Advanced Automatic Collision Notification (AACN)

White Paper

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Overview

Advanced Automatic Collision Notification (AACN) captures crash data from vehicle collisions and sends the information to emergency responders, alerting responders of the location and nature of the crash so they can respond more quickly with the appropriate equipment. AACN can improve patient outcomes and save lives through rapid communication of the vehicle location to decrease response time by emergency responders; predict injury severity in vehicle crashes; and support quick transport and treatment of injuries. AACN can improve real-time patient information through automated sharing of vehicle crash data and offers predictive analysis based on vehicle telemetry data.

While AACN technology currently exists, there are limitations on its use and usefulness. For example, OnStar™ uses crash information to predict injury severity but does not share the information when providing a verbal relay of information to public safety answering points (PSAP). Other commercial examples of AACN services include Ford 911 Assist and SiriusXM. Current technology provides an opportunity to benefit responders, victims, and downstream medical care but the culture and processes are not in place to take full advantage of the technology. Limitations to AACN applications are often due to institutional and technological obstacles.

Benefits

Studies of national crash data indicate that AACN offers benefits of faster and more accurate identification of crashes and crash location through global positioning services (GPS), early notification of 911 PSAPs when there are no witnesses and the involved parties are unable to call 911, reduced response times, improved response resource allocation, faster field triage decisions, and reduced transport times. Research published in the journal *Prehospital and Disaster Medicine* shows that demographic and vehicle crash data can be used to create models that predict the likelihood of severe injury and improve patient outcomes (Plevin, Robert Kaufman, Laura Fraade-Blanar, & Eileen M. Bulger, 2017).

This research looked at crash data from the National Highway Traffic Safety Administration's (NHTSA) Crash Injury Research and Engineering Network (CIREN), police-reported crashes in the Fatal Analysis Reporting System (FARS), and national crash data in the National Automotive Sampling System Crashworthiness Data System (NASS-CDS) and found that "longer crash-notification times were associated with an increased likelihood of a patient being taken to a local hospital and later transferred to a trauma center for a higher level of care, and involved more invasive procedures performed in the first three hours of arrival at a trauma center." They found that data in NASS-CDS showed that beyond a 30-minutes crash notification threshold, the likelihood of death with each additional minute of crash notification time increases significantly. Further, crash notification times were higher in rural areas than urban areas and were associated with a higher rate of fatality. These findings support the importance of early crash notification facilitated by AACN.

Vehicle telemetry data in AACN are used to predict injury severity based on the change in velocity of the vehicle on impact, multiple impacts, seatbelt usage, type of vehicle, and direction of force. Early automated notification to the 911 PSAP with GPS-based location information can reduce response time and get the right equipment to the scene to support the extrication and transport of patients. Knowing the location and severity of impact can get the right response to the right location and support transport decisions to get the right patient to the right hospital by the right transport mode. The enhanced information and predictive algorithms are designed to save lives in motor vehicle crashes.

A study published in Traffic Injury Prevention, 2017, looked at data from FARS and NASS-CDS, and estimated that with the full implementation of AACN and the availability of universal cellular coverage, fatalities from vehicle crashes could be reduced by 1.6% to 3.3% per year. The study concluded that “AACN is therefore a key component of integrated safety systems that aim to protect occupants across the entire crash spectrum.” (Lee, Wu, Kang, & Craig, 2017)

Healthcare savings associated with advance patient reporting are the result of getting the patient the right care, at the right facility, at the right time. If a severely injured patient is transported directly to a Level 1 Trauma Center, rather than to a local hospital and then transferred to a trauma center, there are better outcomes and significant savings to the patient in terms of transport and treatment costs. AACN may decrease mortality from a crash through early notification, helping responders determine the need for specialized equipment, and quick patient transfer to the appropriate medical facility or trauma center. “In light of the significant increase in mortality with crash-notification times over 30 minutes, this basic functionality of AACN could have profound effects on patient outcomes.” (Plevin, Robert Kaufman, Laura Fraade-Blanar, & Eileen M. Bulger, 2017). From the responder side, knowing more information up front allows agencies to dispatch the right equipment for the call (e.g. extrication equipment, advanced life support units, medivac, or multiple ambulances), improving outcomes and providing financial savings through appropriate resource allocation.

