



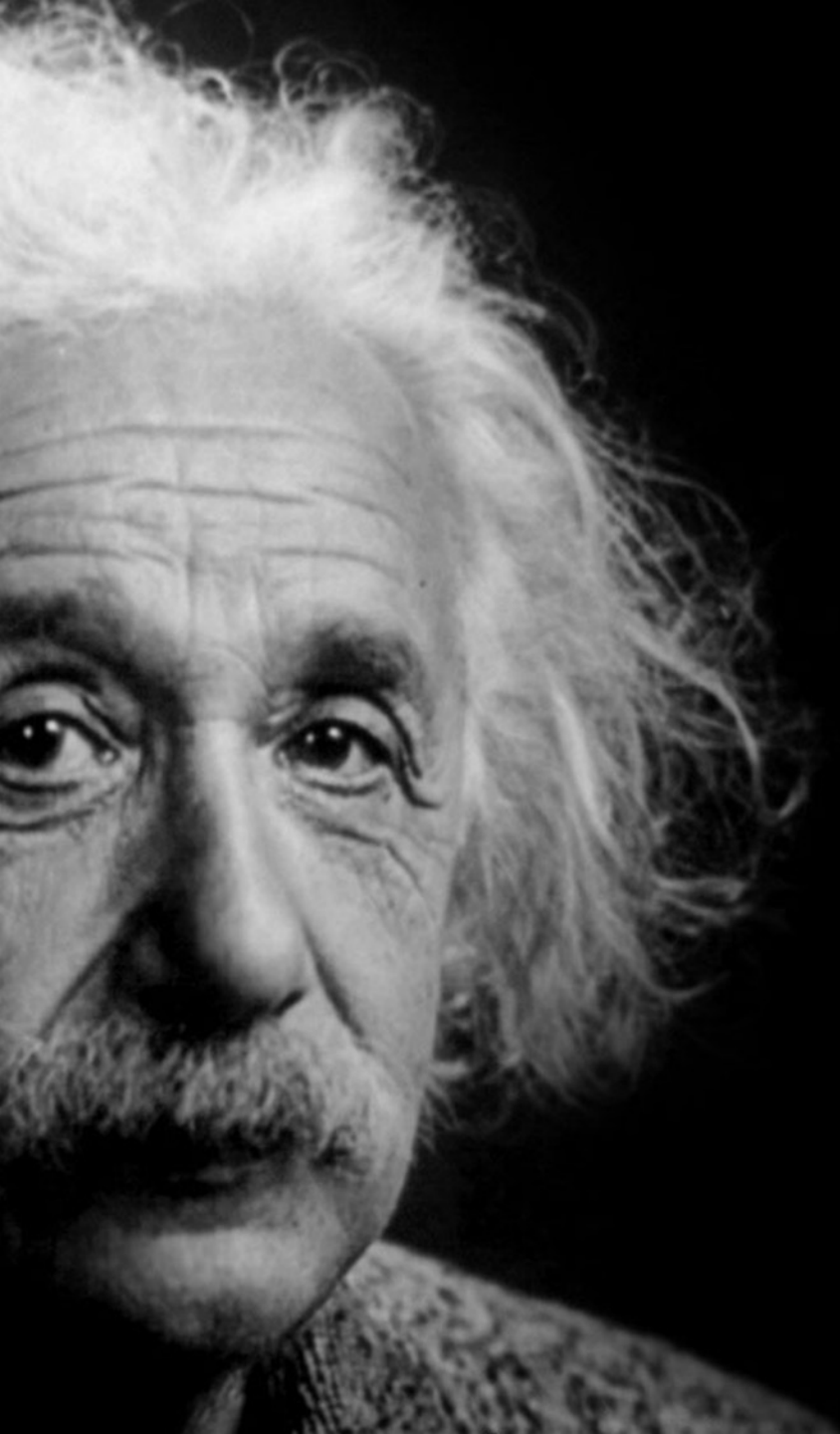
Dutch (urgent) healthcare system 2023

Jaap Hatenboer | Innovation Advisor UMCG Ambulancezorg



umcg
Ambulancezorg





1. Innovation
2. Healthcare
3. Our Journey
4. What is in it for us?

If you can't explain it simply, you don't understand it well enough.

