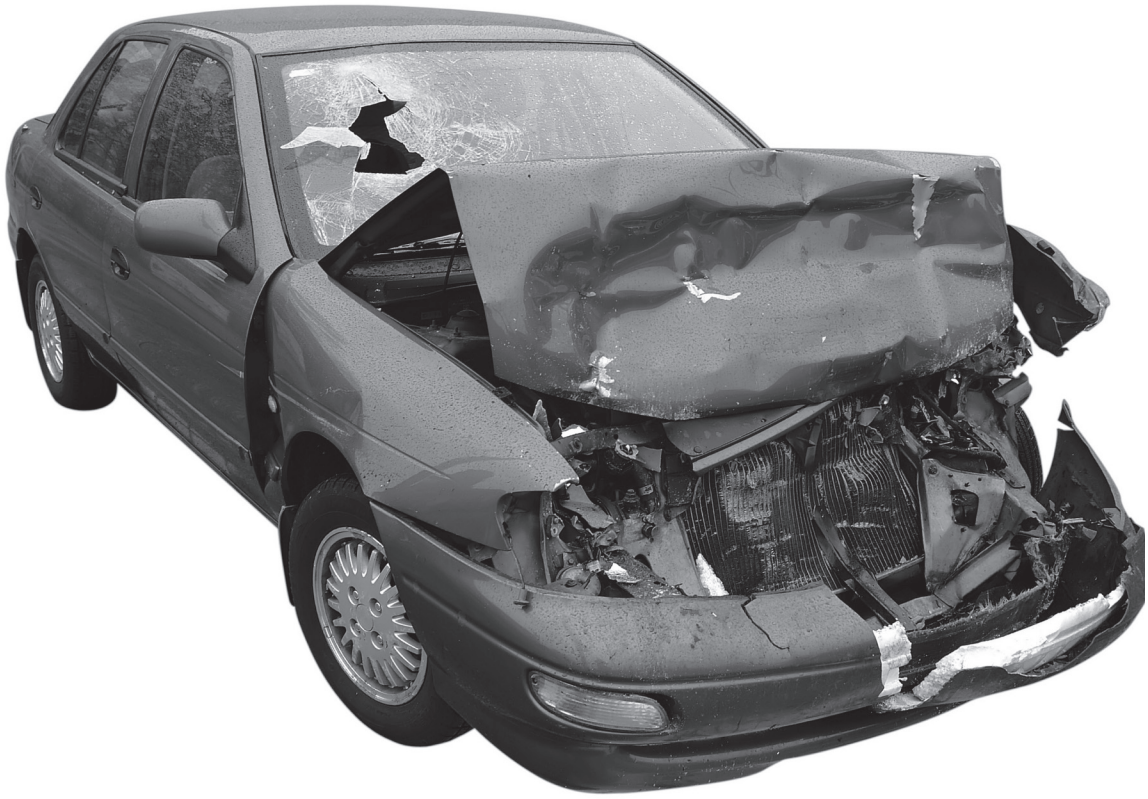
RECOMMENDATIONS FROM THE EXPERT PANEL:

ADVANCED AUTOMATIC COLLISION NOTIFICATION AND TRIAGE OF THE INJURED PATIENT



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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Injury Prevention and Control
Division of Injury Response

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BACKGROUND

The optimal way to reduce the morbidity, mortality, and socioeconomic consequences of injuries is to prevent their occurrence.[1,2] When an injury does occur, however, emergency medical service (EMS) providers must ensure that patients receive prompt emergency care at the scene and are transported to an appropriate health care facility for further evaluation and treatment. Determining the facility to which an injured patient should be transported can have a profound impact on subsequent morbidity and mortality. Although basic emergency services are generally consistent across emergency departments, certain hospitals known as "trauma centers" have additional expertise and equipment for treating severely injured patients. Trauma centers are classified by state or local authorities depending on the scope of resources and services available, ranging from Level I, which provides the highest level of care, to Level IV.

Not all injured patients can or should be transported to a Level I trauma center. Patients with less severe injuries might be served better by transport to the nearest emergency department. Transporting all injured patients to Level I trauma centers, when many do not require that high a level of resources and expertise, unnecessarily burdens those facilities and makes them less available for the most severely injured patients.