Current and Future Opportunities

Automatic Crash Notification (ACN) provides basic vehicle crash information, generally airbag deployment and location, through voice services from a call taker in a service center to a PSAP following the Association of Public-Safety Communications Officials/National Emergency Number Association (APCO/NENA) interface protocols. Advanced Automatic Crash Notification (AACN) includes additional information from vehicle sensors to improve and enhance response. With an evolution to NextGen 9-1-1 (NG9-1-1), the system will be able to transmit voice and data at the same time and support video. NG-AACN calls are NG9-1-1 calls with extensions for AACN. With NG-AACN, vehicles will be able to transmit location and crash data as part of the call setup, allowing data to be displayed to the PSAP call taker using NG9-1-1 architecture. The call taker will also be able to request updated data from the vehicle during call, send action requests to the vehicle, and request vehicle camera feeds. With NG9-1-1, data transmission does not interrupt the talk path.

As AACN evolves to NG-AACN, the PSAP interface will be standardized, allowing faster call processing and simplifying call handling. Standards will support equal access and advanced call routing. The goal is to support enhanced information sharing with first responders using FirstNet, as FirstNet uses the same protocols and standards as NG-AACN and NG9-1-1. FirstNet was authorized by the U.S. Congress in 2012 to develop, build, and operate a nationwide broadband network for first responders. FirstNet is intended to cross jurisdictional communications networks to provide high-speed data and location information, including video and images, giving priority to public safety personnel during emergencies. With the evolution of AACN, FirstNet may offer direct transmission of AACN data to responders, providing fast, life-saving information in the field.

New vehicles have the capacity to send data to support emergency response. The vehicle emergency data set (VEDS) is defined jointly by NENA and APCO. As vehicles advance, new data sets can be defined without interfering with deployed systems. The data can be configured to meet the needs of individual users. NG-AACN information can be provided in a standard way or be configured for PSAP preferences to include more data or hide data for those not needing access. For example, patient records could be hidden from call takers but available to emergency medical services (EMS) responders and trauma physicians. Beyond enhanced EMS, there are a number of advantages AACN offers to other emergency responders. Vehicle telemetry can also be provided to traffic management centers to help identify the location and direction of travel of a crash and provide an indication of severity and potential impact to the roadway system.

A study led by the Center for Disease Control's (CDC) in 2010, focused on developing an injury severity algorithm using vehicle telemetry and demographic data. Such algorithms can be used with AACN to predict and transmit injury severity predictions to PSAPS. Currently, vehicle manufacturers have developed different algorithms. For effective integration of AACN into PSAP and emergency response systems, the data and algorithms should be open and applied in a consistent manner.

A more recent study presented in 2017, investigated revisions to the incident severity prediction algorithm that included additional information on the principal direction of force and adjusted the older occupant parameter to 60 years old from 55 years old. Using NASS-CDC data from 1999-2013, the study found that revisions to the algorithm improved predictive performance with the expanded information on crash direction but not for increased age. The study resulted in an updated injury severity prediction algorithm (ISP v2) with additional direction of force information, improving the prediction of serious injuries to 72.7 percent sensitivity (true positives) from the 63.4 percent sensitivity of the original CDC algorithm (Wang, 2017)

Connected and automated vehicles (CAV) can benefit from the inclusion of AACN. As vehicles become more automated and rely less on drivers responsible for decision making and control, safety functions such as those provided through AACN should be fully integrated into the vehicle. A fully automated vehicle may be carrying children, elderly, or other passengers unable to initiate an emergency call in the event of a crash. AACN, available today and evolving to provide increasingly better information through vehicle telemetry, should be considered a fundamental safety function of CAV technology. CAV generally include advanced communications capabilities and vehicle telemetry, making the inclusion of AACN a minor expense with a significant public safety benefit.

Effective March 31, 2018, all new cars and light vans sold in the European Union must be fitted with eCall devices. These eCall devices include a minimum set of data (location, fuel type, airbag deployment) to alert rescue services of a crash. In the event of a crash, eCall not only sends this information, it establishes a phone connection to the appropriate emergency call center. The service is automated by a crash or can be actuated manually, for example by a witness reporting a crash. The minimal data set and service are included with all new vehicles with no service fee, which has resulted in advancements of ACN not seen in North America. Studies indicate that eCall can improve response time in urban areas by 40 percent, and by 50 percent in rural areas. They estimate a 4 percent or more reduction in the number of fatalities and a 6 percent reduction in the number of severe injuries. Global automakers selling vehicles in Europe must meet eCall requirements; however, this requirement has not translated to the U.S., where there are different protocols but similar data sets (European Global Navigation Satellite Systems Agency (GSA), 2018). Although North America lead the way in AACN, the new requirements and high saturation levels anticipated from the new European regulations are moving Europe past the US and Canada.

Challenges to AACN Implementation

Challenges to the implementation and widespread use of AACN include technical, institutional, and cultural challenges; in some cases, issues may cross two or more of these categories. For example, the current OnStar™ model of a separate call center arose to address the technical challenges of sharing data directly with PSAPs and the additional workload associated with taking calls from the OnStar™ system. In some cases, there is a resistance on the part of vehicle manufacturers to share personal or proprietary data directly with a PSAP, even if the technical issues are overcome. The separate call center system model solves these issues but creates delays and gaps in information being relayed to responders as a result of technical, institutional, and cultural considerations.