Albert Einstein



Portsmouth Historic Dockyard

The Fighting Temeraire tugged to her last berth to be broken up, 1838

HMS Victory is a 104-gun first-rate ship of the line of the Royal Navy, she is the world's oldest naval ship still in commission.

With 245 years' service as of 2023, ordered in 1758, laid down in 1759 and launched in 1765 - she is best known for her role as Lord Nelson's flagship at the Battle of Trafalgar on 21 October 1805.

After 1824, she was relegated to the role of harbour ship.

In 1922, she was moved to a dry dock at Portsmouth, England, and preserved as a museum ship and she has been the flagship of the First Sea Lord since October 2012.



The Most Advanced Warship Of The Victorian Era

HMS Warrior was Britain's first iron-hulled, armoured battleship and for a short period, the fastest, largest and most powerfully-armed warship in the world.

In the late 1850s, Britain and France were involved in an arms race.

Both sides were embracing new technologies like armour plating to try and create the ultimate battleship.

In 1860 this produced the revolutionary HMS Warrior, a product of Britain's naval mastery in the 19th century and the Industrial Revolution that was changing everything.

Listed as part of the National Historic Fleet, Warrior has been based in Portsmouth since 1987.



**Learning is not compulsory; it's
voluntary. Improvement is not compulsory;
it's voluntary. But to survive,
we must learn.**

