

AEAI Propulsion

Sept 13, 2022

It takes a system to save a life - Next is now!

The interface between propulsion technologies and the challenges of Emergency Medical Services

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Disclaimer

Nadine Levick MD, MPH, FACEM, FRACGP, Israel EM, Israel PEM

- I am a doctor, not an engineer
- Conducted the worlds first ambulance crash tests
- Chair, National Academies Science, Medicine & Engineering Subcommittee TRB EMS Transport Safety ANB10(5), USA
- Founder of EMS Safety Foundation
- Recipient, International Society of Automotive Engineers, Women's Leadership Award



Emergency Medical Service (EMS) Roles

- Emergency medical care and transport
- Communications and dispatch
- Disaster management
- First Aid education



EMS

- like the fire department, is a revenue sink
- does not generate revenue like commercial trucking
- it is a passenger vehicle 'work environment'
- Historically disconnected from the automotive industry



a passenger vehicle 'work environment'



Safety in EMS is INTERDISCIPLINARY

- clinical practice
- public health/disaster management
- communications/dispatch
- automotive safety
- impact biomechanics
- human factors
- fleet safety
- **?new propulsion technologies?**

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EMS transport special requirements

- Most are short trips ~ 10 mins in urban areas
- Vehicle occupants oriented in multiple configurations, including recumbent
- In an urban area, vehicle staging and positioning - occasionally requires idling
- On scene vehicles have medical equipment that requires power, and also AC or heating
- A small minority of trips are longer distance

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Most EMS trips are NOT critical

- < 3% of EMS runs are critical
- 97% of transports are routine, non-critical
- 25- 30% EMS runs are non transport
- 30% of EMS transports to the ED are discharged home within 4 hours
- 24/7 national physician video interactive telemedicine support for these cohorts

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An important Fact....

- **ONLY <3%** of transports is it a life threatening emergency
- 97% of transports are routine and NOT a critical emergency

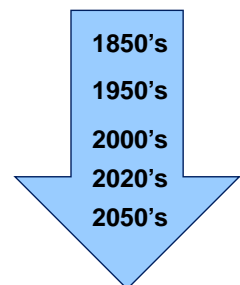
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**So ambulance design
technical science....
Not really a new issue**

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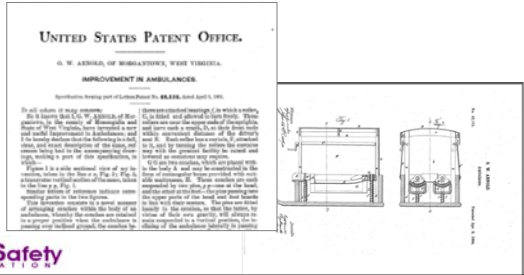
Timeline of Ambulance Propulsion Systems

- Horse and buggy
- Gasoline
- Diesel
- Electric
- Hydrogen
- Other.....



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1864 Ambulance Design Patent
 re: safety of ambulance design
 > 150 years ago



If you were to survey paramedics for what would enhance safety and efficiency then....

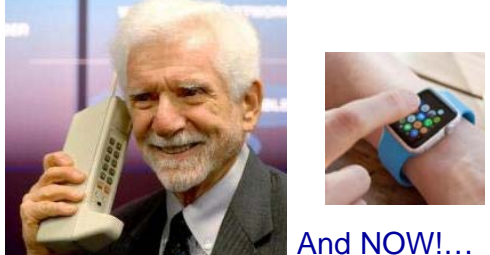
- Likely “more rest stations”
- Not likely – “the combustion engine”
- Let alone the Hydrogen powered eVTOL

Innovation and designing a safe system

the reality of change in EMS is challenge to the adoption and integration of transportation innovation



1980's Then....



And NOW!...



USA 1980's Then....



And 2022...



Ambulances currently are primarily Diesel/Petrol

- Is the mainstream for EMS vehicles globally

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Limited design and safety standards largely due to exemptions

in USA the Ambulance Manufacturing industry is outside of the mainstream automotive industry

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In the USA there are more safety standards for moving cattle than for moving patients



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EMS vehicle is a work and patient care environment!!



