

Ballistic Trauma  
Second Edition

# Ballistic Trauma

## A Practical Guide

Second Edition

*Edited by*

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and C. William Schwab

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With 161 Illustrations

Foreword by Martin Bell

*Creating opportunities with disabled people*  
**LEONARD CHESHIRE** 

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# Foreword

This is a book first and foremost for surgeons and those who work with them in the management of ballistic trauma and treatment of its victims. But the book is also of value to others with front-line experience and an interest in the issue of harm reduction, whether in war or “peace,” on the field of battle or at the scene of a crime. These pages can also be studied fruitfully by politicians, most of whom lack medical or military expertise, in helping them understand the real world consequences of the decisions that they make. (My own special interest, cheerfully declared, is that of a beneficiary—having once been hit by mortar fire as a war reporter, I am grateful for the care of the surgeons and nurses who so expertly put me back together again and returned me to front-line duty).

I believe that we live in the most dangerous times since the global warfare of the mid-twentieth century. Appropriately, the editors of this book have set their remit wider than the most recent advances in the relevant fields of medical science—necessary advances—to keep pace with those in ballistic science, as man finds ever more ingenious ways of killing and maiming his own kind.

Napoleon III is reputed to have declared, “The history of artillery is the history of progress in the sciences, and is therefore the history of civilization.” I wonder, where does that leave us in the early twenty-first century? Nowhere very civilized, for sure.

In their preface to the first edition, in 1997, the editors noted: “The lesson of history is that you cannot take the experience of an urban hospital onto the battlefield. It also can be said, that you cannot do the reverse, and nowadays there is further confusion from the deployment of troops to peace-keeping duties performed under the scrutiny of the media. The latter is not the same as war.”

A great deal has happened since then, including the events of 11 September 2001, to change or qualify that judgment. Civilian and military targets are attacked, not only by insurgent and revolutionary forces, without distinction, discrimination, or regard to the Geneva Conventions. The front lines are everywhere and all around us, as much in the concrete defences

of the Palace of Westminster as the contested streets of Najaf or the abandoned villages of Darfur. Nor is there any monopoly of virtue—or realistic concept of one side which observes the rules, against another which violates them. This book properly draws attention to the use by the Western powers of the cluster bomb—a weapon that has the properties of an aerially sown antipersonnel mine. The APM is banned by international treaty. The cluster bomb is not. Yet international law prohibits any weapon “of a nature to cause superfluous injury or unnecessary suffering.”

One of the most controversial issues covered here is the distinction between civilian and military casualties—insofar as it exists, or indeed if it exists at all. The impact on the human frame and human tissue of a high-velocity bullet or a mortar fragment will be exactly the same, whether the victim is clad in combat fatigues or jeans and a T-shirt. In his firsthand analysis of the circumstances of the siege of Sarajevo from 1992 to 1995 (p. 583) John P. Beavis puts the ratio of civilian to military casualties at 63% to 37%. In the war in Iraq (2003–?) the ratio is probably higher, although the figures are politically sensitive, and therefore not divulged. In other conflicts, such as the wars in Angola and the Drina Valley of Bosnia, I would suggest that a 90% to 10% ratio would be nearer the mark. So much for the advance of civilization through the enlightening power of the artillery shell.

Professionals in the field of ballistic trauma will learn much from each other in this new edition. A more general conclusion they will draw, I hope, is that the present epidemic of global violence is not an acceptable outcome of continuing failures of politics and diplomacy. I am with Robin M. Coupland on this (p. 132): “Armed violence resulting in ballistic trauma should be considered for what it is—a global health issue.” Those who deal with the effects of ballistic trauma surely have the least reason to be indifferent to its causes.

There are certain ways of expressing this in plain English, admittedly nonmedical and nonspecialist. One is religious: that we are all members one of another. The other is political: that politics is too important to be left to the politicians.

*Martin Bell*  
London 2004

# Preface to the Second Edition: Why This Book, Why Now?

In 1997, Professor J.M. Ryan and others produced the reference work *Ballistic Trauma: Clinical Relevance in Peace and War* (Arnold, 1997). Much of this is still valid, but a number of concepts in care of the ballistic casualty have changed. These include developing ideas on fluid resuscitation and refinement of field protocols based on operational experience.

Authors, editors, and colleagues expressed the view that there was a need for a practical guide encompassing these developments, along the lines of *Conflict and Catastrophe Medicine* (Springer, 2002). The aim was to distill real-life practice and try to capture that which often is lost or diluted in traditional texts.