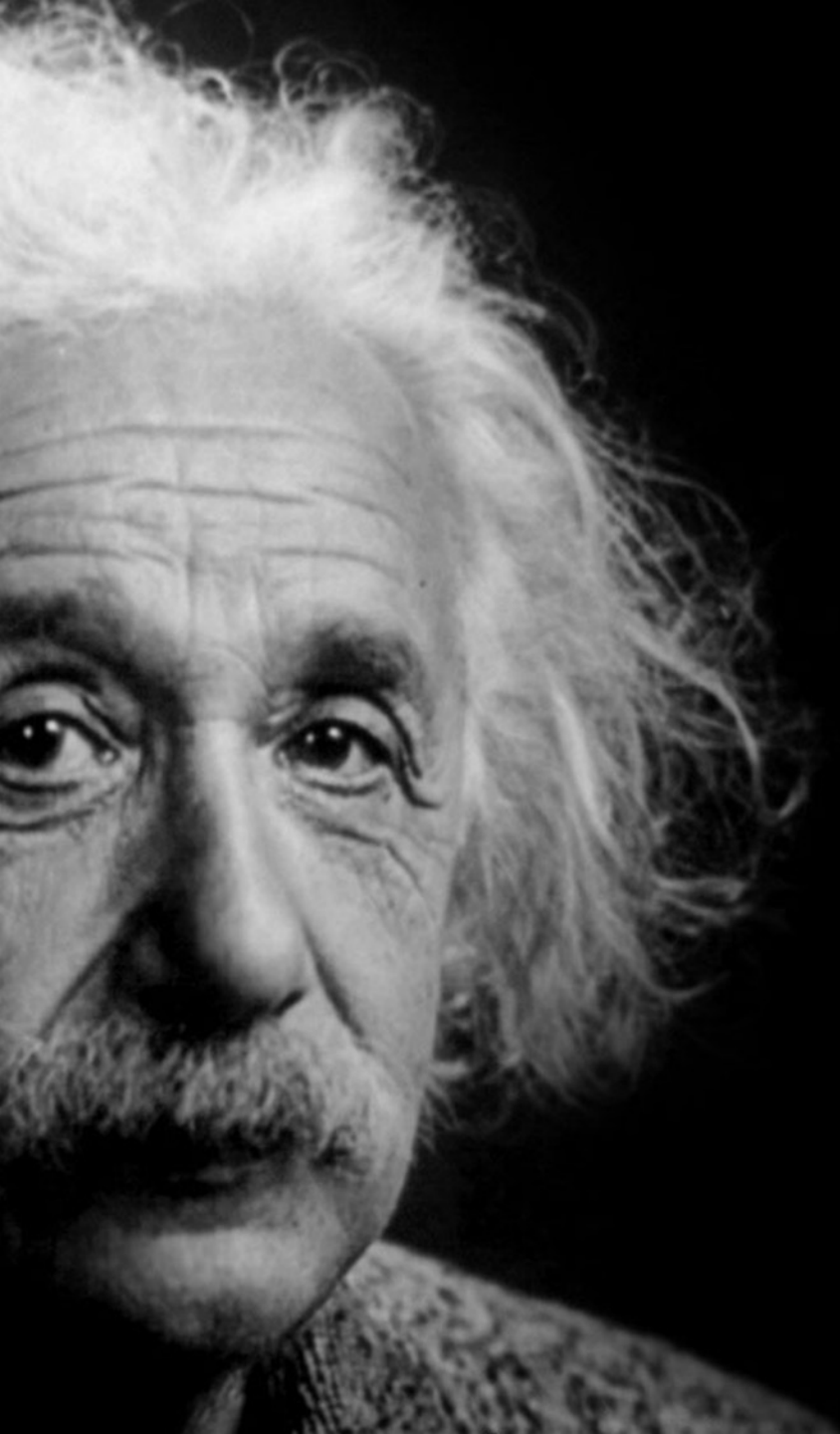
Must

W. Edwards Deming



HEALTH CARE GROUPS CALL ON PREMIERS TO **MAKE CANADA'S COLLAPSING HEALTH SYSTEM THEIR TOP PRIORITY**

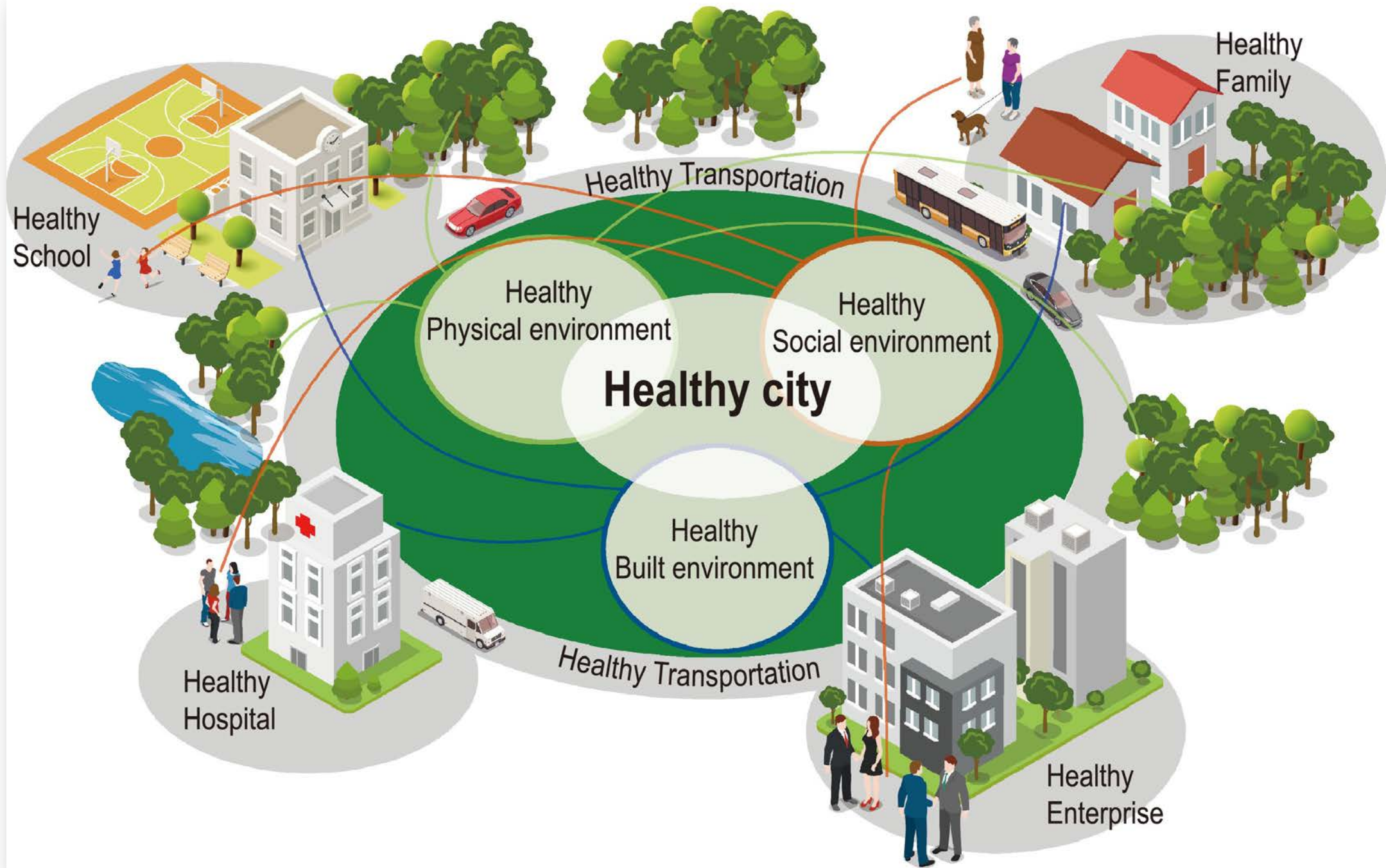
<https://www.cma.ca/news-releases-and-statements/health-care-groups-call-premiers-make-canadas-collapsing-health-system>



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In case of a health concern,
first consult your family physician.



3 Types of Business Models



Today's hospitals and specialist physician practices combine a mix of solution shop, value-adding process, and (a few) facilitated network activities



Hospitals become focused solution shops, practicing intuitive medicine

SOLUTION SHOPS

Fee for service

- Consulting firms
- High-end law firms
- R&D organizations
