

SUPPLEMENT

The US National Violent Death Reporting System: domestic and international lessons for violence injury surveillance

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Objectives: This article reviews and comments on the development, strengths and limitations of the US National Violent Death Reporting System (NVDRS) from a variety of domestic and international perspectives.

Methods: The authors were provided preliminary copies of the manuscripts in this special edition and examined them to understand and put in context the elements and uses of the NVDRS so far. Their comments are based on their reading and interpretation of these papers plus their own combined experience in injury and public health surveillance from four different countries: the US, Colombia, Australia, and South Africa.

Results: The NVDRS is bigger than the sum of its parts because it links existing data from multiple sources. Its adoption of modern relational database technologies offers advantages over traditional injury surveillance databases and creates new opportunities for understanding, collaboration, and partnerships. Challenges include overcoming resource limitations so that it can become a truly national system, measuring and improving its sensitivity and comparability, and the need to examine mortality in context with serious non-fatal violent events.

Conclusions: The NVDRS is an important work in progress for the US. Each country should examine its own needs, traditions, resources, and existing infrastructure when deciding what kind of violence surveillance system to develop. However, collaboration in developing common definitions and classifications provides an important foundation for international comparisons.

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Violence is now recognized as an important public health issue across the globe. The World Health Organization (WHO) has reported that about 1.6 million victims die annually from violence¹ and it remains among the leading causes of death for people 15–44 years worldwide, accounting for 14% of deaths among males and 7% of deaths among females.¹ Data are a key foundation for the practice of violence prevention. In the US the federally supported and coordinated but state implemented National Violent Death Reporting System (NVDRS) aims to improve access to and the quality of fatal violence data by linking existing data from vital statistics, coroners, medical examiners, police, and crime laboratories. This commentary reviews and reflects on the development, strengths, and limitations of the NVDRS. It is based on our reading and interpretation of the papers that make up this special issue plus our combined experience in injury and public health surveillance from different countries.

Prior to the implementation of the NVDRS and its predecessors, public health agencies relied mainly on death certificates for injury mortality surveillance. Vital statistics death registries are helpful, but as “thin” data sources with no connection to other relevant data (for example, on perpetrators), and typically without published information on data quality, they are considered limited. They provide a basic statistical sketch of the groups at risk for violent death, but are inadequate by themselves for understanding the myriad factors underlying violent events or providing sufficient detail to guide many prevention efforts.

EMERGENCE OF THE NVDRS

The NVDRS is the embodiment of a long line of thoughts and efforts by scores of professionals going back decades. Firearm related violence, in particular, drew calls for its recognition as a public health problem at least as far back as the 1970s.^{2–4} No

doubt scholars could go back in time even further to document key events, spokespersons, and publications that raised the issue of violence as a public health problem.* In the late 1980s, this idea was resonating at the same time as a more visible and better funded federal public health presence in injury control emerged at the U.S. Centers for Disease Control and Prevention (CDC). This confluence sparked, if not the first, perhaps the most influential calls for surveillance of violence; leading to the creation of the NVDRS.

Among the first of these calls was the November 1988 letter to the editor of the *New England Journal of Medicine* by James Mercy and Vernon Houk, specifically urging routine firearm injury public health surveillance.⁵ This was followed by a recommendation in the landmark 1989 Cost of Injury report calling for “... a national fatal firearm injury reporting system ...”⁶ and a proposal by Teret *et al*, published in the *Journal of the American Medical Association* in 1992, that the “... creation of such a system should be recognized as a national health priority”.⁷

A variety of firearm injury surveillance efforts that involved more than a half-dozen states and New York City were

Abbreviations: NVDRS, National Violent Death Reporting System; CDC, Centers for Disease Control and Prevention; NCIPC, National Center for Injury Prevention and Control; FARS, Fatality Analysis Reporting System; NHTSA, National Highway Traffic Safety Administration; NVISS, National Violent Injury Surveillance System; CODES, Crash Outcome Data Evaluation System; ICD, International Classification of Disease; WHO, World Health Organization.