With 9/11, the world changed. Since then, major conflicts have occurred in Afghanistan and Iraq, and operations are still ongoing. Many of the authors and editors deployed to these conflicts with nongovernmental organizations, Aid Agencies, and the military. Others are working with these injuries on a day-to-day basis at one of the USA's busiest trauma centers.

This has delayed the production of *Ballistic Trauma: A Practical Guide*, but means that people are writing with recent experience of managing ballistic injury. Colleagues returning from deployment have emphasized the need for clear guidance on managing ballistic injury, especially as more and more military reservists are being deployed and their day-to-day work may not include managing these types of injury.

Authors have been given a relatively free hand in structuring their chapters so they would be unconstrained by the book's style and be able to pass on their lessons unhindered.

Finally, our request is that this book be a "living" document. Give us feedback. Record what treatment works and what treatment does not. Use this knowledge to improve the care of the ballistic casualty.

Peter F. Mahoney  
James M. Ryan  
Adam J. Brooks  
C. William Schwab

# Preface to the First Edition, *Ballistic Trauma: Clinical Relevance in Peace and War*

This book aims to bring together the science behind and the management of ballistic trauma. It is directed at the surgeon, though perhaps not an expert, who might find him or herself having to deal with patients suffering from penetrating trauma in environments as diffuse as a late twentieth-century hospital or the arduous conditions of a battlefield.

The book also brings together the views of UK and US experts from military and civilian backgrounds. This composite view was deliberate, as it was recognized that these potentially diverse views reflected the complexity of an international problem that increasingly impinges on the practice of surgery in today's world.

The UK editors were the joint professors of military surgery to the three armed services and the Royal College of Surgeons of England, along with a medical scientist with an international reputation in the field of ballistic science. The US editor is Professor and Chairman of the Department of Surgery at the Uniformed Services University of the Health Sciences and has extensive experience in the management of ballistic trauma.

Though the book is influenced heavily by the military background of many of the authors, it is directed at a much wider audience, particularly those who may have to deal unexpectedly with the consequences of the trauma seen in an urban environment. It compares and contrasts the differing civil and military management viewpoints and goes on, where relevant, to debate the areas of controversy in the specialized fields of the relevant authors.

The subject of ballistic trauma is controversial in part because its management depends so much upon the situation in which it occurs. Thus, there often is confusion and a misunderstanding that emanates from the failure to recognize that the location of surgical facilities, the number of injured, and whether the injuries are sustained during peace or war may have a profound effect on the way patients are treated. The lesson of history is that you cannot take the experience of an urban hospital onto the battlefield. It also can be said that you cannot do the reverse, and nowadays there is further confusion from the deployment of troops to *peace-keeping* duties

performed under the scrutiny of the media. The latter is not the same as war.

The book has four sections. The first section is on the science behind understanding ballistic trauma; it also adds to its declared remit by including a chapter on blast injury. The second section is on general principles of assessment and initial management. The third section deals with management from a regional perspective, and the fourth section is on more specific but general problems. The intention is to provide surgeons with an understanding of the fundamentals of ballistic trauma, the mechanisms and some insight into the significance of new weapons, as well as the variations on the principles of management.

The book acknowledges that no single viewpoint can address the management of patients sustaining ballistic injuries and does not fall into the trap of recommending rigid and single guides unless there is a convergence of opinion. Its approach has been to provide a greater understanding so that the clinician facing the clinical problem feels sufficiently informed as to make coherent choices appropriate to the circumstances.

J.M. Ryan  
N.M. Rich  
R.F. Dale  
B.T. Morgans  
G.J. Cooper  
1997



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# Section 1

## Introduction, Background, and Science

### Introduction

This first section of *Ballistic Trauma* considers wider issues surrounding firearms injury. This includes firearms use and misuse in different countries and cultures, as well as the legal treaties and restrictions that attempt to limit the damaging effects of weapons. These issues are addressed in the chapters on small-arms control and international humanitarian law.

Many health-care professionals have little experience of how firearms and munitions work; this is addressed in the chapters on “Guns and Bullets” and “Bombs, Mines, Blast, and Fragments.”

Health-care professionals need to know that the injuries produced by firearms and fragments can be modified by helmets and body armor, as outlined in the chapter on “Ballistic Protection.”

The management and handling of the ballistic casualty has associated legal, as well as clinical, implications, and some of the procedures and pitfalls are considered in the “Forensics” chapter.

