First Line Technology
Technical White Paper

Contents

A Scalable Approach to Mass Casualty Transport

1. Abstract

How much mass casualty transport and patient evacuation capacity does a community need? This paper presents a maturity model that enables emergency and evacuation planners to assess their readiness to handle large scale mass casualty or patient evacuation incidents.

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2. October 29, 2012: Super Storm Sandy

As Superstorm Sandy slammed into New York City with powerful winds and driving rain, hospital administrators at three of the city's major medical centers knew they had a massive problem.

NYU Langone, Bellevue, and the Veteran's Administration Hospital are all situated within 200 yards of the East River. As a powerful storm surge caused the river to overflow its banks, all three hospitals had to evacuate many non-ambulatory patients, some of which needed advanced life-saving devices.

The number of patients that needed to be moved far exceeded the capacity of available ambulances. As a result, the evacuation process was slow and many of the patients had to be moved during the heart of the storm, putting them, and their caregivers at risk.

While this event was an extreme example, many communities could face one or more mass casualty incidents or evacuation scenarios annually. They may be caused by natural disasters such as hurricanes, floods, tornadoes, and earthquakes. Additionally, we are seeing more man-made mass casualty incidents such as the Las Vegas, Orlando, and Parkland shootings as well as the use of trucks and other vehicles as weapons. Transportation incidents such as train derailments, bus crashes, and multi-car accidents can also create a surge of non-ambulatory victims.

Whatever the cause, public health professionals, emergency medical service providers, and emergency managers need to be prepared for these types of events with a more scalable, affordable, and flexible, mass casualty transport capability.

Many communities attempt to manage mass casualty and patient evacuation situations through mutual aid agreements with other communities or healthcare systems. However, when an event is as massive as Hurricane Katrina or Superstorm Sandy, all the communities in a region may be affected and unable to send ambulances to help. Even if they send ambulances, the response and patient evacuation times could take longer due to the lack of familiarity of local traffic patterns by the ambulance drivers from other communities.
Up to now, the only other option would be to buy and staff additional ambulances or purchase specialized, advanced life-saving equipped, multi-patient medical transport vehicles (MPMT).

A single ambulance can cost $200,000 or more and has a patient carrying capacity of one to two patients. Staffing the vehicle could cost between $45,000 and $80,000 or more for full time EMTs annually.

A turnkey, fully equipped at advanced life-saving level MPMT costs between $500,000 and $1,000,000 per unit depending on the medical equipment required. Typically, these types of specialized, turnkey vehicles can handle between 18 and 24 patients at a time. Staffing costs may run between $100,000 to $250,000 annually for four or more full-time EMTs.

Given the current frugal budgets in most jurisdictions, together with deep grant reductions, many communities might have to save for years to buy and staff more ambulances or a single fully equipped MPMT.

What is needed is a scalable, affordable, and flexible approach to mass casualty and patient evacuation.

3. A Better Approach

What has been missing in the current approaches is the ability to convert existing transportation assets on a permanent, or as needed basis to handle mass casualty situations. Now, affordable conversion kits enable most jurisdictions to have sufficient mass casualty transport assets on hand to handle almost any situation.

By leveraging surplus or end of service school or metro buses, using a conversion kit such as the AmbuBus from First Line Technology, a community can have a vehicle that can transport up to 18 non-critical patients for under $50,000.

The organization can often borrow the vehicles for temporary use or buy them for a nominal amount from the school or transportation district. They then purchase one or more AmbuBus conversion kits which cost between $45,000 to $50,000. Once assembled, which takes two people about two hours, the converted AmbuBus can carry up to 18 non-critical patients, two or more EMTs, and medical supplies.