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April 9, 2022 –
EMT killed in ambulance crash



Firefighter EMT killed, 2 others injured in ambulance crash on SR-87 in Mesa

June 12, 2022
Patient dies after ambulance crash



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Testing the real world



this all takes place in 60 milliseconds - the blink of an eye



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Propulsion systems in EMS and Innovation



Electric propulsion in EMS

- New ambulance vehicles now being developed on electric platforms
- Electric mini Ambulance - 2017
- Initial USA deployments as of March 2022
- Benefits?:
 - Clean
 - Lower loading height
 - Cost saving



Electric Mini Ambulance - 2017


World's first narrow electric ambulance inaugurated by United Hatzalah

UH has treated 2.5 million people in the last quarter-century, around 300,000 per year, or 900 to 1,000 a day, all at no cost to the patient.

By JEFF SIEGEL, Published OCTOBER 3, 2017 12:24 Updated OCTOBER 3, 2017 16:16



Lightning Motors - 2022



Lightning ZEV3 Transit Ambulance Type II

The Lightning ZEV3 Transit Ambulance Type II is equipped with a state-of-the-art electric drivetrain which delivers the best efficiency of any vehicle in its weight class while providing a quiet, smooth and flexible driving experience that your EMS's - and patients - will love.

Available in 140-mile and 200-mile range versions. Use our premium, practical, vehicle service only (VSO) approach, and we arrive on the road. Charging is simple and easy, with both Level 1 AC charging and DC Fast Charge supported. Lightning supports 40 battery configurations for direct connection to supplemental HVAC components.

Medical equipment and emergency lights are supported with an additional mounting providing auxiliary 12V DC power.

We use the highest quality components available, including our thermally managed batteries which deliver the best range, efficiency and lifetime of any ambulance in the market.

Model	Light ZEV3 (200kWh Passenger Van)
Seating	16-20 (5 + 11-15) Seater
Chassis	Light
Charging system	Level 1 AC (up to 11.5 kW) and DC Fast Charge (up to 60 kW) with J1772/CCSI/CHAdeMO
Efficiency	100 MPGe (100 City with 40 kWh) 100 Highway
Driving range*	up to 140 miles (up to 200 miles)
Battery capacity	40 kWh (up to 120 kWh)
Charge time	3 hours Level 1 AC up to 11.5 kW (up to 12.0 kW) 15 minutes DC Fast Charge (up to 60 kW) (up to 30 min)
Performance level	40+ mph electronically limited
Vehicle Rating when Equipped	100-140 (100-140)
Features	• 400V Battery Pack (optional) • Electric generator and battery Lighting • ABS (optional) • 10 year / 100,000 mile warranty
Available	• Professional Maintenance • Parts & Repairs • Direct Support • 24/7/365



USA, First all electric ambulance deployed March 2022

Mobile healthcare provider welcomes first all-electric ambulance to its fleet

By Jeff Sisk



The first all-electric ambulance is being deployed to the first all-electric ambulance in the US.

Canadian Electric Ambulance Development October 2021

electrive.com

5th Oct 2021, 10:24 pm


Lion & Demers present first fully-electric purpose-built ambulance

Demers Ambulances and Lion Electric have unveiled the first all-electric and purpose-built ambulance for the market in the second half of 2021.

Both, based on purpose-built manufacturing systems, demonstrate the Lion Electric Company, which is known as a leading manufacturer of all-electric vehicles, has taken a significant step towards the development of an all-electric ambulance. The new ambulance is the first of its kind to be developed in Canada.

The design of the ambulance is to be assembled in Lion's plant in Ontario and that assembly will be supported by Demers Ambulances in Ontario. The vehicle production will then move to the Lion's plant in Ontario, before eventually being made available nationwide. Demers recently has announced its plans to acquire the production and service of the ambulance in Ontario and that the vehicle will be supported by the Lion's plant in Ontario.

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“Partnering with our employees, customers, partners, and relevant officials to support this project has become a reality, and we are now ready to begin production. We are excited to see the first production units of the Lion Electric ambulance in Ontario, before eventually being made available nationwide. Demers recently has announced its plans to acquire the production and service of the ambulance in Ontario and that the vehicle will be supported by the Lion's plant in Ontario.”



Design Challenges – Paramedics are not automotive engineers

The first **all-electric** and purpose-built ambulance.