*William Farr, for example, made “diseases that are the direct result of violence” one of the five primary groups in his influential classification of diseases in the middle of the nineteenth century (Humphreys NA (ed): *Vital statistics: a memorial volume of selections from the reports and writings of William Farr*. London: Sanitary Institute, 1885:254–5. Reprinted for the New York Academy of Medicine by the Scarecrow Press, Inc, Metuchen, NJ, 1975)).

initiated by the CDC in the mid 1990s. A special issue of the *American Journal of Preventive Medicine* summarized these efforts in 1998.⁸ Many of the people involved in these early programs were influential in the activities that evolved into the NVDRS. Yet, as local firearm injury surveillance was expanding during this period, so were political pressures to curtail the CDC's support for firearm related activities. Thus, despite continued recommendations for improved firearm injury surveillance,⁹ other calls from the public health community,¹⁰ and strengthening evidence on the prominence of firearm injury in the US compared with other developed countries,¹¹ it became clear that the CDC was not going to be able to maintain these efforts. But it was also becoming clear to those involved that the entire area of intentional injuries needed improved surveillance. So it was that the 1999 Institute of Medicine report *Reducing the burden of injury* recommended: "... the development of a fatal intentional injury surveillance system, modeled after FARS [the National Highway Traffic Safety Administration's (NHTSA) Fatality Analysis Reporting System], for all homicides and suicides."¹²

As the case for surveillance of all homicides and suicides grew, the private sector stepped in. With support from the Joyce Foundation and others, a pilot program began known as the National Violent Injury Surveillance System (NVISS). The NVISS was the direct forerunner to the NVDRS and most of the methods and data definitions later used in the NVDRS were tried and established by 12 collaborating NVISS sites. The Harvard School of Public Health provided NVISS technical leadership, with assistance from CDC officials.

In light of these new directions and renewed energy, a key meeting sponsored by the Joyce Foundation and Harvard School of Public Health was held in May 2000 which helped to strengthen a focus on all violence fatalities. It was here that the basic scope and approaches to what later came to be known as the National Violent Death Reporting System were hammered out and the participating agencies agreed that the CDC should be the logical leader.¹³ More details regarding the emergence and early development of the NVDRS can be found in the above references, articles in this issue, and in an overview published in this journal in 2004.¹⁴

STRENGTHS

Many of the strengths of the NVDRS, both as it exists and as its proponents intend it to become, are apparent and discussed in articles in this issue. We focus here on strengths that relate to the fact that the NVDRS makes use of multiple sources.

Although originally described as a fatality investigation system modeled after the FARS, the NVDRS is actually more like the NHTSA's data linkage program called the Crash Outcome Data Evaluation System (CODES). This is because the NVDRS does not create new primary data (FARS creates original data from regionally coordinated case investigations). Rather, the NVDRS links existing data from multiple sources. Like the CODES, the NVDRS is bigger than the sum of its parts. The linkage techniques are different, but the aims are the same.

The advantages of combining data from multiple sources will become apparent not just to NVDRS personnel, but eventually to the data contributors. Administrative systems, such as those contributing to the NVDRS, often develop and exist in isolation and without careful attention to purposes, design, data comparability, and quality assurance. Participation in a program like the NVDRS necessitates attention to these matters and provides opportunities for comparison with how similar systems operate. Changes prompted by this may be uncomfortable in the short term for some agencies, but can result in more efficient and effective systems.

The NVDRS links data from a defined set of data sources. Potential exists to further enhance its value by linking data from additional data sources. The example in this issue of Weis *et al*, linking South Carolina's NVDRS to state human service data, demonstrates this well.¹⁵ The potential of linking administrative data for health and safety goes even further than this, as exemplified by systems in Manitoba¹⁶ and Western Australia.¹⁷

Another major strength of the NVDRS results from the huge effort that has gone into standardizing data elements from different sources and providing access to a uniform relational database that can be easily queried. Many other public health data systems have not been designed or adapted to current relational database technology. The NVDRS' relational design enables efficient storage and manipulation of data and straightforward construction of complex queries. A benefit of the relational data structure is that it simplifies analysis of NVDRS data in terms of violent incidents that result in at least one death, while still allowing person-based analysis. Thus, suspects and multiple victims can be identified together, allowing for study and comparisons of victim and perpetrator characteristics. This was a major aim of the founders of the system and the effort has succeeded.