Research has shown that the level of care an injured patient receives can also have a significant impact on health outcome. The National Study on the Costs and Outcomes of Trauma (NSCOT) evaluated the effect of trauma center care on mortality in moderately to severely injured patients and identified a 25% reduction in mortality for severely injured patients who received care at a Level I trauma center rather than at a nontrauma center.[3]

DEVELOPMENT OF THE FIELD TRIAGE DECISION SCHEME: THE NATIONAL TRAUMA TRIAGE PROTOCOL

The Centers for Disease Control and Prevention (CDC) has taken an increasingly active role in the intersection between public health and acute injury care, including the publication of the *Acute Injury Care Research Agenda: Guiding Research for the Future.*[4] Building on these activities, CDC and the American College of Surgeons-Committee on Trauma (ACS-COT), with additional financial support from the National Highway Traffic Safety Administration (NHTSA), convened a series of meetings of the National Expert Panel on Field Triage to guide the 2006 revision of the Triage Decision Scheme. The expert panel was assembled to bring additional expertise to the revision process (e.g., EMS, emergency medicine, public health, the automotive industry, other federal agencies) in order to provide:

- a vigorous review of the available evidence;
- assist with the dissemination of the revised scheme, and the rationale behind it, to a larger public health and acute injury care community;
- emphasize the need for additional research in field triage; and
- establish the foundation for future revisions.

The major outcome of these meetings was the creation of the Field Triage Decision Scheme: The National Trauma Triage Protocol (Decision Scheme)(see Appendix A).[5]

VEHICLE TELEMATICS AND ADVANCED AUTOMATIC COLLISION NOTIFICATION

During the National Expert Panel on Field Triage meetings, members discussed the potential for vehicle telematics to more accurately guide trauma triage decisions. Telematics is defined as the combination of telecommunications and computing.[6] Vehicle telematics systems combine and integrate directly into the vehicle's electrical architecture, cellular communications technology, Global Positioning System (GPS) satellite location capability, and sophisticated voice recognition.[7]

While vehicle telematics provide a wide array of services, Advanced Automatic Collision Notification (AACN) was the telematics service that was of particular interest to the National Expert Panel members. AACN is the successor to Automatic Crash Notification (ACN) and is found on a number of motor vehicles. (AACN is now installed in approximately 5 million vehicles in the United States and Canada.) AACN alerts emergency services that a vehicle crash has occurred and automatically summons assistance.[7]

When a crash has occurred (as determined by various sensors, airbag deployment, or seatbelt pretensioners), the AACN system initiates an emergency wireless call to a telematics service provider (OnStar, ATX, etc.) to deliver the vehicle's GPS location and crash-related data, and opens a voice communications channel to the emergency call center. AACN improves the data sent from the ACN version by including crash severity data collected by in-vehicle sensors.

INCORPORATION OF "VEHICLE TELEMATICS CONSISTENT WITH HIGH RISK FOR INJURY" INTO THE DECISION SCHEME

In earlier versions of the Decision Scheme, a number of vehicle crash characteristics were incorporated into the prehospital triage decision evaluation. These included, among others, high vehicle speed, vehicle deformity >20 inches, and intrusion >12 inches for unbelted occupants as mechanism of injury criteria. National Automotive Sampling System Crashworthiness Data System (NASS-CDS) data indicate that risk for injury, impact direction, and increasing crash severity are linked.[8] An analysis of 621 Australian motor vehicle crashes indicated that high-speed impacts (>60 km/hr [>35 mph]) were associated with major injury, defined as Injury Severity Score [ISS >15], ICU admission >24 hours requiring mechanical ventilation, urgent surgery, or death (OR = 1.5; CI: 1.1–2.2).[9] Previously, the usefulness of vehicle speed had been limited because of the challenges to EMS personnel in estimating impact speed accurately. New AACN technology installed in some automobiles can, however, identify vehicle location, measure change in velocity ("delta V"), and detect the crash's principal direction of force, airbag deployment, rollover, and the occurrence of multiple collisions.[8] As a result, and in recognition that this information might become more available in the future, vehicle telemetry data consistent with a high risk for injury (e.g., change in velocity and principal direction of force) was added as a triage criterion.

EXPERT PANEL ON ADVANCED AUTOMATIC COLLISION NOTIFICATION AND TRIAGE OF THE INJURED PATIENT

In follow up to the need to explore further how AACN could improve triage, CDC selected and convened an expert panel (see Appendix B). The purpose of the panel was to develop a medical protocol for utilization of AACN data from crashes to better predict severity of injury and use this information to improve the ability to respond to crashes and appropriately triage crash victims. This panel included representation from the following disciplines: public safety answering points (911 call centers), EMS, emergency medicine, trauma surgery, engineering, public health, vehicle telematics providers, NHTSA, and the Health Resources and Services Administration's EMS for Children program.