- Diagnostic activities of hospitals



Focused value-adding process hospitals & clinics provide procedures after definitive diagnosis

VALUE-ADDING PROCESS BUSINESSES

Fee for outcome

- Retailing
- Manufacturing
- Food Services
- Medical Procedures



Facilitated networks take dominant role in the care of many chronic diseases

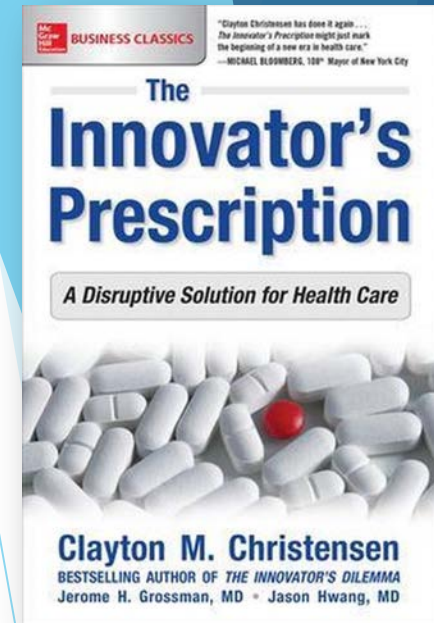
FACILITATED USER NETWORKS

Membership, Advertising

- eBay
- Insurance
- Education
- Telecommunications
- D-Life (for diabetes patients & families)



Te Whatu Ora
Health New Zealand
Waitematā





London Ambulance Service

NHS Trust

The London Ambulance Service NHS Trust (LAS) is responsible for operating ambulances and answering and responding to urgent and emergency medical situations within the London region of England.