# 1

## The International Small Arms Situation: A Public Health Approach

NEIL ARYA and WENDY L. CUKIER

### Introduction

Whether emergency room physicians, trauma surgeons, psychiatrists, pediatricians, or family doctors, physicians throughout the world bear witness to the terrible consequences of small arms on human health. A physician stemming a bleed in the chest of a gunshot victim is not concerned with whether the shooting was a suicide, an accident or a homicide, whether it took place in a conflict situation or in peacetime, or whether the perpetrator was a gang member, a soldier, a non-state actor, or a law-abiding gun owner. What matters to the physician is whether bullet struck bone, whether bone shattered, whether metal and bone splinters punctured vital organs or blood vessels, or severed the spinal cord—in short, whether the patient will survive and if so, what his or her future health will be.<sup>1</sup> Medical treatment has advanced in the last decade, but physicians have long recognized that preventing death and injury in times of war<sup>2</sup> or peace<sup>3</sup> can produce more significant benefits than an exclusively treatment-based approach.

Public health approaches to the small-arms issue based on evidence and science involve various disciplines of expertise, including epidemiology, but also psychology, sociology, criminology, economics, education, and medicine. A harm-reduction approach begins with the premise that the weapons, by their very nature, are designed to kill, harm, or threaten other beings. Given the accepted utility of legal firearms in society, the goal is typically not a ban, as was the case with antipersonnel mines, but regulation or “harm reduction.”

This public health approach to injury might begin with a careful analysis of the epidemiology and etiology of the injury and concentrates on the causal factors that produce the injury. The injury-prevention model examines the interactions between the environment (both physical and social), the host (the victim), the agent (the firearm), and the vector (the ammunition). The focus is on understanding the causal chain and breaking the chain at its weakest link with “fact-based” interventions.<sup>4</sup> Interventions may

address the underlying factors, for example, programs to improve the social and economic conditions that give rise to violence. Interventions may focus on reducing the severity of violence—efforts focused on supply of weapons, for example, which attempt to control exports or access to small arms. Finally, interventions may focus on “treatment”, trauma care, rehabilitation, and reintegration.<sup>5</sup>

This model is a useful one for understanding the problem of small arms and the approaches to reducing their negative effects on health. This chapter will consider:

1. Basic Concepts
2. The Health Effects of Small Arms
3. Causal Factors
4. Proliferation of Legal and Illegal Small Arms
5. Interventions
6. Evaluations
7. Conclusions

## Basic Concepts

### **What Are Small Arms?**

Broadly speaking, small arms are those weapons designed for personal use. They are lightweight and would include “man-portable” weapons such as personal and police firearms such as revolvers and self-loading pistols, rifles and carbines, light machine-guns, sub-machine guns. (e.g., The Uzi of Israel, and the HK MP5 of Germany) and assault rifles (e.g., the Russian AK-47 “Kalashnikov, the US M-16, the Belgian FAL, and the German G-3).<sup>6</sup>

Light weapons are those designed for use by several persons serving as a crew. Light weapons include heavy machine-guns, hand-held under-barrel and mounted grenade launchers, portable anti-aircraft guns, portable anti-tank guns, recoilless rifles, portable launchers of anti-tank missile and rocket systems, portable launchers of anti-aircraft missile systems, and mortars of calibers of less than 100mm. Ammunition and explosives form an integral part of small arms and light weapons used in conflicts, and include cartridges (rounds) for small arms, shells and missiles for light weapons, anti-personnel and anti-tank hand grenades, landmines, explosives, and mobile containers with missiles or shells for single-action anti-aircraft and anti-tank systems.

The Small Arms Survey estimates there to be stockpiles of at least 688 million small arms and light weapons in the world, of which about 59% are in legal civilian possession, 38% are in the arsenals of national armed forces, 3% are held by police forces, and, most surprisingly, far less than 1% are in the hands of insurgent groups.<sup>7</sup>

People generally believe that military, law enforcement, and selected security officials need weapons in order to protect society. Civilian firearms ownership is also considered by many to be legitimate for sports, recreation, and wildlife control, including such activities as target-shooting and managing pests. Aboriginal peoples (Native Americans) in North America see hunting as a tradition, a way of life, and, for many, even livelihood. When law enforcement is unable to adequately defend certain individuals, possession of handguns might be considered as acceptable for purposes of self-defense. In most developed countries, however, this is rare. The United States is the notable exception.