The expert panel met three times from 2007 to 2008, with the second meeting serving as a subset of the entire panel to deliberate on available data. Key discussion points included:

- Crash characteristics that predicted a 20% or greater likelihood of having a serious injury were considered significant and warranted special recognition and action.
- Severe injury was defined as having an ISS of 15 or greater.
- If additional data was available from direct verbal contact with vehicle occupants, this should be used to refine or alter the prediction of vehicle crash telematic data. Specifically, knowing the number of occupants, age, gender, and level of consciousness would be important additional data elements in predicting severity of injury.
- More work needs to be done, but the available information strongly supports immediate utilization of vehicle telemetric data in field triage decision guidelines.

The following section, "Recommendations from the Expert Panel on Advanced Automatic Collision Notification and Triage of the Injured Patient" summarizes the expert panel's conclusions.

RECOMMENDATIONS FROM THE EXPERT PANEL ON ADVANCED AUTOMATIC COLLISION NOTIFICATION AND TRIAGE OF THE INJURED PATIENT

- Advanced Automatic Collision Notification (AACN) shows promise in improving outcomes in severely injured crash patients by:
  - Predicting the likelihood of serious injury in vehicle occupants.
  - Decreasing response times by prehospital care providers.
  - Assisting with field triage destination and transportation decisions.
  - Decreasing time to definitive trauma care.
  - Decreasing death and disability from motor vehicle crashes.

- Current AACN data transmitted from the vehicle to the telematics provider can improve accuracy in triage of the injured patient.

- Seatbelt use by an occupant significantly influences injury severity. Information regarding belt use should be included in AACN data transmission.

- AACN providers should obtain specific occupant information that is known to alter or influence injury severity and to significantly influence response to injury, including age and gender.

- Further refinement of the best data to obtain will require further investigations and data analyses.

- Because AACN data have not been previously used in clinical decision-making, pilot studies should be implemented as soon as possible using the following protocol (See Appendix C):

  1. In the event of a crash, the following electronic information will be transmitted by the vehicle to the AACN providers:
     - Delta V
     - Principal direction of force (PDOF)
     - Seatbelt usage/or without
     - Crash with multiple impacts
     - Vehicle type

     This information is received by the AACN provider and analyzed to identify those patients who, based upon the data alone, have a $\geq$ 20% risk of having a severe injury (defined as an [ISS] > 15). If the analysis indicates that the risk of severe injury is < 20%, then the AACN provider proceeds per standard protocol.

  2. If the AACN data analysis indicates a $\geq$ 20% risk of severe injury, then the AACN provider directly contacts the vehicle occupant to obtain more information. During the communication with the occupant, the AACN provider will inquire about:
     - Age ($\geq$ 55 years old have increased risk of severe injury)
     - Injuries to vehicle occupants
     - Number of patients
     - Number of vehicles involved in the crash

This information may help refine the AACN data; in effect, moving the 20% value either up or down as the occupant information increases or decreases the likelihood that a severe injury has occurred. For example, if the occupant is able to communicate clearly that he or she is uninjured and < 55 years of age, then the risk of severe injury is lessened. Similarly, if there is no (or inappropriate) voice response from the occupant, if the occupant is over or equal to age 55 years, or if he or she indicates an injury, then the risk of severe injury remains at least 20% (based upon the AACN data alone) and is potentially greater.

3. If the AACN provider determines that the occupant is at ≥20% risk of severe injury, then communication should be made with the relevant Public Safety Answering Point (PSAP) that AACN data obtained from the vehicle indicates that the occupant is at risk for a severe injury, and that the PSAP should dispatch resources as appropriate according to local protocol and consistent with the Field Triage Decision Scheme: The National Trauma Triage Protocol.

4. If the AACN data indicate that the risk of injury is <20% and the AACN provider subsequently obtains occupant information that raises concern for a severe injury (e.g., injuries, age), then this specific information can be communicated to the PSAP.

5. AACN providers will also communicate the following information to the PSAP, when available:
   - Age of occupant(s)
   - Presence or absence of injury(ies) based on voice communication
   - Number of other vehicles involved, if any
   - Location confirmation or disparity between electronic and voice communication

- There should be a national system to collect and analyze AACN and injury data. This should be integrated as much as possible into current national data systems, e.g. the National Accident Sampling System (NASS), the National Emergency Medical Services Information System (NEMSIS), and the National Trauma Data Bank (NTDB).

- The feasibility of AACN providers acquiring components of the Glasgow Coma Scale through voice communication with vehicle occupants and transmitting that information to PSAPs (or 911 call centers), emergency medical services (EMS), and receiving hospitals should be investigated further.

