50 % of ICU nurses
- Weekly trauma lectures for medical staff and nursing 48 lectures given
- Quarterly meetings with Prehospital for education and case reviews

Trauma Guidelines established

Education given to all department's pharmacy, blood bank, ICU, case management, PT,OT, lab.

Trauma Drills and education conducted



Continual process improvement

- HRO applied
 - Tier 1 time out
 - Tier 1 trauma checklist to ensure that all items and key aspects are accomplished prior to or shortly after arrival
 - Monthly trauma committee meetings
 - Monthly meetings with Level 1 referral centers



Issue identified

- As a level 4 trauma center applying for level 3 status
 - Gap analysis showed the need for subspecialty care particularly Neurosurgery
 - Applied Military concept of damage control surgery and set up agreement with Loma Linda University
 - Patient with multisystem trauma but too unstable to make the transport from active hemorrhage
 - Take them to the operating room stop the bleeding
 - Shunt major vessels
 - Pack abdomens and stop hemorrhage
 - 1:1:1 resuscitation
 - Fasciotomies, chest tubes

Transport Takes Them Directly from OR to ED at Loma Linda

- Process is set up
 - Call Loma Linda trauma surgeon → let them know what we have
 - ED at St Mary's does EMTALA paperwork
 - Patient goes to OR for damage control surgery
 - Transport comes directly to OR and takes patient from OR to ED
 - Trauma team receives patient at Loma Linda
 - Trauma surgeon at St Mary's calls surgeon at Loma Linda to give DR to DR hand off



Transport on
Site (Based
at St Mary's
Medical
Center)



What does this look like so Far?

In 10 months, 2170 traumas
54 penetrating trauma 7 deaths

87 % survival

12.9% mortality

Military > 90% survival

NTDB median 67.5% survival



11 medivacs to loma Linda from OR

- No DOA to Loma Linda
- 2 mortalities (in sicu)
- 9 survived to discharge
- 82 % survival
- Better than NTDB average of 67%
- Still work to do



Questions

- 1. True or False
 - Civilian trauma centers have a higher survival rate for penetrating trauma than does the military? (**False**)
- 2. The three components of the Utstein formula of survival are quality science, efficient education, and _____.
 - a Prehospital whole blood
 - b punitive measures for poor outcomes
 - c **Well functioning chain of survival**
 - d burdensome administrative processes

Questions

- 3. True or False
 - HRO's simplify processes and “hope for the best”?
(False)
- 4. What percentage of the staff have to be “on board” with an idea to feel that it is inevitable?
 - a. 5 -7%
 - b. 10 -12 %
 - **c. 25-30%**
 - d. 80-90%



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