It is one of the busiest ambulance services in the world, and the busiest in the United Kingdom, providing care to more than **8.6 million people**, who live and work in London. Population density is 14,500/sq mi (**5,598/km²**)

The service employs around **5,300 staff**.

The LAS responded to over **2.1 million 999 calls for assistance**, and over **1.2 million incidents** in the year ended March 2020.



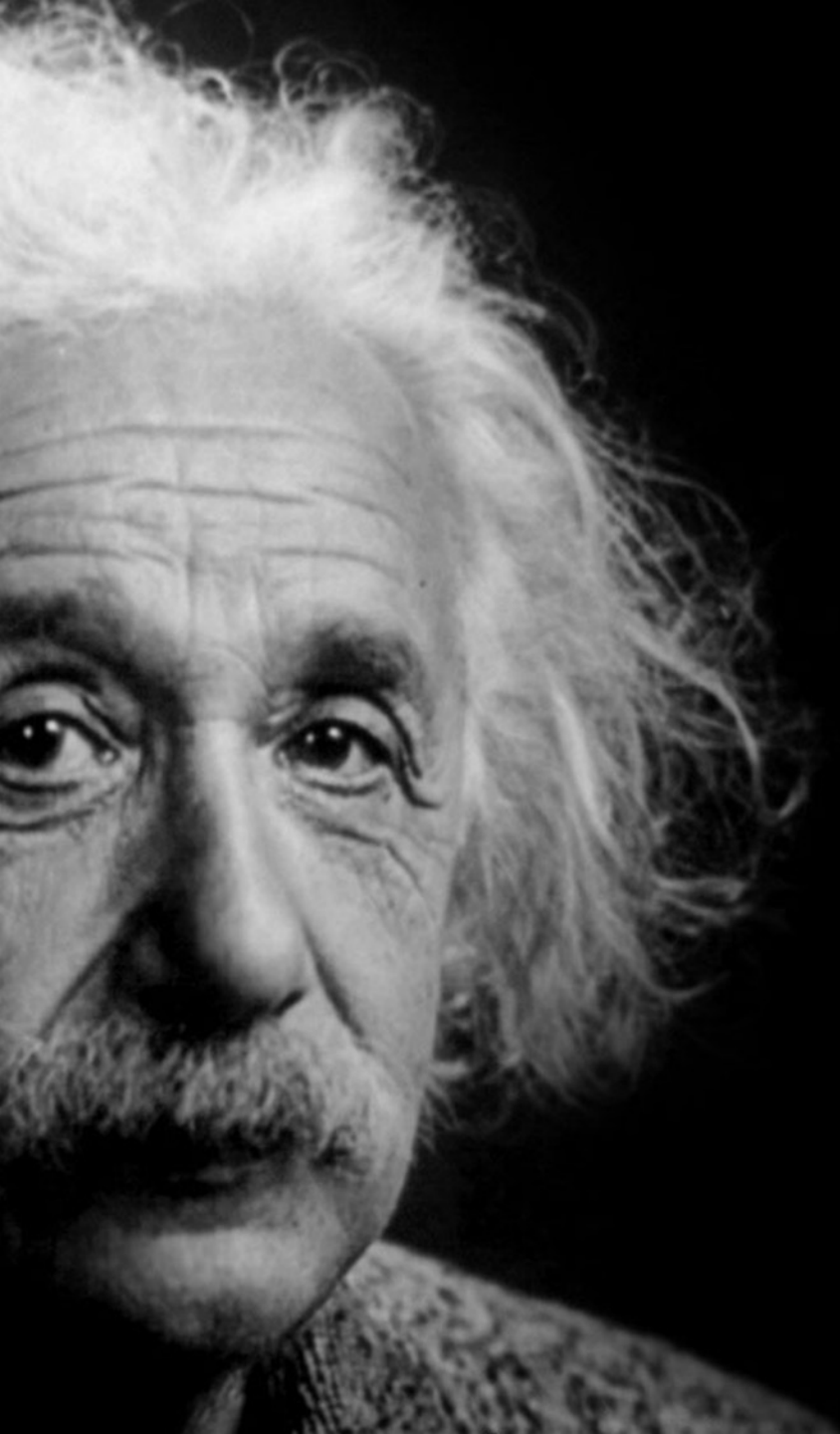
AMBULANCEZORG
NEDERLAND

The Netherlands is the 16th most densely populated country in the world and the second-most densely populated country in the European Union, with a density of **531 people per square kilometre (1,380 people/sq mi)**.

The macro budget in 2021 was €745 million. For this macro budget, ambulance care is available 24/7 throughout the entire year and **1,408,115** deployments took place in 2021.

At the end of 2021, the population of the Netherlands was more than **17.5 million**. In other words, ambulance care in 2021 cost an average of approximately **€42.35 per inhabitant**.

The number of ambulance care staff rose from 5,925 in 2017 to **6,863** in 2021. This is an increase of more than 15%.