By having one permanently converted AmbuBus and additional AmbuBus conversion kits to handle patient surges in situations where there is advance warning such as hurricanes, a community can have sufficient mass casualty transport capability to meet almost any situation

4. Mass Casualty Transport Maturity Model

Level 1	Level 2	Level 3	Level 4
			1 or more On-Demand (temporary) AmbuBuses at BLS level
			1 or more No-Notice (permanent) AmbuBus converted to ALS level
		1 or more No-Notice (permanent) AmbuBuses at BLS level	1 or more multi-patient medical transport vehicle at ALS level
	Mutual assistance ambulances from neighboring communities or contractors	Mutual assistance ambulances from neighboring communities or contractors	Mutual assistance ambulances from neighboring communities or contractors
Available Ambulances	Available ambulances	Available ambulances	Available ambulances

The table above enables mass casualty planners to assess their current approach to transportation capacity and determine what approach gives them the right combination of capacity, flexibility, and affordability,

4.1 Level 1

Communities that only have the ability to manage mass casualties with available ambulances at are a supreme disadvantage. At any given time, a large percentage of the available pool of ambulances may responding to calls, leaving only a few ambulances to respond to the mass casualty incident. Since many ambulances carry only one or two patients, making multiple trips may mean some patients that were non-critical may deteriorate to be at a serious risk of death or permanent damage.

4.2 Level 2

Some mass casualty situations can be handled with the available ambulances from the pool together with ambulances supplied by other communities under mutual aid agreements. However, if the community is remote the response time may be too long. Also, large multi-

jurisdiction events such as hurricanes that cover an entire costal area may mean that no additional help is on the way.

4.3 Level 3

Adding one or more permanently equipped AmbuBus units greatly increases a community's mass casualty transport capacity. Equipping a surplus school or metro bus will add an additional 18 to 24 patient carrying capacity per trip. By permanently installing the conversion kit and housing the AmbuBus at a centrally located fire station or hospital, the unit can be quickly dispatched to the incident site.

Available and mutual support ambulances would be used to treat and convey all critically injured patients and the AmbuBus or AmbuBuses would transport the non-critical patients.

4.4 Level 4

The most advanced level of mass casualty transport capability would see the community utilize their own and mutual support partners' available ambulances to handle all patients in critical condition.

Non-critical patients that require advanced life-saving medical equipment would be transported in either a multiple-patient medical transport vehicle equipped with ALS level medical equipment or an AmbuBus that has been upgraded to ALS level.

Additional AmbuBus conversion kits would be purchased and stored so that in the event of a hurricane or other advanced warning event, they could be installed in other school or metro buses to be ready if needed.

Any available school, metro bus, or truck can be easily converted by two people in about two hours. No power tools are required, and the necessary hand tools and simple-to-follow instructions are included in each kit.

Having this complete arsenal of available mass casualty transport vehicles gives a community a fully scalable and flexible system that can accommodate virtually any situation.

5. Turnkey MPMT or AmbuBus Conversion Kit?

Some communities feel they should purchase a turnkey multiple patient medical transport vehicle that has oxygen flows, medical workstations, and onboard power for advanced life-saving equipment. This is a great option but the cost of purchase, staffing and total cost of ownership considering maintenance, refreshment, insurance, and other costs may put it out of reach for most communities.

Keep in mind that these expensive, and customized vehicles should never be used to transport critically injured patients. The reason is simple. It takes far longer to load 18 to 24 patients than it does the usual one or two patients of a regular ambulance. Some patients may die while others are being triaged, treated, and loaded. All available ambulances should be reserved for critically injured patients.

However, in many mass casualty situations, the number of non-critical patients will exceed the number of critical patients. These patients can be accommodated by either a turnkey MPMT or an AmbuBus. Given the lower total cost of the AmbuBus, the AmbuBus is a better choice for most communities.

A turnkey MPMT can typically carry 24 patients in a single trip. Even at the lowest purchase price of around $500,000, the cost per patient carried would be approximately $20, 833. Assuming the community can make available school or metro buses to convert to AmbuBuses at around $50,000 or less per bus, they can purchase and equip five AmbuBuses for the same amount of money.

Since each AmbuBus can carry 18 patients in a single trip, 5 AmbuBuses will be able to transport 90 patients. The cost per patient carried would be approximately $5,555.

6. A Phased Approach for Funding an Advanced Life-Saving Equipped AmbuBus

Some communities feel they require a fully advanced life-saving equipped multiple-patient medical transport vehicle. They may have to save budget and grant funds for several years before they can buy a turnkey MPMT. In the meantime, they are without any of the additional mass casualty transport capacity they might need.

