Lethality 101: A Complex & Controversial Subject

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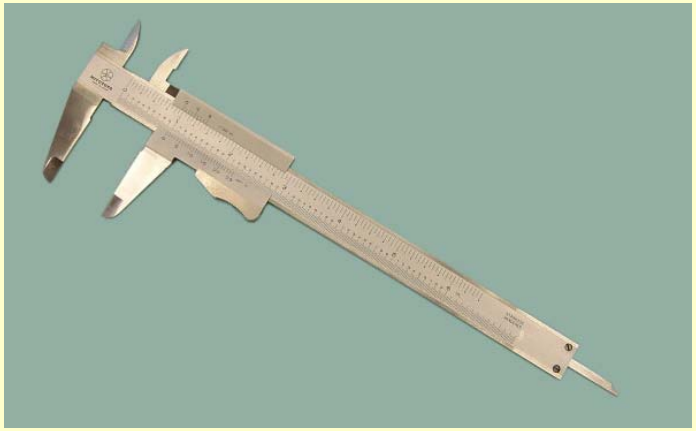

“Lethality” is a gauge or a metric of effectiveness.

The “Lethality” of a system is misleading and ambiguous.

- **Fact**: **“Stopping Power” is the common term for lethality.**
- **Goal**: **A straight forward way to evaluate and compare the typical or expected performance of weapon systems.**
- **Issue: Terminal ballistics or more appropriately “Wound Ballistics” appears simple but involves diverse concepts in a variety of fields and disciplines.**
- **Impact: Whenever the “Lethality” of a system is reported, you have to know specifically what is meant by “Lethality” and what simplifications and assumptions were made to give you that measure of expected performance.**

“When a shooter asks the experts about his weapon’s “lethality”. He is likely to get more responses than he has rounds. These answers, like his shots, will all be off target to some degree.”

A Closer Look at some of the variables

Lethality = **Shot placement** +Ballistics + Projectile/Target interaction
+ Psychology + Legal Restrictions + Logistics

Shooter

Knowledge (choice of target)
Accuracy & Conditioning. (proficiency & physical ability)
Stress (mental state)
Time (time to acquire)

Weapon System (weapon and ammo)

Quality (condition & design of the weapon and ammo. Including ammo tolerance)
Ranging errors (instrumental & shooter skill level)

Environmental

Exposure (Intervening barriers)
Weather Effects (Wind, Temperature, Humidity, etc)

A Closer Look at some of the variables

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Interior Ballistics

Propellant (pressure, flame temperature, etc…
Weapon (twist, barrel length, user restrictions, etc..)
Projectile (mass, diameter, geometry, etc.)
Recoil (this shot and the effect on accuracy of the next shots fired)

Exterior Ballistics

Effective Ranges (close up, far away, or all of the above)
Dispersion / Accuracy Requirements (tied to range)

Terminal Ballistics

Impact Velocity Requirements
Striking Yaw / Angle of Attack
Barrier Effectiveness Requirements (auto glass, steel, drywall, body armor)
Types of Target (hard/soft, prone/frontal/dorsal, etc)
Desired Effect (Suppression, Incapacitation, Death)
Time Frame (immediate, 30 sec, 5 min, 72 hr, etc)

A Closer Look at some of the variables

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Biological Factors

Circulatory Collapse (blood loss)
Central Nervous System and Vital Structure Injury (CNS, etc...)
Role of Pain (plays a role with less than “lethal” munitions)
Shot Line (path through the body)
Adrenaline / Drugs / Alcohol (Effect on pain)
Material Properties of Tissues (bone, muscle, etc are very resilient)

Event Mechanics

Permanent Cavity (the hole)
Temporary Cavity or Cavitation (stretching the medium)
Projectile Deformation / Fragmentation (“energy deposit” / material failure)

A Closer Look at some of the variables

Lethality = Shot placement +Ballistics + Projectile/Target interaction
+ **Psychology + Legal Restrictions + Logistics**

Psychology

Belief System / Motivation (Fight/Flight or no option)
Hollywood Effect (I've been shot! / false expectations of performance)

Legal Restrictions

International Conventions (no expansion, visible to x-ray, etc…)
Domestic Law Enforcement vs. Military (restrictions not the same)

