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Case Report

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Aurora Bridge Bus Crash Review of a Mass Casualty Event Pre-hospital and Hospital Response, Lessons Learned

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ABSTRACT

At 11:11 a.m. on September 24, 2015 an amphibious 'DUKW' tourist vehicle with a driver and 36 passengers lost control due to a catastrophic left front axle mechanical failure. The vehicle crossed the center line into oncoming traffic and struck a charter bus transporting 50 members of an international college group including students and staff.[1] This event occurred on an urban bridge with heavy traffic, causing complete closure of the roadway in both directions. Based on Emergency Medical Service (EMS) calls, a Mass Casualty Incident (MCI) response was activated at the levels of EMS, the inter-hospital EMS coordinating system: Disaster Medical Control Center (DMCC), the regional inter-hospital coordination group Northwest Healthcare Response Network (NWHRN) and the City of Seattle. Forty-nine patients were transported *via* the EMS system to 8 area hospitals. There were 4 deaths at the scene and one victim later died of his injuries. The incident had many unique features that affected the incident response including: location on a bridge with limited access points, involvement of an amphibious DUKW vehicle, involvement of two commercial vehicles mandating investigation of the National Traffic Safety Board, the incomplete manifest of the tourist vehicle, large numbers of foreign nationals, and the timing of the event (mid-day in the middle of the week) allowing robust involvement of the all parts the health care system. This mass casualty event demonstrates the challenges to a complex mass casualty response and how many aspects of our disaster response system met those challenges.

KEY WORDS: Mass casualty; Emergency medicine; Disaster response.

ABBREVIATIONS: DMCC: Disaster Medical Control Center; NWHRN: Northwest Healthcare Response Network; MCI: Mass Casualty Incident; EMS: Emergency Medical Service.

INTRODUCTION

Seattle has a long history of disaster related events and many unique features with regards to disaster risks, vulnerabilities, and response capacity. Region is surrounded by water-ways and water based transportation and its many bridges have been the sites of major accidents and collapse. In 1989, there was a prior fatal bus accident on the Aurora bridge and in 2015 a bridge on the I-5 interstate collapsed over the Skagit river.[2]

Due to real and anticipated risks, the Seattle area has robust and complex mechanisms for identifying and responding to disasters and mass casualty events. Seattle Fire and the Medic One pre-hospital paramedic based Emergency Medical Service (EMS) system along with private ambulance transportations companies has been used as a global model. There is a well-established and experienced public health department (Public Health Seattle King County) and long standing intra-hospital and inter-healthcare system collaboration regarding disaster preparedness and response. For example, the use of Aninter-hospital resource tracking system: WATrac, and the public-private partnership of Northwest Healthcare Response Network

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(NWHRN) which coordinates many disaster related activities including planning and education. The City of Seattle maintains a department of emergency management with coordination, collaboration and communication capabilities. Finally, the Disaster Medical Control Center (DMCC) located at Harborview Medical Center provides centralized physician directed triage of patients to area hospitals based on information from the field and communication of surge capacity through WATrac.

The event described in detail below demonstrates some of the complex systems and collaborations at work with mass casualty events in our city.

REPORT

Aurora Avenue, State Route 99 (SR99) is a major Seattle North-south Highway with approximately 38,000 vehicles per weekday.[3] The Aurora Bridge, built in 1932, is 2,945 ft. (898 m) long, 70 ft. (21 m) wide, and 167 ft. (51 m) above the waterway connecting Lake Union with Puget sound. It is one of six bridges connecting the center and north of the city and has dense urban/suburban development on both ends. The bridge was the site of a prior mass casualty incident in 1998, when the driver of a city bus was shot resulting in the bus driving off the bridge and landing on an apartment building with associated death and injuries.[4]

At approximately 11:00 a.m. on Thursday September 24, 2015 a world war II era (1945) General Motors Corporation DUKW amphibious tourist vehicle, was traveling north bound in the center lane with a driver and believed to be 36 passengers. At the same time a 2009 Motor Coach Industry luxury bus with a driver and 50 passengers was driving south bound in the center-lane. Neither vehicle was equipped with seatbelts. The DUWK, a 6 wheeled amphibious two-ton military vehicle,was refurbished in 2005 for tourist use. In 2013, the parent company of the Seattle based operation issued a warning and recommended repair for a potential axle failure in the DUWK vehicles.[5] Immediately before the accident the driver reported hearing a loud "bang" caused by a mechanical failure at the left front axle assembly, resulting in loss of control and the DUWK crossing the midline, striking the bus. The driver's side of the DUWK struck the bus and entered the passenger portion of the bus behind the driver's area. Several DUWK passengers were ejected. Three other vehicles also incurred collisions while attempting to avoid the primary collision (Figure 1).