However, some communities like Eureka County, Nevada have taken a different approach to funding an advanced life-saving equipped MPMT.

They applied for grant funds to purchase a Basic Life-Saving equipped AmbuBus in the first year and deployed it at that level. In the second year, they applied for the funds needed to fully equip their existing AmbuBus with the advanced life-saving equipment they need.

By taking this phased approach, they have the capacity they need today and the capabilities they want later.

7. Additional Advantages of the AmbuBus

In addition to the significant cost savings, the AmbuBus has other advantages that make it a better choice than MPMTs.

The patient stretchers in many MPMTs are permanently installed. That means the MPMT can never be used in any other configuration or for any other purpose that patient transport. The MPMT has to be permitted as an ambulance with all the complexity and disadvantages that that entails. The MPMT sits unused virtually all the time.

On the other hand, an AmbuBus can be quickly reconfigured many ways. The vehicle can be reconverted back for school or metro transportation. The top rows of stretchers can be removed so that the unit can be used for firefighter rehab.

An optional wheelchair package can be fitted to the frame to provide adequate space to safely accommodate one to three wheelchairs in addition to the stretchers. This capability makes it a better choice than a MPMT for hospital or nursing home evacuations and special needs transport.

An optional completely portable, mass casualty oxygen system can be installed to enable simultaneous delivery of individually monitored oxygen for up to nine patients per system. An AmbuBus can also be equipped with a multiple patient monitoring system with portable, easy-to-use FDA-cleared Wireless Vital Signs Monitors that can handle up to 20 patients.

The AmbuBus conversion kit can be set up free standing in a shelter or hospital hallway to manage hospital surge capacity or pandemic quarantine. It can also be used at an airport for the staging of large-scale aeromedical evacuations.

8. How Many Mass Casualty Transport Vehicles Should a Community Deploy?

A significant consideration for mass casualty transport planners is the question of how much capacity do they need to deploy? That answer may vary for every community based on population, traffic patterns, and frequency of major storms such as hurricanes and tornadoes.

One way to begin to calculate a logical approach to vehicle deployment is to consider the time it would take a mass casualty transport vehicle to respond, load, transport, unload, and return to an incident as well as the number of trips it would take to handle many casualties.

Assume there are 50 total casualties and none of them are critically injured. If you had to transport all fifty patients in ambulances, it would take many trips since most ambulances can transport only one or two patients depending on configuration.

A Patient Transportation Planning and Prediction Equation was developed to enable planners to see the resources needed.

The equation is stated as X = Nt/Tn.

- The letter X equals the number of ambulances.
- The letter n equals the number of patients transported per unit.
- The letter N equals the number of persons requiring transport
- The letter t equals round trip travel time including return to service
- The letter T is the total time available for operations

To calculate the time and resources needed to transport the fifty patients the calculation would be:

- n = 1.5 (1.5 patients per ambulance on average)
- N = 50 (total number of patients)
- T = 1 (goal for all transports)

X = (50 x 1) / (1.15)
X = 50/1.5
X = 33.3333

The total number of ambulances required would be 34. Since each ambulance would require two EMTs, the total staffing requirement would be 68 EMTs.

Now assume that one or more AmbuBuses that could accommodate18 non-critical patients was available.

The equation would be calculated X = (50 x 1) / (1 x 18)

X = 50/18
X = 2.7777

The total number of AmbuBuses required would be 3. Since each AmbuBus would require 3 EMTs, the total staffing requirement would be 9 EMTs.

9. Conclusions

Communities that currently lack adequate mass casualty transport capacity to meet their historical, current, or future needs should consider adopting a flexible, scalable, and affordable approach to mass casualty transport. While the idea of purchasing and staffing enough ambulances or a turnkey multiple-patient medical transport vehicle is attractive, these expensive approaches provide far less mass casualty transport capacity than buying one or more AmbuBus conversion kits.

Individuals wishing to evaluate the applicability of the AmbuBus for the needs of their community should contact Jason Croson, Product Manager for the AmbuResponse Family of mass casualty transport solutions at jcroson@firstlinetech.com. He can be reached by phone at (703) 955-7510 extension 140.

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