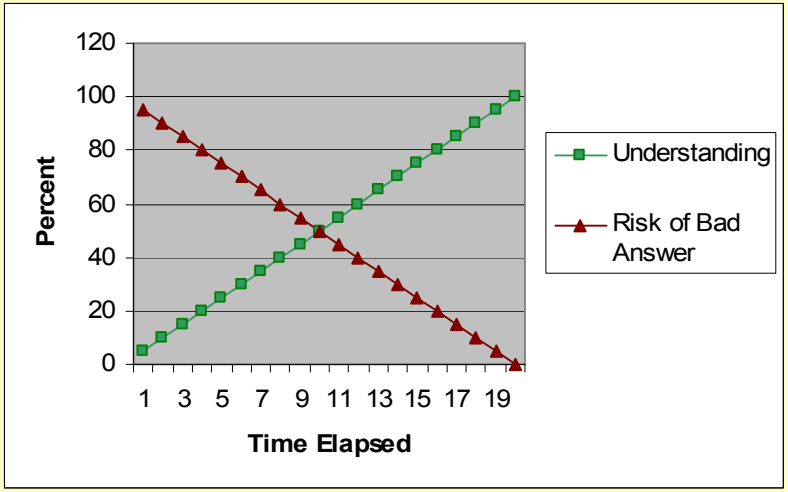
Logistics

Time Considerations: Expected length of time till re-supply
Stowed Kills vs. rounds carried (weight considerations)
Versatility (How many weapon systems / countries / services use this ammo?)

WHICH SYSTEM IS BEST?!?!?!?!?!?!?!?!?!?!?!

Answering the Question: (How long is it going to take?)

- Understanding the science
- Simplify the problem
- Develop and Test a simplified model (make assumptions)
- Compare and Validate the results to the "real world"
- Make improvements to the model
- Develop a new test for the more complex model
- Validate and repeat.



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What's been done? History of Army Research:

- **Simplistic tissue simulants and tests were developed, validated, and refined. (e.g. gelatin)**
- **More complex models were developed.**
- **A probability based / Vegas style approach/model for determining weapon effectiveness was developed.**
- **Further expansion/refinement of the model occurred (looking at additional scenarios)**
- **Initial computer models were developed**
- **Vegas style computer model validated against field data from multiple sources.**
- **Model also takes into account the role of the soldier and his ability to perform that role after being hit. (assumption of 100% motivation)**

Gelatin as a tissue simulant

Gelatin is generally used and accepted as a tissue simulant because:

- **it is homogenous presenting the same physical characteristics block after block**
- **it is transparent, so that events inside the block can be recorded by high-speed video;**
- **its retarding properties and density are sufficiently similar to muscle tissue**
- **the "wound profile" is comparable to penetration, expansion, and fragmentation patterns observed by experienced doctors (controversial)**
- **the properties of the medium and their correlation to ballistics have been extensively evaluated and controversially validated for well over seventy years.**

Independent Evaluations

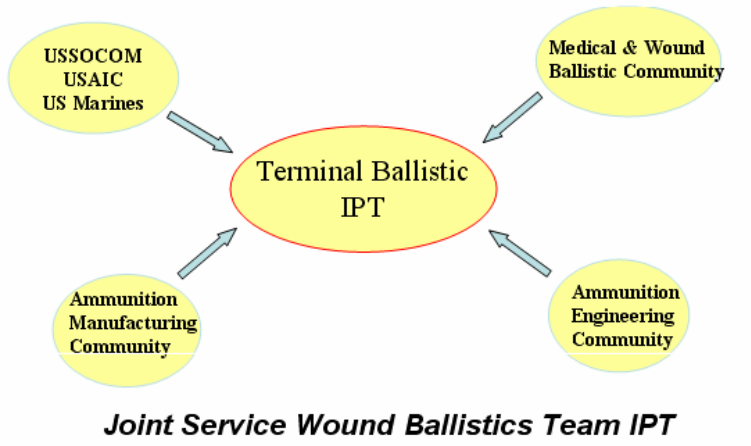
Given:

- The number of branches of science this field covers
- The length of time that testing has been going on
- Different agencies having different needs and limited budgets
- Real world limitations not providing “Hollywood” style effects. Users want more than we can give them.
- The number of half truths that are on the internet on this subject
- And the secretive / controversial / problematic nature of this sort of testing

Outcome not surprising:

- Different government test centers used different “lethality” gauges.
- Users were getting conflicting answers

Working Together / Standardization



Joint Service Wound Ballistics Team IPT

IPT Goals

1. **Clarify** the user requirements.
2. **Define** "Lethality" and "Incapacitation". Quantify these effects with respect to time.
3. **Standardize** the ballistic gelatin block method. Come to agreement on how to test projectiles for terminal ballistic performance.
4. **Evaluate** a brief ballistic gelatin block test.
5. **Determine** which characteristics are most important to gauge a projectiles terminal ballistic performance. What is best to take away from the gelatin block tests.
6. **Develop** a ranking system to grade various projectiles performance.

1. **Using past research to guide us**
2. **Bringing together the best minds**
3. **Building bridges between "gauges"**
4. **Building research relationships**

"The IPT is working with the test community to search for common ground. Everyone brings something to the table."

We're Building our "lethality" tools to give better answers faster throughout the ballistic test community

Questions?