Designed by paramedics, for paramedics.



A collaboration with Demers Ambulances, the eFX Ambulance is purpose-built to be 100% electric. Based on a Lion's chassis, the eFX Ambulance is specifically engineered to enhance the comfort and safety of paramedics, allowing them to remain focused and to provide optimal care to their patients at all times.

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LITMOTORS
SOMA SAN FRANCISCO CALIFORNIA

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Litmotors- electric gyrotech

Technology

Self-Balancing Cyro-Technology Stabilizes the Vehicle

Allows acceleration from 0 to 60 miles per hour in under 5 seconds while leaning freely up to a 45° angle around a sharp corner.

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The ambulance response vehicle of the future?



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Israel's Ree platform?

Ree Automotive presents first electric transporter

The Israeli start-up for autonomous, together with Daimler and Magna Steyr, has presented a demonstration vehicle called Phoenix. The electric delivery vehicle is based on the eFX platform with the Lion's chassis.

The RT is the result of a joint effort between the technology firm and Demers Ambulances. The technology has been adapted again compared to other demonstrators from the beginning of the year. For example, there is a 100% electric range of 170 miles and a range of up to 100 miles.

The body of the vehicle, called 'Phoenix' presented by Ree, comes from Daimler and Magna Steyr. It is a fully electric and includes an interior body designed to take full advantage of the flexibility of the Lion's chassis. At 7 meters, the vehicle is 1.2m wide and has a total height of up to 3 meters. It is also noted that the bodywork is made of aluminum.

The Israeli company is producing technology based on gyro technology called 'gyrotech', in which displacement components are integrated to stabilize the vehicle. These also include the engine. The gyro technology and the power electronics, such as the motor, are produced by the company. The gyro technology can also be used in other applications, such as in a self-balancing scooter and for first aid can be used in a variety of other applications, all without needing it also possible. This also means that the technology is not dependent on the amount of power, because the gyro platform does a very important job in stabilizing the vehicle.

The new model full size of the car is 100 percent (and 100% the largest size) to the Phoenix concept. In addition, the demonstrator provides battery level of an electric drive system, which is supported to provide a range of 100 kilometers in an urban traffic. The car is powered by a 200-horsepower engine, and range relative to Lion's chassis but it is a 100% electric.

What is more, Ree is the product of a joint effort between the technology firm and Demers Ambulances. The technology is not dependent on the amount of power, because the gyro platform does a very important job in stabilizing the vehicle. The gyro technology can also be used in other applications, such as in a self-balancing scooter and for first aid can be used in a variety of other applications, all without needing it also possible. This also means that the technology is not dependent on the amount of power, because the gyro platform does a very important job in stabilizing the vehicle.

Ree Automotive



- Clean
- Energy efficient
- Low loading height

P7 CAB CHASSIS

The P7 cab chassis is built on REE's ePower™ technology which packs critical system components into one location (hood and wheel). This results in a fully flat chassis and in an available interior space for passengers, cargo and battery.



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Hydrogen

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Hydrogen powered Ambulances now exist, but is it the propulsion system of choice??



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Hydrogen-electric - November 2021



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Thought leaders – Urban Aeronautics Ambulance Transport Safety since 2002

*X-Hawk:
The Revolutionary, Modular, Aerial Vehicle*

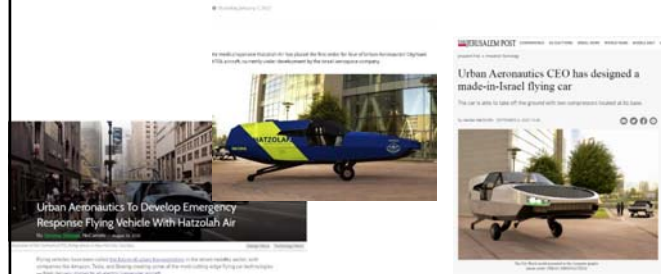


Whereas most designs for new, aerial vehicles offer incremental improvements in the state of the art, the X-Hawk flying platform presents a revolutionary advance in both the mobility and utility of aerial vehicles. Simply put, nothing like it has ever hit the market before.