In conflict and in crime, small arms may be used by those wishing to use force to achieve their aims. Small arms are easily available and cheap. AK-47s, for instance, are manufactured in over 40 countries and can be purchased for as little as \$10–12 in Afghanistan and Angola.<sup>7</sup> They are durable, easy to produce, easy to operate, and often may be concealed easily and trafficked past legal restrictions where these exist. Most importantly, they are extremely deadly and provide the user with a high capacity for killing. A single gunman with an assault rifle can slaughter dozens of people in a matter of minutes.<sup>8</sup>

It is important to note that the reliability of weapons-availability data varies considerably. In highly regulated states, official estimates of legally licensed firearm owners and registered firearms may be reasonably reliable, but estimates of illegal weapons in circulation are difficult. In other cases, estimates are based on surveys such as the International Crime Victimization Survey, but these estimates can vary significantly for a single country.<sup>9</sup> Apart from surveys, it has been suggested that, in industrialized countries, one of the most reliable ways to estimate firearm ownership is to examine suicide data.<sup>10</sup> The Small Arms Survey considers there to be about 230 million weapons in the US, 98% of which are in civilian possession, 0.3% in police possession, and 2% in military possession.<sup>11</sup>

In less developed countries, the capacity for collecting consistent, reliable, and relevant data on small arms for evaluation, is limited by various cultural, economic, infrastructural, and logistical factors, especially in conflict and post-conflict situations. In many post-conflict countries in Central America and Africa, where only a tiny percentage of guns are registered, estimates of the total in circulation vary widely. The Small Arms Survey cites many examples of wild projections of number of arms, in particular, local claims in Mozambique of 6 million AK-47s in circulation, and widely reported figures of the wildly implausible 60 million weapons manufactured in Yemen.<sup>10</sup>

## The Health Effects of Small Arms

### *Overview*

An estimated 300 000 people die annually due to firearms used in armed-conflict situations. Together with the estimated 200 000 people who die each year from firearms used in non-conflict situations,<sup>12</sup> these deaths would amount to almost one death each and every minute. Putting these 500 000 deaths per annum in a public health context ranks them ahead of the mortality and morbidity caused by landmines and only slightly behind other public health priorities in terms of damage, such as HIV/AIDS (2.9 million), tuberculosis (1.6 million), and malaria (1.1 million).<sup>13</sup> They represent about a quarter of the 2.3 million deaths due to violence,<sup>14,15</sup> of which 42% are suicides, 38% are homicides, and 26% are war related.<sup>16,17</sup>

The limitations of the data concerning the mortality and morbidity of small arms have been noted. In developed countries, different data sources yield different results; for example, Emergency Room (ER) Codes often produce different data than the Uniform Crime Reporting (UCR) Codes. In addition, while homicide is one of the more reliably reported crimes, other crimes (or injuries) involving firearms may not be reported or recorded accurately, even in highly developed countries.<sup>18</sup> Language might play a role in this—the definition of homicide in Spanish includes involuntary manslaughter. Even US and Canadian definitions differ. Hospital records may be unreliable if coding is not a priority. In under-developed countries, reporting of injuries or deaths may be affected by fear of authorities. Cultural factors may come into play; for example, suicides are under-reported when there is a religious taboo against them, whereas “accidents” may be over-reported. Domestic violence in many settings is still not considered a crime and injuries that result from domestic violence may be unreported or reported as self-inflicted wounds or accidents.<sup>19</sup>

Reporting of death and injury in conflict zones is even more unreliable. Nevertheless, it is maintained that small arms and light weapons remain the weapons of choice in the vast majority of the world's conflicts.<sup>20</sup> International Committee of the Red Cross (ICRC) personnel working in conflict zones claim that these weapons are responsible for more than 60% of all weapons-related deaths and injuries in internal conflicts—far more than landmines, mortars, grenades, artillery, and major weapons systems combined.<sup>21</sup>

The costs of small arms in conflict are reinforced by research undertaken by the World Health Organization (WHO). Because the victims are often the youngest and healthiest of society, it is important to calculate the impact of disability-adjusted life years (DALYs) of the survivors, as well as the impact of the number of deaths. Krug estimates that, whereas war may have ranked 16<sup>th</sup> in 1990, by 2020 war may be the 8<sup>th</sup> leading cause of DALYs.<sup>22</sup> Many of the deaths caused by small arms are considered to be

preventable, making this *pandemic* a major concern for public health professionals.

### *Health and Well Being*

Death and injury are the most obvious consequences of small arms. Acute injuries may include damage to major organs or vital structures, rupture of major vessels, shattering of bones, trauma to the brain, or severing of the spinal cord. Psychological consequences also take their toll on survivors, the families of victims, whether they survive or not, and on the perpetrators. These include post-traumatic stress disorder, emotional detachment, social withdrawal, suspicion, and recurrent nightmares. In the longer term, there may be rehabilitative issues. What health professionals may fail to appreciate are the many indirect effects.