Those who have worked with NVDRS soon realize how deficiencies in information available from many states' coroner offices, and even some medical examiner offices, make aggregating, standardizing, accessing, and using their data difficult and time consuming. Initiating or expanding cooperation between public health officials, researchers, and the people and agencies responsible for primary collection of data may prove to be one of the most important and long lasting legacies of the NVDRS. Similarly, the promising start by the many states using NVDRS for suicide activities, described by Powell *et al*, is an excellent example how these data create new opportunities for understanding, collaboration, and partnerships¹⁸

LIMITATIONS

In addition to strengths and benefits, the NVDRS has several limitations and challenges to overcome. Many of these have been acknowledged before, including difficulty agreeing and applying definitions for cases and variables, legal restrictions on data access, the need to build new relationships, gaps in medical examiner and coroner data systems, and funding limitations.¹⁴

As mentioned in this issue by staff from the CDC,¹⁹ the word "National" in the NVDRS is an aspiration, yet to be achieved. Let us put the aspiration into numerical context. For 2004, 14 382 cases were entered into the system (personal communication from the CDC, 20 July 2006). This total does not include the states of California, Kentucky, New Mexico, and Utah that began data collection for 2005. As these new states ramp up participation they are expected to increase total coverage to about 17 600 cases of violent death per year. However, demographically speaking, this means that the current NVDRS has not been implemented for about two thirds of the US population. Furthermore, the expansion of the NVDRS leveled off in 2005; the first time this has happened since its inception in 2003. The 2006 federal appropriation for the NVDRS is \$3,341,000 with a small cut planned for 2007.²⁰ With level or even diminishing funding, NVDRS expansion is in limbo. The CDC has estimated that full 50 state coverage (plus the District of Columbia and the US Territories) would cost \$20 million (personal communication from the CDC, 9 May 2006). Therefore, its evolution into a truly national system is uncertain without significantly increased resources. The NVDRS aims to be like the FARS in terms of complete

national coverage, but like the CODES it has not yet extended beyond those select states that are best able to put the required agreements together and compete for the limited program resources.

Like any new data system there are also concerns about data quality. Lack of validation of police and criminal justice data that go into the system is one of these. Inclusion of information about suspects, as well as about victims, is an important part of the NVDRS, but how good is the information, and how can we know? The papers in this issue do not go into much detail on capabilities and plans to assess completeness, validity, and reliability of these data and few aggregate analyses on the completeness of variables have been published.

Since NVDRS case finding is mostly based on a standard scan of death certificates, its overall sensitivity is limited by the completeness and accuracy of reporting and coding in the existing vital statistics system. This is especially an issue for suicides where several factors combine to reduce reporting completeness. These factors include social stigma surrounding suicide events, laws making assisted suicide a crime, the potential for recording of self-intent to have adverse financial consequences for dependents, and the latitude given to physicians and coroners when making cause-of-death determinations. Death certificates are also likely to record some injury deaths among the elderly as non-traumatic, reflecting instead pre-existing medical conditions.²¹ While this phenomenon has mostly been observed for deaths due to unintentional injuries such as falls, it might also affect elderly deaths due to violence.

Another important weakness of the NVDRS is paradoxically one of its strengths: its focus on fatal events. A focus on mortality makes sense when resources are limited and surveillance systems are new, but deaths are only one outcome across the severity spectrum. The public health and societal issue at hand is serious violence. Far too many of these incidents end in death, but most serious violence incidents do not. In the US, for example, approximately 268 000 cases of hospitalized violence related injury occurred in 2004.²² This is five times the 54 701 violence and undetermined deaths reported in the entire US in 2003 and almost 19 times the number of cases aggregated in the 2004 NVDRS. A clear understanding of the characteristics of events that progress to death and those which do not cannot be derived from a system that focuses only on fatal endpoints. By definition, fatal events differ from non-fatal events in terms of outcome. Understanding predictors of that difference should be a focus of a more comprehensive violence surveillance system.

Non-fatal events are also important when interpreting risk among subgroups. For example the Sanford paper that examined differences in North Carolina violent deaths by gender noted that fatal suicide rates were much higher among males compared to females (18.6 per 100 000 compared to 5.4).²³ But national emergency department data show the opposite relationship (females 169.38 per 100 000 and males 121.79).²⁴ These differences are largely explained by different patterns of methods of self-harm through the well known fact that, in the US, males are more likely to use firearms and females drugs and poisons for self-harm. The point is that these differences may be lost or overlooked by focusing only on fatal cases.