Different systems exist today among vehicle manufacturers, each with different PSAP interfaces and operational interactions. Some of these issues could be overcome with standard message sets and NG9-1-1 technology. Many PSAPs see AACN as a complication that adds time to the current PSAP functions. Within PSAPs, there are call-taking, processing, and dispatch functions. Information available through AACN may create additional activities for each of these PSAP functions, causing some resistance to its use. This could be overcome through training and the realization of benefits in automated information, reducing delay that can come from having to communicate with driver or with a separate call center. It is also important that the AACN system not be a separate system in the PSAP to reduce extra work and training. Another workload concern by call takers relates to false positive activations, which is currently addressed by having separate AACN call centers. PSAPs also do not want to receive raw crash data and would prefer information on a scale that predicts the risk of severe injury and the need for extrication.

One of the significant challenges to fully implementing AACN is gaining the support from EMS and the medical directors who write the protocols that will institutionalize its use. Most medical directors have not modified response protocols to take crash data and relay it to responders. To this end, it is essential to build awareness of the benefits of AACN and provide evidence-based research and support in the form of model language and documented outcome improvements. Related to response protocols and responder training, there is a concern with how responders use the additional information effectively. Specifically, responder 'tunnel vision' or 'framing bias,' based on advance information, has been identified as concern. This may occur if responders are more focused on what telemetry data indicate than on treating the patient. This can be overcome through protocols and training.

Vehicle manufacturers use different algorithms to predict injury severity. With the exception of General Motors, who has published its algorithms, vehicle manufacturers' algorithms are proprietary. There is a sensitivity by most manufacturers to sharing data openly, which limits data availability and algorithm validation. Without a consistent approach to data points, data sharing, and injury severity prediction algorithms, it is difficult to build a robust use of AACN.

Another challenge to full deployment of AACN is the transition to NG9-1-1. During the transition to NG9-1-1, systems will need to support both circuit-based and nextgen technology. Without adequate investment in NG9-1-1, it will be difficult to transmit information to agencies. It is also important to overcome issues related to cost sensitivity by auto manufacturers and consumers. Without Federal requirements or incentives, such as inclusion in the New Car Assessment Program (NCAP), auto manufacturers are resistant to including additional features. On the consumer end, the subscription model also reduces saturation of AACN with less than half of consumers renewing subscriptions after the initial free period of service.

Recommendations and Research Needs

A research project, managed by the American College of Emergency Physicians and the National Association of EMS Physicians, and funded by the National Highway Traffic Safety Administration, is focused on developing and disseminating online educational training on the benefits of AACN in improving patient outcomes for motor vehicle crashes. "The training program will include information on the biomechanics of crash injuries and how crash data are used to predict injury severity. After a crash, electronic data transmitted via AACN can be to inform EMS dispatch and triage decisions." (Is Your System Using AACN Data?, 2017)

AACN was incorporated in the Guidelines for Field Triage of Injured Patients protocol in 2011, with the addition of guidelines for predicting injury severity based on vehicle telemetry data in 2012. For this to be fully integrated into field response, standardized data sets, modified response protocols, and call taker, dispatcher, and responder training are all essential. Similarly, pilot studies are needed to test effectiveness of the injury prediction algorithms and to engage the larger stakeholder community in an evidence-based study. A Federal effort is needed to support modification of response protocols with medical directors, providing sample language and training materials. Continued investment in NG9-1-1 is also necessary for full deployment of AACN.

An information campaign should be developed to share research findings on the benefits of AACN. An example of AACN advancement efforts can be seen in this video (Cine Learning Productions) on the advantages of AACN. The Transportation Safety Advancement Group

(TSAG) communities, which represent EMS, emergency communications, law enforcement, fire/rescue, transportation operations, technology/telematics, and academic and research organizations, are not only good target audiences for such a campaign, they can also lead the campaign among their constituent members. TSAG could serve as a champion for AACN and create a rallying point for its advancement.

At the national level, the recognition of AACN in NCAP Ratings would encourage auto manufacturers to include AACN in new models to enhance their ratings. This would not be as strong as a Federal requirement to provide AACN technology, as the European Union has done with eCall, but it would certainly be a step toward nationalizing this important safety technology. Federal requirements for CAV technology should include basic data sets and cellular-connected vehicles should be required to provide AACN. Additional regulations to provide standard safety message data and a service subscription for the life of the vehicle would significantly enhance transportation public safety.

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