### *Social and Environmental Costs*

The presence of a large number of weapons in society may foster a climate of fear, whether or not an armed conflict is raging. Increased incidence of crimes involving the use of weapons, such as robberies and assaults, has been shown in societies with a large number of arms.<sup>23</sup> Instability may result in the creation of refugees and internally displaced peoples (IDPs).

Social instability makes protecting the environment essentially impossible and even irrelevant to victim and perpetrator alike. Natural resources are destroyed in armed conflicts exacerbated by small arms. People, forced to flee their homes, eat or burn whatever they can find in order to survive.

### *Economic Impacts*

In many areas of the world, the economic well being of populations is significantly affected by small arms use and possession. The direct effects include the cancellation of direct medical care and rehabilitative services, the disruption of basic human services, the negative impacts on property values and tourism, and the undermining of responsible governance. The indirect effects include economic downturns, lost growth, and reduced productivity. The Inter-American Development Bank estimated the direct and indirect cost of violence for Latin America at \$140–170 billion US per year.<sup>10</sup> In Colombia, violence primarily related to small arms has been calculated as costing up to 25% of the country's gross domestic product (GDP).<sup>24</sup>

In First World, non-war situations, the impact is also significant. The direct cost of deaths and injuries due to firearms in the US has been calculated at \$14 000 for each fatal gunshot and \$38 000 for each injured person. The total impact goes much further than emergency medical care and rehabilitation, to psychological support for victims and their families, to children growing up without parents, and to those relations and contacts who continue to live in fear. Societal financial costs extend to police services and to lost pro-

ductivity. Ted Miller has estimated costs of firearm-related damage as being \$195 per person per year in Canada and \$495 in the US.<sup>25</sup> These figures have been criticized on the grounds that they assign monetary values to substantially unquantifiable factors, such as pain, burden of suffering, loss of livelihood, and quality of life.

### *Humanitarian Relief Efforts*

Gun violence depletes health-care resources, such as blood supplies, in the field and in emergency rooms. Victims may occupy hospital beds or take the time of rehabilitative personnel. When the damage is extensive, it makes careful testing of blood for HIV and other viruses impossible. Armed violence promotes the flow of IDPs and refugees. Within refugee camps, assaults and injuries further strain the resources of humanitarian aid agencies, UN peacekeepers, and the international community, decreasing access to basic services.

International relief operations are disturbed and may be suspended when aid workers themselves become targets of attack or require additional costs for security. More than twice as many ICRC personnel were killed in Chechnya and Rwanda alone in the 1990s than in all other conflicts since the Second World War.<sup>9</sup>

The nightly show of armed conflicts and their consequences on our television screens may lead to a perceived need for a quick remedy in these zones, diverting resources from more enduring treatments of the underlying ills of poverty, deprivation, lack of access to education, and social injustice. During the 1990s, international relief aid for regions in conflict increased from \$1 billion to \$5 billion a year, while at the same time, long-term development aid dropped.<sup>9</sup>

### *Effects on Women and Children*

Men, who are overwhelmingly the perpetrators of violence and the users of small arms, represent the vast majority of direct casualties. In war situations, however, noncombatants may account for more than 35% of casualties. Among these, women and children often are represented disproportionately.<sup>26,27</sup>

Women's experience of small-arms violence is different than men's. In many parts of the world, women are more at risk from guns in the hands of their intimate partners than they are at risk from strangers or combatants. Women also may be more vulnerable to the secondary effects of small-arms violence, which include psychological, social, and sexual assaults. Studies in post-conflict societies have shown that women's perception of security differs considerably from men's: women more often experience the presence of small arms in the household as threatening, while many men feel more secure in the presence of a weapon.<sup>28</sup>



Children are made victims when they die, lose a parent, lose limbs, or suffer sexual violence. Yet the incredible firepower of modern weapons also allows children to become combatants and victimizers. In West Africa in particular, demobilization of these child soldiers has become a major issue. Yet even these children, who may have committed terrible atrocities, are victims in another way. They have been robbed of their childhoods, have lost their ties to their family, and often know little else other than war. They may have become addicted to drugs and may have become accustomed to a certain lifestyle that may be difficult to achieve without violence. As United Nations' Deputy Secretary-General Louise Frechette<sup>29</sup> has noted:

Small children have big dreams. Small arms cause big tragedies. Clearly, the two do not mix. And yet, from war zones to inner city streets to suburban classrooms, this combustible blend is wreaking havoc and ruining lives.