Another drawback is that a narrow focus on fatalities cannot accurately portray trends in serious violence if factors outside underlying rates of violence perpetration that mitigate (or enhance) the risk of death are also changing. For example, a group of factors thought to play a major role in trauma case-fatality rates is the development and implementation of quality emergency medical response tied

to modern trauma care systems.²⁵ Trauma systems work. It has recently been reported that trauma center care in the US lowered by at least 20% the risk of death for seriously injured patients compared to treatment received at non-trauma centers.²⁶ Without the advancements in emergency medical and trauma care over the last 50 years, according to one analysis, the US would be experiencing 45 000 to 70 000 homicides annually instead of the 18 000 currently observed.²⁵ Suicidal acts, on the other hand, are often secretive and rapidly lethal. Nevertheless, similar factors may be operating on suicide fatality trends but have not been studied. Emergency response and clinical care are not the only factors—other than levels and types of violence—able to influence observed levels of violence mortality. The authors of a comparison of injury case fatality rates in the US and New Zealand concluded that other possible reasons for observed differences included geography, proportion of population in rural areas, and data issues.²⁷

A data issue that NVDRS comparisons have brought to greater attention is differences between states in the proportion of violent deaths found to be of undetermined intent. What does this say about local traditions, biases, and laws, and about the wisdom and difficulty of comparing different states and jurisdictions? Breiding and Wiersema's²⁸ related call to include the full continuum of fatal self-harm within a suicide classification deserves serious consideration, though that might be difficult for elements of the legal system to go along with.

INTERNATIONAL PERSPECTIVE

What can other countries learn from the NVDRS experience in the US? Can answers to some of the challenges facing the NVDRS be found in the experience of other countries? Perhaps the most compelling lesson offered by the NVDRS is the extent to which the nature of the system and the timing of its development reflect particular institutional, political, and public health circumstances prevailing in the US. Is a system that developed in this way likely to be applicable elsewhere? Perhaps in some instances, but this certainly cannot be taken for granted.

A more general answer to the question of methods for violence surveillance might be obtained by reviewing and comparing approaches that are in place in various parts of the world, including the NVDRS as one model. Such a review, perhaps in the form of a clearinghouse, should take account of difference in the problem (that is, levels and types of violence), setting (for example, political and administrative arrangements) and resources, as well as technical properties of information systems. Findings might well reveal a diversity of circumstances, requiring a diversity of surveillance systems. The NVDRS model, perhaps with modifications, might serve some of these. The International Collaborative Effort on Injury Statistics, convened by the US National Center for Health Statistics, has developed a network of investigators capable of undertaking such comparative work, given resources.²⁹

Although it is likely that one size will not fit all when it comes to international violence surveillance, we see potential for collaboration, involving sharing of knowledge and some elements of infrastructure. For example, a system developed in Australia at about the same time that the NVDRS was developing in the US collects data on nearly all sudden and unexpected deaths, including violent deaths.³⁰ Three noteworthy points about that system, in the context of this commentary, are that (1) it was developed jointly by and for death investigators as well as researchers, providing a basis for sustainability; (2) the potential for data comparability has been designed into the system by including ICD-10 and International Classification of External Causes of Injury

codes; and (3) the system has been selected for adoption in another country (New Zealand), but only after careful assessment and a country similar to the one in which the system originated.

There are international issues, too, with regard to the case definition adopted by the NVDRS. Although the NVDRS includes victims of “terrorism” within its scope by including the applicable ICD codes, there are few such events to code in the US since the September 11 attacks. Other countries may have different experience and perspectives, and differentiating violence due to terrorism from other concerns is often difficult and contentious. The exclusion of war related deaths from the NVDRS may not suit other countries where civil strife and international conflicts take a much larger toll on their own territory than they do on US soil. One important question in this regard: are there important international differences in the definition of homicides if they come from terrorism, war, armed conflict or simply from crime? Or do homicides have only one definition which is differentiated by the circumstances where the event occurs. Also, the omission of fetuses from the NVDRS case definition deserves review since most states in the US now have legislation regarding fetal homicide and fetal death certificates could be used to identify cases.

In Colombia, case definitions for violence related mortality surveillance come from local initiatives called “observatories of violence” where officials from police, attorney offices, forensics, transport, and health share registries in a unified form of data collection validating one by one each registry according to a consensus definition.³¹ After this process the information is used by the local Mayor or Governor to draw and evaluate public policies on a monthly basis. This low cost surveillance method has been implemented in 24 Colombian cities and expanded to Peru, Guyana, Honduras, Guatemala, Panama, El Salvador, and Nicaragua.