- A study should investigate what AACN data best predicts a need for extrication.

- A system of real-time communications should be established between all components of the trauma system, including: AACN providers, PSAPs (or 911 call centers), EMS, emergency medicine, and trauma surgery.

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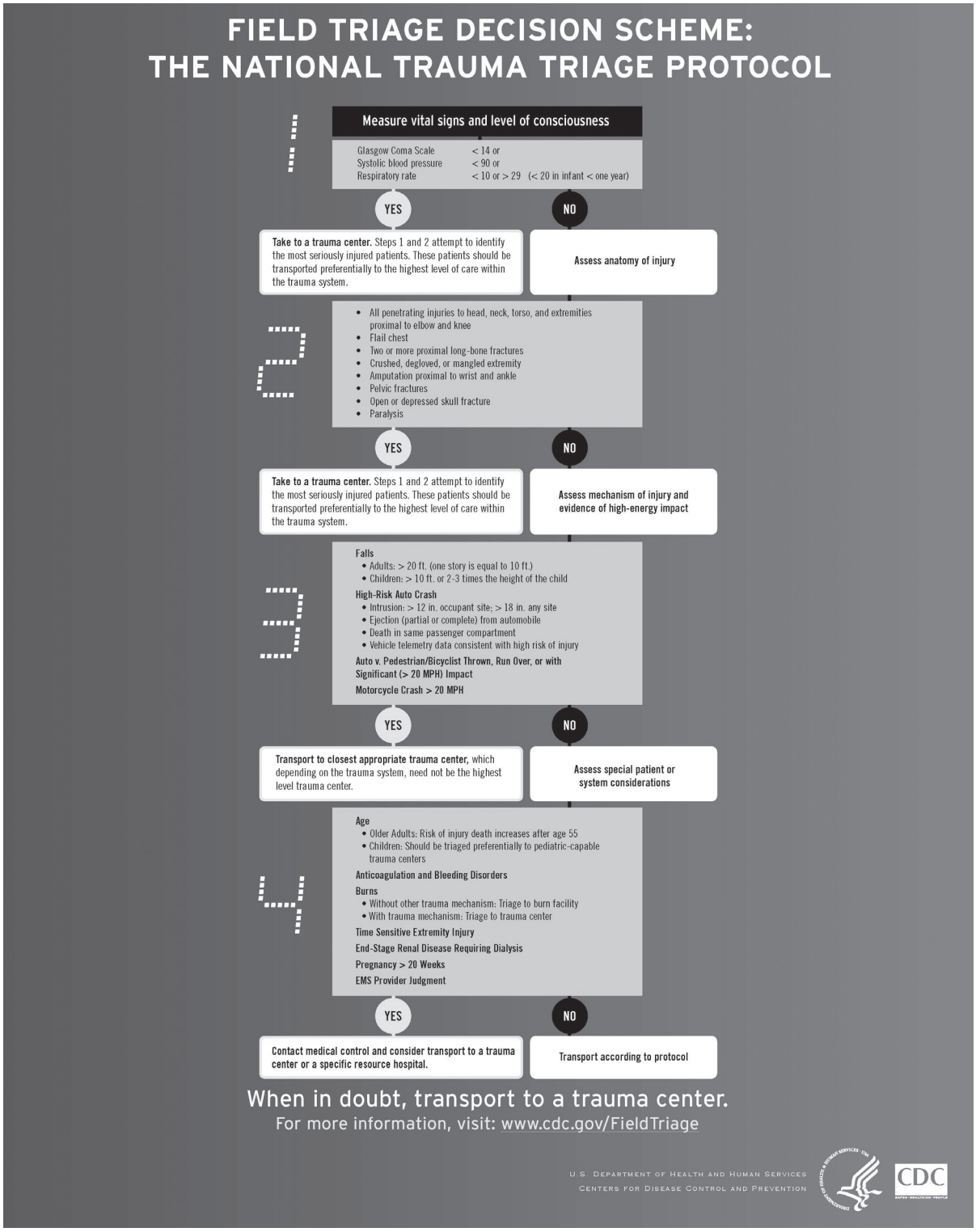
APPENDIX A:



THIS FIELD TRIAGE DECISION SCHEME, ORIGINALLY DEVELOPED BY THE AMERICAN COLLEGE OF SURGEONS COMMITTEE ON TRAUMA, WAS REVISED BY AN EXPERT PANEL REPRESENTING EMERGENCY MEDICAL SERVICES, EMERGENCY MEDICINE, TRAUMA SURGERY, AND PUBLIC HEALTH. THE PANEL WAS CONVENED BY THE CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC), WITH SUPPORT FROM THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION (NHTSA). ITS CONTENTS ARE THOSE OF THE EXPERT PANEL AND DO NOT NECESSARILY REPRESENT THE OFFICIAL VIEWS OF CDC AND NHTSA.