### **Regional Perspectives**

#### *North America*

The US has more than 28000 deaths per year from small arms—accidents, suicides, and homicides—by far the highest rate in the developed world.<sup>30</sup> The Centers for Disease Control (CDC) data show that gun-related deaths have now dropped slightly behind motor-vehicle accident (MVA) deaths in the 15–24 age category, after three years in the mid 1990s, when gun deaths actually exceeded MVA deaths. In the US, 38% of firearm deaths are due to homicide; this is similar to patterns found in Third World countries such as Colombia, Brazil, and Jamaica, where firearm homicide rate is comparable to or surpasses the firearm suicide rate. This is the opposite of the pattern in most industrialized countries, where the firearm suicide rate is approximately 5 times the firearm homicide rate.<sup>10</sup>

Each year in Canada, approximately 1000 people die as a result of firearms and a comparable number suffer injuries requiring hospitalization.<sup>31</sup> The bulk of the deaths, over 80%, are suicides. There are about 150–175 firearm homicides each year and less than 50 accidental deaths.<sup>31</sup> Despite media portrayals of gun violence as an urban phenomenon, the murder rate in communities in Canada with populations greater than 500 000 is half that of rural locations, where there are more guns.<sup>32</sup>

#### *Europe*

Britain's rates of firearm death are much lower than those in other countries. England and Wales have a firearm suicide rate of

*Continued*

0.2 per 100 000, a total suicide rate of 7.0, a firearm homicide rate of less than 0.1, and a total homicide rate of 0.6.<sup>33</sup> Rates in other western-European countries are somewhat higher.

Finland has a much higher rate of firearm death, with firearm homicides at 0.4 per 100 000, firearm suicides at 5.2, and total firearm deaths at 5.7. It should be noted that the high firearm suicide rate represents less than 20% of total suicides.<sup>34</sup> Alcohol often plays a role.

Estonia, though next door, has a much different pattern of firearm death, perhaps because of the influence of gangs and organized crime. Its firearm suicide rate is 3.7 (one tenth of the total suicide rate), and its firearm homicide rate is 6.3 (about a third of the total violent homicide rate).<sup>35</sup>

### *Africa*

Shortly before the end of 1989, Charles Taylor invaded Liberia with 100 poorly trained soldiers equipped only with small arms: AK-47 assault rifles, a few machine guns, and some hand grenades. Within a matter of months they had seized several mines, using the profits to purchase additional light weapons. In less than a year, Taylor was able to overthrow the government of President Samuel Doe (himself no paragon of virtue). Less than two years later, rebels, aided by Taylor, repeated the same “success” story next door in Sierra Leone. Weapons originating in Bulgaria and Slovenia, arriving by way of Senegal, from the Ukraine by way of Burkina Faso, and from Liberia, continued to fuel this war. By the time of a ceasefire in July of 1999, the death toll was greater than 50 000 people; another 100 000 were deliberately injured and mutilated.<sup>9</sup>

The triumphant tale of the South-African transition to a multiracial democracy is remarkable in that, in the end, it occurred with relatively little violence. Unfortunately, the toll of overtly “political” conflict is dwarfed by the costs of other forms of violence: 25 000 South Africans were murdered in 1997 alone compared with 15 000 people killed between 1990–1998 in acts deemed “political”. Handguns have been the weapon of choice, rather than military-issue rifles such as the infamous AK-47s. Violence in South Africa remains a major impediment to the provision of basic health-care, diverting resources from other health and social services. It has been identified as a great threat to human rights, economic and social development, and perhaps to democracy itself.<sup>36</sup>

### *South and Central America*

In Brazil, there are about 45 000–50 000 murders per year, of which 88% are committed with firearms. These have increased about 320% since 1979.<sup>36</sup> Firearms account for the majority of deaths in the 15–19 age

category. Interestingly, Brazil reports ten times as many injuries as fatalities from firearms, whereas most industrialized countries, such as Canada and Finland, report approximately equal proportions.<sup>18</sup> This may reflect the fact that in Brazil, in contrast to highly industrialized countries, firearms are more likely targeted at others than at one's self.

In Colombia, there was an increase of 366% from 1983 to 1993. By 1998 there were 18000 firearm murders per year (a rate of about 50 per 100000),<sup>37</sup> accounting for 80% of total homicides.<sup>36</sup> A large proportion of these remain in the nation's capital, Bogota, as well as in the cities of Cali and Medellin, historic centers of the cocaine trade.