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Urban Aeronautics, eVTOL 2021 (electric Vertical Take Off and Landing)

Hatzolah Air orders four CityHawk aircraft from Urban Aeronautics



Unmanned operational Prototype



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eVTOL, Hydrogen powered, 2021



Urban Aeronautics has unveiled a redesigned version of its Cityhawk eVTOL aircraft, which will now feature a hydrogen-electric propulsion system to drive its ducted fans. (Image: Urban Aeronautics)

URBAN AERONAUTICS SWITCHES TO REDESIGNED HYDROGEN-POWERED CITYHAWK eVTOL AIRCRAFT

CHARLES-ROBERT / 7 JUL 20 2021

Urban Aeronautics is aiming to retain the Cityhawk's current projected range, speed, and payload when it replaces the aircraft's current Safran Arriel turboshaft engine with a propulsion system based on hybrid's new hydrogen fuel cells. The company recently completed the latest round of initial flight tests using the current technology, demonstrating and aims to build the first of the new version in 2022.

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eVTOL and EMS – February 2022

What are the ideal applications?

- When
- Where
- What and for
- Which medical conditions
- How to calculate cost and risk benefit

Urban Aeronautics study analyzes eVTOL operations in EMS response

Friday, February 05, 2022

eVTOL ambulances could slash emergency medical services (EMS) response times and boost positive outcomes in more than half of cardiac arrest cases, according to a new study involving Urban Aeronautics' Cityhawk vehicle.



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Other

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EMS Jet Suit - September 29, 2020

- British inventor Richard Browning founded the pioneering aeronautical company Gravity Industries in March 2017
- 1,050-horsepower system
- 5 mini jet engines –
 - 2 each built into units attached to the hands
 - 1 built into a backpack

Jet suit paramedic takes Lake District test flight

Inventor Richard Browning gets potentially life-saving suit through its paces in groundbreaking exercise



Richard Browning jet suit paramedic training in Lake District

Defying gravity as they have never makes rigging across mountainous landscapes and landing with pinpoint accuracy, the jet suit paramedic could save lives part of what could become an extraordinary new service being trialled in the Lake District.

If given the green light by ambulance service chiefs, the paramedic powered by lightweight jet packs would fit across mountainous terrain within minutes to reach its intended destination.

In an awe-inspiring test flight, the inventor Richard Browning, looking Britain's like Bluebird's Jack Maas, put the suit through its paces on the Langdale Pikes.

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- Power: 1050bhp
- Turbines: 5
- RPM: 120,000
- Fuel: Jet A1 or Diesel
- Dry weight: 27kg
- Flight time: 5-10 minutes
- Current speed record: 85 mph



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Autonomous vehicles and drones



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Unmanned Ambulance drones



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And even now AED Drones!

Ambulance Drone Delivers Defibrillator by Air (VIDEO)



Automatic external defibrillators (AEDs) are now a common sight at airports and sports venues, but they're nowhere near as being ubiquitous. Alec Kocornik, a graduate industrial design student at TU Delft University in Holland, developed a drone with a built-in defibrillator that can quickly fly exactly to where it's needed.



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Manned Drones



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eHang passenger drone



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? The ambulance of the future ?Electric, ?Hydrogen, ?eVTOL

First passenger drone makes its debut at CES



A Chinese company claimed a world first on Wednesday by unveiling a three-seater capable of carrying a human passenger.



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URBAN AERONAUTICS SWITCHES TO REFINISHED HYDROGEN-POWERED CITYWING E-VOL AIRCRAFT

New Tools, New Vehicles new industry relationships

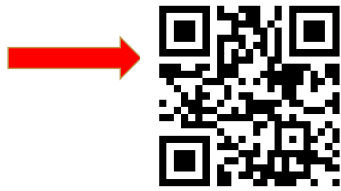
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Summary

- EMS ambulance is a unique transportation sector
- Increasing recent interest in new propulsion systems
- Electric and hydrogen ambulances are now being developed and deployed
- Collaboration between new propulsion technologies expertise and EMS is key to optimized development and outcomes

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Your electronic handout/resource
link with all text slides



Or if you are
> 45 years

www.objectivesafety.net/PDFHO.htm

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<http://www.objectivesafety.net>
Your Handout and Additional Resources



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