APPENDIX B:
ADVANCED AUTOMATIC COLLISION NOTIFICATION AND TRIAGE EXPERT PANEL

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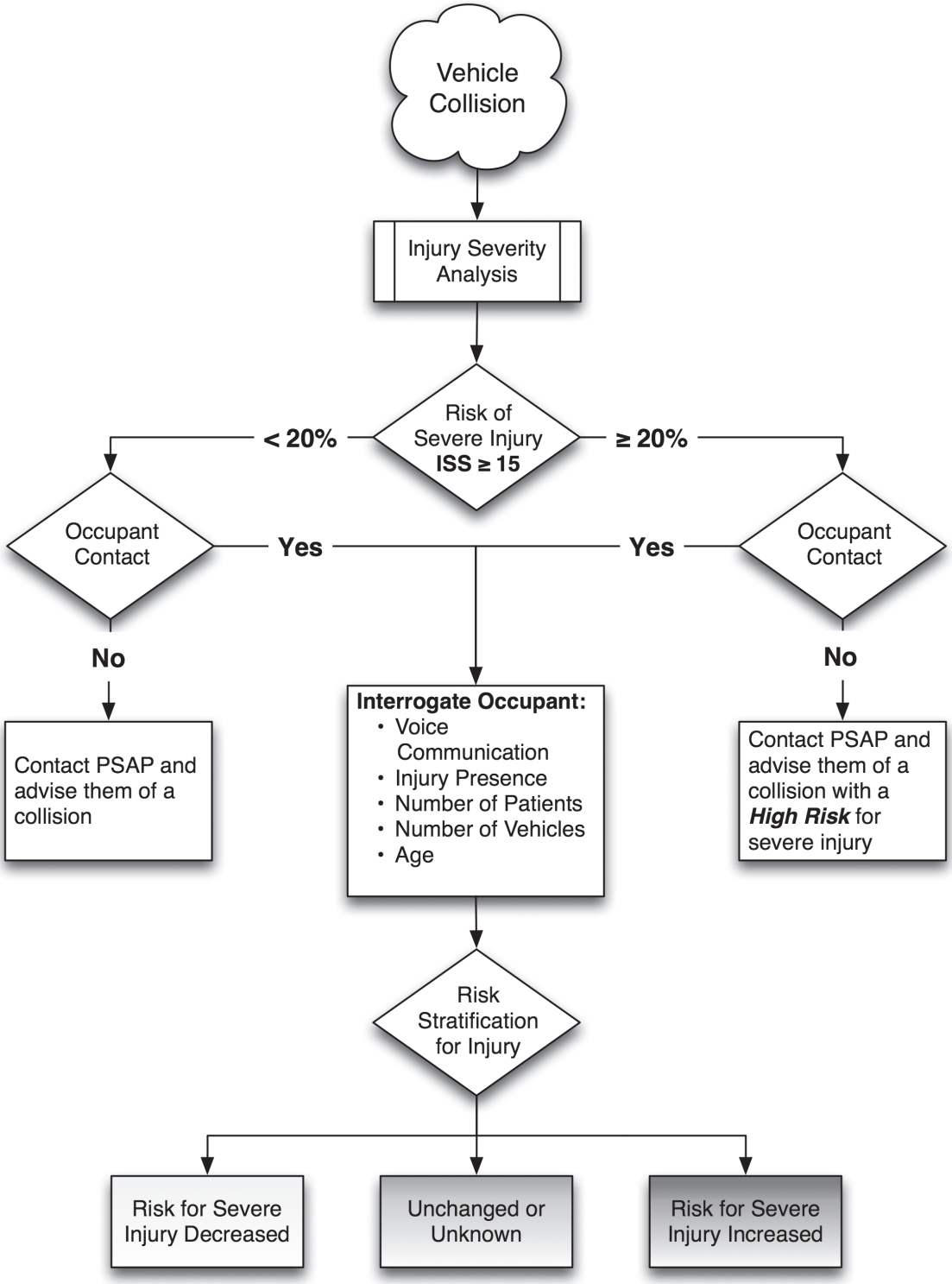
APPENDIX C:
ADVANCED AUTOMATIC COLLISION NOTIFICATION PROTOCOL



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