It is calculated that in 1998–1999, the number of violent deaths from small arms in Nicaragua, El Salvador, and Guatemala exceeded those that had occurred in the respective civil wars.<sup>7</sup> During the civil wars in Nicaragua, Honduras was a transit point for arms, and weapons, including AK-47s, could be purchased cheaply (for less than \$20) and easily along the border. Honduras' murder rate is about 45 per 100000, and a strong majority of these homicides (36 of the 45 per 100000 in 1999) are committed with firearms.<sup>38</sup> Guatemala's murder rate is similar and El Salvador's is somewhat higher. Over 75% of El Salvador's murders are committed with firearms, and more than 60% of violent deaths in total are caused by firearms or explosives. Seven percent of 9 to 13 year olds admitted to carrying a gun to school. The vast majority of weapons in the country are pistols and revolvers.<sup>39</sup>

## The Causal Factors

“[T]he root causes of ethnic, religious and sectarian conflicts around the world are quite complex and varied, typically involving historical grievances, economic deprivation, inequitable distribution of resources, human rights abuses, demagogic leadership and an absence of democratic process.”<sup>9</sup> Socioeconomic factors such as poverty, family disruptions (separation, death, divorce), alcoholism, mental illness, history of violence, and illicit drug use all serve as predictors of individual and group violence, both in first- and third-world settings. Yet research indicates that households and societies with these problems and without guns do not have the same rate of death and injury.<sup>40</sup>

Social conditions have a significant impact on the desire to obtain weapons. Individuals or groups who feel chronically marginalized may be driven by political desperation or domestic despair. Individual criminals and crime organizations may see user-friendly, cheap, and readily accessible weapons as a dramatic and speedy means to gain access to political or economic control.

Child psychiatrist Joanna Santa Barbara's *Cycle of Violence* illustrates how the weaponization of states or communities with pre-existing social conditions undermining stability can ignite, fuel, prolong, or exacerbate armed conflicts.<sup>41</sup> Societal and economic conflicts may spin out of control; political conflicts in individual states may be transformed into armed conflicts that cross borders.

The greater insecurity generated throughout society may in itself lead to a spiraling demand for, and use of, firearms and small arms. States may lose their monopoly on the use of force, leading to progressive privatization of security forces and spreading weapons throughout civilian society. Glorification of weapons on television and in movies may fuel demand further. A population may become acculturated to violence and intractable conflict may develop, sustaining a demand for weapons that may be accelerated simply by their availability.

The development of a culture of firearm violence certainly would hamper efforts towards non-violent conflict resolution, impede peace-building processes, and inhibit the establishment of civil society and stable models of governance.

A number of scholars have maintained that while the proliferation of small arms does not cause violence, it increases the lethality of violence.<sup>42</sup> Studies undertaken by the ICRC, for example, provide evidence that if small arms remain in circulation after political "conflicts" have ceased, violence among warring factions is replaced by interpersonal violence. Afghanistan in the mid 1990s illustrates the problems faced by armed societies once the fighting has stopped. Meddings compared the circumstances and rates of weapons-related injuries in Kandahar for 5 years before the region came under uncontested control by the Taliban, and the first year-and-a-half in peace after the Taliban's establishment of control (after a six month hiatus allowing for some semblance of stability). Weapons injuries declined only 20–40%, while the rate of gun deaths actually increased. In this "peaceful" post-conflict region, there was a high rate of non-combat injury and 80 deaths per 100000; 50% of these were firearm related. Meddings attributed the failure to reduce injury and death more substantially to two factors: a) after peace was established, there was no disarmament and the weapons remained in circulation, and b) although this one area of the country was at peace, there were armed conflicts between factions in other parts of the country.<sup>43</sup>

There is similar evidence from developed countries "at peace." The famous *New England Journal of Medicine* comparison of Seattle, WA, and Vancouver, Canada, showed that murder rates vary between cities just a few kilometers apart and in many other ways similar.<sup>44</sup> In terms of total firearm deaths, Cukier found that the US rate (11.4 per 100000) is about three-and-a-half times that of Canada's rate, roughly correlating to the number of firearms per capita. While the murder rate without guns in the US is roughly equivalent (1.3 times) that of Canada, the US murder rate

with handguns is 15 times the Canadian rate.<sup>45</sup> Zimring and Hawkins compared transnational patterns of violent crime and concluded that while assault rates in Canada, New Zealand, and Australia are higher than in the US, American rates of *lethal* violence dwarf other industrialized countries.<sup>46</sup> Similarly, suicides attempted with firearms are more likely to succeed. A study of more than 20 developed countries demonstrated that this direct correlation of the percentage of households with firearms and firearm death rates held true across linguistic, cultural, and geographic boundaries.<sup>47,48</sup> Miller and Cohen added England and Wales, the US, and Australia to the mix and still found that over 90% of variance in death rate could be explained by access to firearms in those areas. This would suggest that a 1.0% increase or decrease in the number of households with guns in Canada would be associated with a 5.8% increase or decrease in the death rate.<sup>49</sup>

