Gunshot Wounds: A Review of Ballistics, Bullets, Weapons, and Myths

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Undergirding this review, prepared jointly by six trauma care providers associated with the Division of Trauma, Critical Care, Burns, and Emergency Surgery of the University of Arizona's Department of Surgery and the University of Colorado's Department of Surgery, are the almost irrefutable corollaries that "it is known that where there are guns, there will be gunshot wounds," and thus "where there are guns, people will be shot." These statements, albeit appearing on their faces obvious, are contextualized through the comparison of the United States to other countries within the Organisation for Economic Cooperation and Development, out from which this nation stands as a stark aberration. And thus, by extension, the fact the United States is disproportionately burdened with gun violence is plainly buttressed by the conspicuous statistical weight of the following disparity: The country's population only makes up close to 5% of the global population, yet this nation is home to somewhere between 35% and 50% of all guns on the face of the planet.

The frequency of domestic mass shootings, as indicated by the table below, taken from the review, has helped homicide and gunshot wound rates in the United States to remain at the same points as in 1950. Meanwhile, the mortality rates associated with every other major cause of death have declined in a pronounced, marked fashion in the interim. Yet, despite the consistent frequency of gunshot wounds throughout this epidemic, there still exist many misunderstandings and a large degree of confusion that stems from the media, lack of information, and other extraneous sources. The intention of the authors is to provide additional clarity on associated topics by way of sharing facts on gunshot wounds, ballistics, bullets, and weapons.

Frequency of Mass Shootings

TABLE 2. Mass Shootings in the United States 2000 to 2015

Date	Location	Killed	Wounded
December 26, 2000	Wakefield, Massachussetts; office	7	0
March 5, 2001	Santee, California; school*	2	13
October 28, 2002	Tucson, Arizona; university	3	0
July 8, 2003	Meridian, Mississippi; workplace	5	9
March 21, 2005	Red Lake Indian Res, Minnesota; school*	9	7
January 30, 2006	Goleta, California; post office	6	0
October 2, 2006	Nickel Mines, Pennsylvania; school	5	5
February 12, 2007	Salt Lake City, Utah; shopping mall*	5	4
April 16, 2007	Blacksburg, Virginia; university	32	17
December 5, 2007	Omaha, Nebraska; shopping mall	8	4
February 14, 2008	Dekalb, Illinois; university	5	16
April 3, 2009	Binghamton, New York; immigration services center	13	4
November 5, 2009	Fort Hood, Texas; military base	13	32
February 12, 2010	Huntsville, Alabama; university	3	3
August 3, 2010	Manchester, Connecticut; court	8	2
January 8, 2011	Tucson, Arizona; shopping center	6	13
October 12, 2011	Seal Beach, California; hair salon	8	1
April 2, 2012	Oakland, California; university	7	3
July 20, 2012	Aurora, Colorado; movie theater	12	58
August 5, 2012	Oak Creek, Wisconsin; temple	6	3
September 28, 2012	Minneapolis, Minnesota; offices	6	2
October 21, 2012	Brookfield, Wisconsin; salon	3	4
December 14, 2012	Newtown, Connecticut; school	27	1
June 7, 2013	Santa Monica, California; home	5	0
September 16, 2013	Washington, District of Columbia; Navy yard	12	3
April 2, 2014	Fort Hood, Texas; military base	3	16
May 23, 2014	Isla Vista, California; neighborhood	6	7
June 18, 2015	Charleston, South Carolina; church	9	0
July 16, 2015	Chattanooga, Tennessee; military centers	5	3
October 1, 2015	Roseburg, Oregon; college	9	9
November 29, 2015	Colorado Springs, Colorado; planned parenthood clinic	3	9
December 2, 2015	San Bernardino, California; workplace	14	21
	Total	265	269

*Teen shooters. Total number of mass shootings defined as more than two victims and does not count the assailant whether they were killed or committed suicide. In comparison with the previous 16 years, from 1984 to 1999, the total number of deaths was 135, and wounded was 156.

Comparison of Types of Tissue Damage Described

Key factors at play when predicting the type of and the extent of any tissue damage stemming from a gunshot wound include the muzzle kinetic energy, the overall distance between the muzzle of the firearm and the target that it ultimately hits, and the dissipation of kinetic energy as the bullet either leaves the target's or stays lodged within it. Another major component is the precise type of tissue the bullet actually hits upon reaching its target.

Once a bullet makes impact with a target, the kinetic energy is transferred to tissue. The variability of human tissue means that an injury is subject to its own variability. For example, the liver, spleen, and brain are minimally elastic compared to skin and lung tissue. The former types are more susceptible to damage from a bullet wound than the latter and can be more severely injured by the same bullet, holding all other factors constant. Furthermore, bone fracture and fragmentation stemming from gunshot wounds are common because bones lack elasticity. This can result in missile-like movement by the pieces of bone, which may produce additional injuries in nearby tissues.

Laceration or crushing injuries stem from shear force, such as that which is experienced when a bullet hits a target. Because bullets are subject to rotational forces, they typically do not follow straight paths. The rotation of a bullet after it leaves a firearm will determine the degree at which it first makes impact with a target. If a larger part of the bullet makes first contact at the point of impact, then a larger area of tissue will be crushed and injured. From there, the injured tissue further determines the bullet's path and its course.

As a bullet travels through the tissue, and after it has begun lacerating and crushing, the void opened up becomes a cavity. This phenomenon is a type of tissue injury called cavitation. Higher-velocity bullets produce larger cavities by delivering a pressure wave that moves tissue away. These bullets may even produce additional cavities that are significantly larger than the actual bullet.

The relative density and elasticity of the tissue will factor into additional cavities, and stretching and tearing will likely occur. Whereas skin, muscle, and intestines can better absorb energy than other areas, organs that have low tensile strength are liable to shatter or split because of these cavities. Those organs include the liver, spleen, kidney, and brain.

The Effect of "Rounds on Target"

According to the review and the research cited therein, "rounds on target" is a better predictor of lethality than the make and model of the gun used. The study cites a majority opinion exists among trauma surgeons that the location of a gunshot wound on the human body is more relevant to survival than the size of the gun that delivered said wound. Thus, a firearm capable of greater precision and accuracy, as well as allows for more undisturbed firings, will be deadlier than another firearm that may, for example, produce a great deal of recoil. A firearm such as a handgun that imparts more kinetic energy will produce more recoil accordingly. This will affect a gunman's ability to aim and accurately fire subsequent shots, which will directly affect the number of rounds on target. Barring a shot delivered to the

brain, spinal cord, or certain locations of bones within the leg, a target will not be killed or incapacitated immediately, meaning that multiple shots may be required on the part of a gunman if they wish to kill their target. Therefore, weapons that allow for more rounds on target are inherently more likely to be effective for killing.

Conclusion

It is incumbent upon the United States “to address numerous issues to prevent gunshot wounds including the costs, regulation of weapons, mental health issues, and better enforcement of current regulations while balancing these needs with citizen’s rights,” the authors argue in their final presentation of findings. With the country housing within its borders more firearms available than the majority of all the world’s other nations and serving as home to the most gunshot wounds per annum of any state not actively involved with a war occurring inside of its territorial boundaries, the connection between the presence of guns and the preponderance of gun-related injuries and deaths is wholly evident. Furthermore, a firearm’s lethality and the severity of an injury sustained by a target on the receiving end of that weapon’s bullet are altogether linked. Given their collective prevalence, gunshot wounds, their regularity, the extent of the wounds they cause, and the casualties they produce constitute a public health epidemic.

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