For the NVDRS the definitions emerged from the NVISS but are recommended now by the CDC/NCIPC. Some systems in other countries actively involve partners working together to assemble the databases (similar to death review teams), rather than having a lead agency combine data from different sources in a fairly independent fashion. Which approach works best under what circumstances may be difficult to judge. In South Africa, the most detailed source of information on non-natural mortality is the mortuary-based National Injury Mortality Surveillance System, which is coordinated by a research agency that collates information arising from the postmortem investigation from several sources, including the forensic pathology services, police documentation, hospital records, and state chemical laboratories.³² Forensic pathologists supply the cause and “apparent manner” of death which is not routinely captured in vital registration data sets.

Not all countries have the high rate of gun violence observed in the US. Thus, the US situation may not translate directly into the violence surveillance needs of other countries. Countries with low rates of gun violence might consider starting off with fatal and serious non-fatal injury due to violence, or by incorporating surveillance of fatal injuries due to violence as part of a broader system of surveillance of fatal injuries.

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The issue of the impact of trauma care on case-fatality rates has special international relevance. This is because countries with less effective or non-existent EMS and trauma care systems that institute a fatality surveillance system may be capturing a much greater proportion of serious violence events since their case-fatality rates are probably higher. The mix of mechanisms used in assaults, self-inflicted harm and legal interventions will also affect the pattern of fatalities and cause specific case-fatality rates. Using fatality data to make

cross country judgments about underlying trends of violence in different societies with different medical care systems, traditions, and weapon availability must be made with caution. Put simply, reported differences in country-specific rates of fatal violence should not be assumed to mean that certain societies are more violent than others but may relate partly to the absence of modern EMS and trauma care systems, or to other factors.

Having said that, there are certain components used by the NVDRS that may enable its replication in resource poor settings. Indeed, most other countries rely on many of the processes and procedures that the NVDRS incorporates through their law enforcement, vital registration, and criminal justice agencies. The NVDRS reliance on manual linkages between the different component systems and processes is a feature that might be emulated in different settings at a minimal cost. The key will be to identify and enable local coordinators who are best able to incorporate and leverage existing networks. One approach may be to set up an international steering body through an appropriate multilateral agency, such as WHO, to assist in the development and piloting of home grown systems that offer enough similarity and synergy to enable international comparison and the pooling of data.

CONCLUSIONS

The internationally known public health leader, William Foege, is fond of comparing prevention to the building of a grand house of worship.³³ He often talks about the fable where an observer watching a soaring cathedral under construction asked one of the builders what he was doing. He replied “I am cutting stones”. The next worker is similarly queried and replies: “I am mixing mortar”. But the next worker, when asked replies: “I am building a cathedral”. Borrowing from his allegory, injury surveillance workers are often dedicated stone cutters and mortar mixers. But the violence prevention cathedral is far from completion and sometimes we forget what it is we are trying to accomplish.

The distraught mother of a son killed in a drive-by shooting, the bewildered children of a victim of domestic violence, the wife looking at emotional and financial ruin after her husband’s suicide; they do not think in terms of

Key points

- The National Violent Death Reporting System (NVDRS) evolved over a period of time building upon the efforts of many people.
- Because the NVDRS links existing data from multiple sources its sum is bigger than its parts.
- NVDRS adoption of modern relational database technologies offers advantages over traditional injury surveillance databases.
- The NVDRS creates important new opportunities for understanding, collaboration, and new partnerships.
- The NVDRS challenges include overcoming resource limitations so that it can become a national system, measuring and improving its sensitivity and comparability, and the need to examine mortality in context with serious non-fatal violent events.
- Each country should examine its own needs, traditions, resources, and existing infrastructure when designing violence surveillance systems. Common definitions and classifications, even if only for some data items, can provide a foundation for international comparisons.

injury surveillance, data linkage, and computerized data systems. Instead they suffer in deep personal anguish at their loss, they ponder their own safety and wellbeing in the days ahead and they wonder how they will ever feel whole again. When violence prevention can fully utilize the benefits of accurate, complete, and truly national coverage of all serious violent events comes the hope that the violence prevention cathedral will be a major step closer to completion. With that hope comes the opportunity to soothe the souls of violence victims, and the loved ones they leave behind, by preventing these events from happening in the first place.

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