VICTIMS AND RESPONSE

The Seattle Fire Department, which manages all initial EMS and rescue responses within the City of Seattle, dispatched an initial Mass Casualty Incident (MCI) response based upon reports of multiple victims including at least 10 victims lying on the highway. The initial response was comprised of two ALS ambulances, two BLS ambulances, seven engine companies with four firefighter/EMT's, two ladder companies with five firefighter EMT's, three chief officers and three support vehicles including an MCI support vehicle with cashed medical supplies. Soon after, the fire department's technical rescue team was added to the response. The limited ingress and egress to and from the incident site on the middle of the bridge was a unique challenge to this event.

Prior to arriving on the location, the supervising ALS officer contacted the charge nurse of the emergency department at Harborview Medical Center and provided a brief report of the incident. Harborview Medical Center serves as the only Level 1 Trauma Center in the region and also functions as the DMCC for coordination of patient distribution in a mass casualty incident. Based upon this early notification, the emergency department, as well as the surrounding hospitals, began to plan the internal response (code external triage) to the incident.

At Harborview Medical Center, emergency medicine attendings and nursing leadership huddled to coordinate the internal response. All active patients already in the emergency department were discharged or transferred to inpatient floors immediately. The department was divided into sections to receive red, yellow and patients not involved in the event. Emergency

Figure 1: Damage to the Bus was Extensive.

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Department and hospital incident command structures were established, including emergency department triage. An emergency medicine attending maintained communication with the scene incident commander and surrounding hospitals *via* the DMCC system. DMCC is a radio and telephone based triage system that allows equitable distribution of MCI victims across the region. EMS communicates with a physician with access to re-time knowledge of emergency department capacity for the regions hospitals and assigns distribution by EMS. Staff was assigned regionally to the different areas of the department.

Patients were re-triaged upon arrival by an Emergency Medicine attending and transferred to the appropriate area, with emergency surgical cases transferred expeditiously to the OR. A novel clinical to heighten efficiency was that patients identified as requiring CT scan imaging received a CT Pan scan or no CT scan at all. Through early notification, organization of incoming staff and clear establishment of incident command structure as well communication with outside hospitals, Harborview Medical Center was prepared to receive and treat the incoming patients.

There were 62 reported injuries; however, this number maybe low due to delayed self-directed medical care seeking (some bus passengers and those in other vehicles walked to a nearby park after the accident and were reported to later seek medical care). There were four victims pronounced dead on the scene and another victim died three days later of his injuries. A total of 49 victims were triaged and transported *via* the EMS systems. These included 14 triaged red, 25 yellow and 10 green. No patients were triaged expectant. A pre-hospital county issued EMS MCI triage tag was used to help patient tracking. The patients were taken to eight area medical centers, with Harborview Medical center receiving all 14 triaged red patients.

A computer based healthcare incident management system, WATrac was used to help track the patients. WATrac assists in hospital and emergency department bed availability to assist inter-hospital coordination on a daily basis and is co-managed by the Washington State Department of Health and Public Health-Seattle King County.

Due to the foreign nationality of many of the victims the tracking of patients and updating of families became a complex process, with contacts involved in 15 countries. The City of Seattle's Emergency Operations Center was established early in the crisis and over the course of five days coordinated with at least 16 city and 11 partner organizations. As well as providing a medium for communication and collaboration, the EOC and partners provided extensive case management including food, housing, transportation and amenities for victims and families as well as coordination's of donations.

DISCUSSION

Many small but not irrelevant elements were in play that made this tragic accident unfold in a manner that maximized healthcare and good outcome for the patients as well as a supportive and informed environment for the victims' families and the general population of Seattle. These items may be considered our lessons learned, and could assist other communities in their disaster preparedness and response. Years of coordination and collaborative agreements and planning, as well as drills came to play as patients were appropriately managed in the field, distributed appropriately to area hospitals who were aware of and prepared for their arrival, their whereabouts were tracked and available to public officials who were able to inform and support family and the public. Several elements also contributed to the event in a negative manner. As a commercial tourist vehicle and a commercial transportation vehicle neither vehicle was required to or had seat belts. Additionally, similar DUKW vehicles have been involved in prior mechanical failures related to multicasualty events in Arkansas in 1999 and Philadelphia in 2010 with 11 and 2 fatalities respectively. The DUKW vehicle does not meet current safety standards, and concerns over the vehicles size, shape, and blind spots and buoyancy have also been raised.[6-8] This combined with the failure implement the recommended 2013 repair raises concerns over the overall safety of these vehicles. Despite the robust response of our community's EMS, city and hospital based emergency services, it is likely many of these injuries and fatalities may have been averted with improved safety guidelines and implementation.

CONCLUSION

The greater Seattle area has a history of, and risks for, a variety of future disasters, as such, many entities have a vested stake in collaborative disaster planning. This recent tragic accident demonstrates some of the complex systems Seattle used effectively to manage this event and may represent lessons learned for emergency planners and trainers.

CONFLICTS OF INTEREST

The authors have no disclosures or conflicts of interest and IRB approval was not indicated for this special report.

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