Some have argued that, to the contrary, possession of firearms decreases violence by allowing citizens to protect themselves.<sup>50,51</sup> For example, widely publicized studies conclude that Americans save thousands of lives each year possessing, using, or threatening the use of firearms. Published estimates of the number of times that a gun is used in the United States for protection in a single year have ranged from 62 000 to 23 million. One study, which asked for details about gun use, estimated that, in 1993, about 400 000 adults felt that they had saved a life by using a gun.<sup>52</sup> Such studies have been critiqued, however, because of the unreliability of self-reported data, flaws in the research design, and lack of corroborating evidence in, for example, police reports.<sup>53</sup>

Others have maintained that relaxing controls on firearms improves public safety; for example, the well-known thesis of John Lott states that with more guns there is less crime, and that the right to carry concealed weapons deters criminals.<sup>50</sup> However, these claims have, on balance, not received support in the medical literature.<sup>54</sup>

In many situations, pre-meditation might be an issue; in others, there is an element of impetuosity. Chapdelaine has noted that gunshot wounds have 5 to 15 times the mortality rate of knife wounds.<sup>32</sup> Guns are the most lethal means of attempting suicide, with a 92% mortality rate per attempt, in comparison with hanging at 78% and drug overdosing at 23%.<sup>32</sup> Suicide attempts may represent a cry for help or a long-term plan. Impulsivity often plays a role in both violence and suicide, particularly involving youth. Guns often represent a permanent solution to a temporary problem.

A gun in the home is far more likely to be involved a fatal or non-fatal accidental shooting, criminal assault, or suicide attempt than to be used to kill or injure in self-defense. Controlling for such confounding factors as sex, race, and age, households with firearms have three times the number of homicides<sup>55</sup> and five times the number of suicides<sup>56</sup> (due to all causes) compared to similar households in the same neighborhoods. Mental illness, illicit drug use, alcohol, and domestic violence also are predictors of death.

Recent purchasers of handguns may be the most at risk.<sup>57</sup> Similarly, risk-assessment instruments for domestic violence in the United States have indicated that firearm ownership is one of the strongest predictive factors of intimate partner femicide.<sup>58</sup>

## The Proliferation of Legal and Illegal Small Arms

The value of legal trade in small arms accounts for perhaps \$7.4 billion US, a relatively small proportion of the roughly \$850 billion spent on military forces annually worldwide.<sup>7</sup> The major arms producers and exporters in the world include the US, China, Russia, and many western and eastern European nations. These countries are economically and politically influential and include all five permanent Security Council members, who have veto power at the UN over any significant action. They view guns as legitimate items of commerce and thus might be reluctant to embrace any measures that would restrict their trade. According to information provided by 77 countries to the UN *International Study on Firearms Regulation*, 45 countries acknowledged that firearms, components, or ammunition were produced legally on their territories.<sup>59</sup> In 1999, the UN Group of Governmental Experts estimated that arms were produced by at least 385 companies in 64 countries.<sup>10,60</sup> The Small Arms Survey<sup>7</sup> has calculated more recently that 98 countries produce or have the capacity to produce weapons, and over 1000 companies are involved. Perhaps the most successful weapon on record is the Kalashnikov or AK-47: designed in 1941, mass produced in 1947, now has licensed production in more than 19 countries, and numbers worldwide are estimated at between 70–100 million.<sup>10</sup>

While most of these weapons end up in the hands of state forces, a significant number are found in the hands of irregular armies, communal factions, crime and drug syndicates, and individuals.

Despite its opposition to regulation on an international level, the US, remarkably, has some of the strictest controls on exports and documentation of transfers. Yet figures for small-arms transfers vary. The 2001 Small Arms Survey placed the value of the small-arms and ammunition trade in the US as being worth about \$1 billion of that country's total \$20 billion in arms exports.<sup>10</sup> The US exports \$367 million of firearms annually through customs (whereas the UK exports about \$57 million).<sup>10</sup> Total sales or transfers of small arms and ammunition in 1998 were considered to be worth \$463 million; these were to 124 different countries.<sup>9</sup> Of these 124 countries, about 30 were at war or experiencing persistent civil violence in 1998; in at least five, US or UN soldiers on peacekeeping duty have been fired on or threatened with US-supplied weapons.<sup>9</sup> This particularly ironic situation has been termed the “boomerang” effect. Yet the general perception within the US remains that the arms industry makes a positive contribution to employment and the economy because of these exports. Recent public awareness