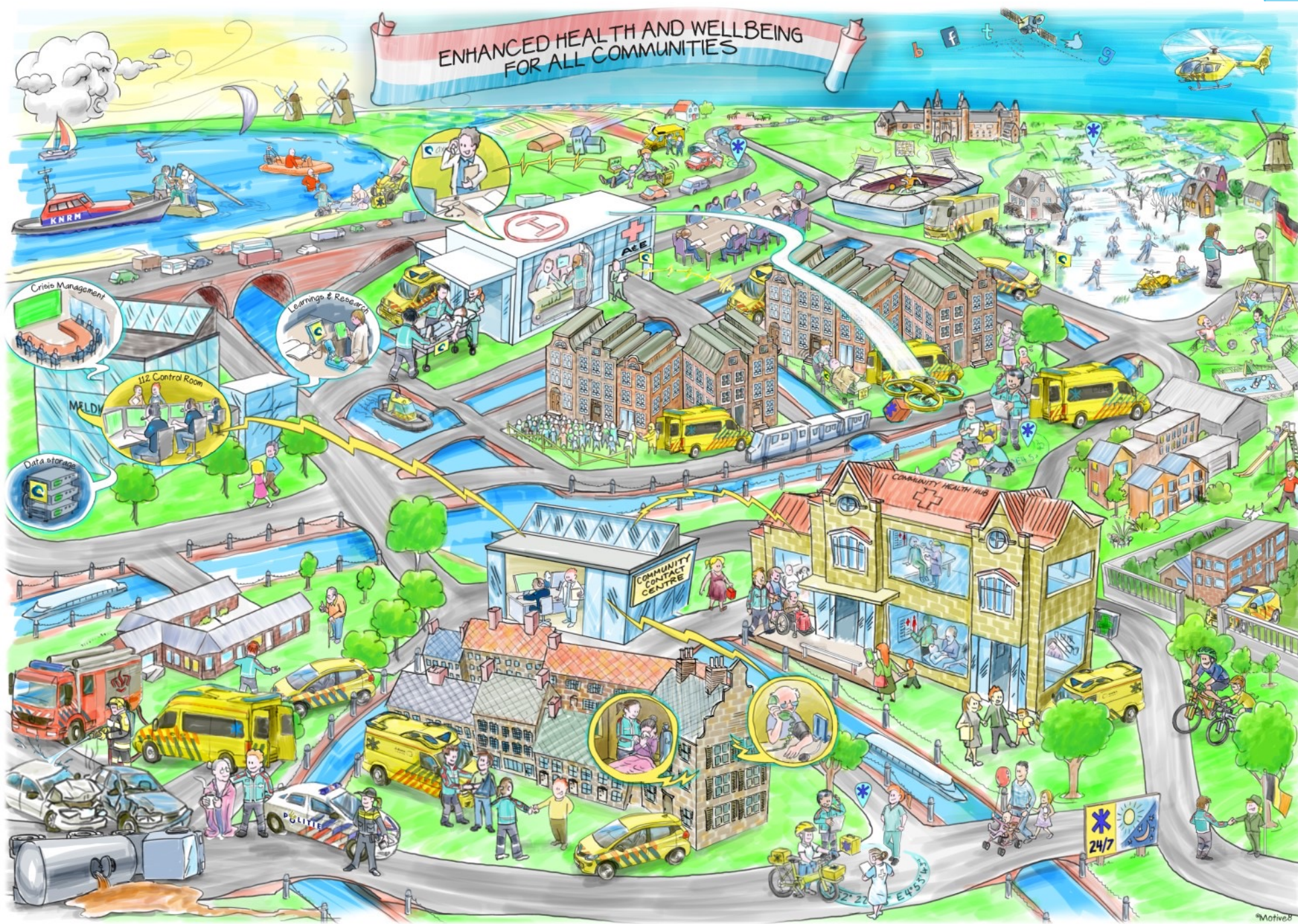


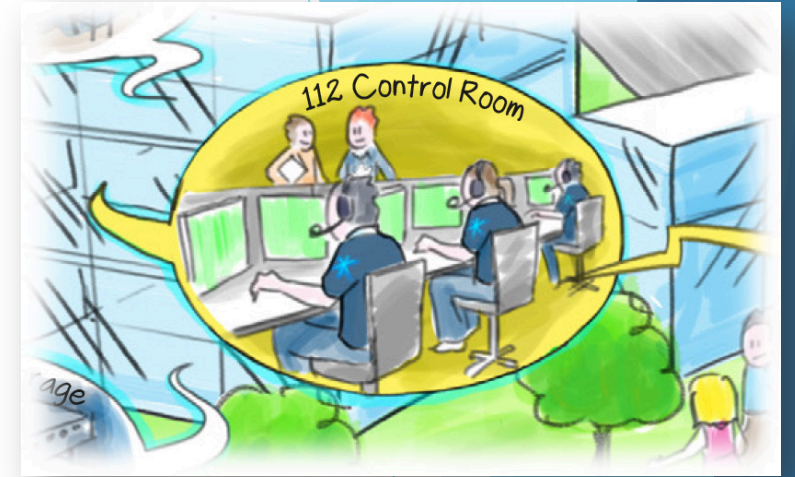
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ENHANCED HEALTH AND WELLBEING FOR ALL COMMUNITIES





On 1 January 2014 the **National Dispatch Centre Organization** [Landelijke Meldkamerorganisatie] (KLMO) began its work.

The National Dispatch Centre Organisation had what is called a multi-governance management board.

The KLMO prepared the ground for the new **national dispatch centre organisation**. From 2020 the 10 local dispatch centres will be merged.



Care coordination is the joint organization and coordination of acute care at regional level, 24/7, by the various health care providers.

It concerns all activities focused on directing, coordinating and monitoring the organization and performance of the care delivered to patients with acute care needs.

The common goal is for patients with acute care needs to receive the **right care** from the **right healthcare provider** at the **right time** and at the **right place**.

Improved urgency classification


The new urgency classification has seven instead of three urgency levels and distinguishes not only urgent and non-emergency ambulance care, but also control room care.

The aim of the new emergency classification is that in case of real emergency in life-threatening situations, in which time really matters (the new category A0, approximately 2-5% of the current number of emergency departments), to be with the patient faster and in where possible, to take a little more time for triage, so that the patient immediately ends up in the right place and receives the most appropriate care.

In the first months of the year, the AZN agency, together with the IG&H consultancy and Nivel, made preparations to further shape the implementation process.

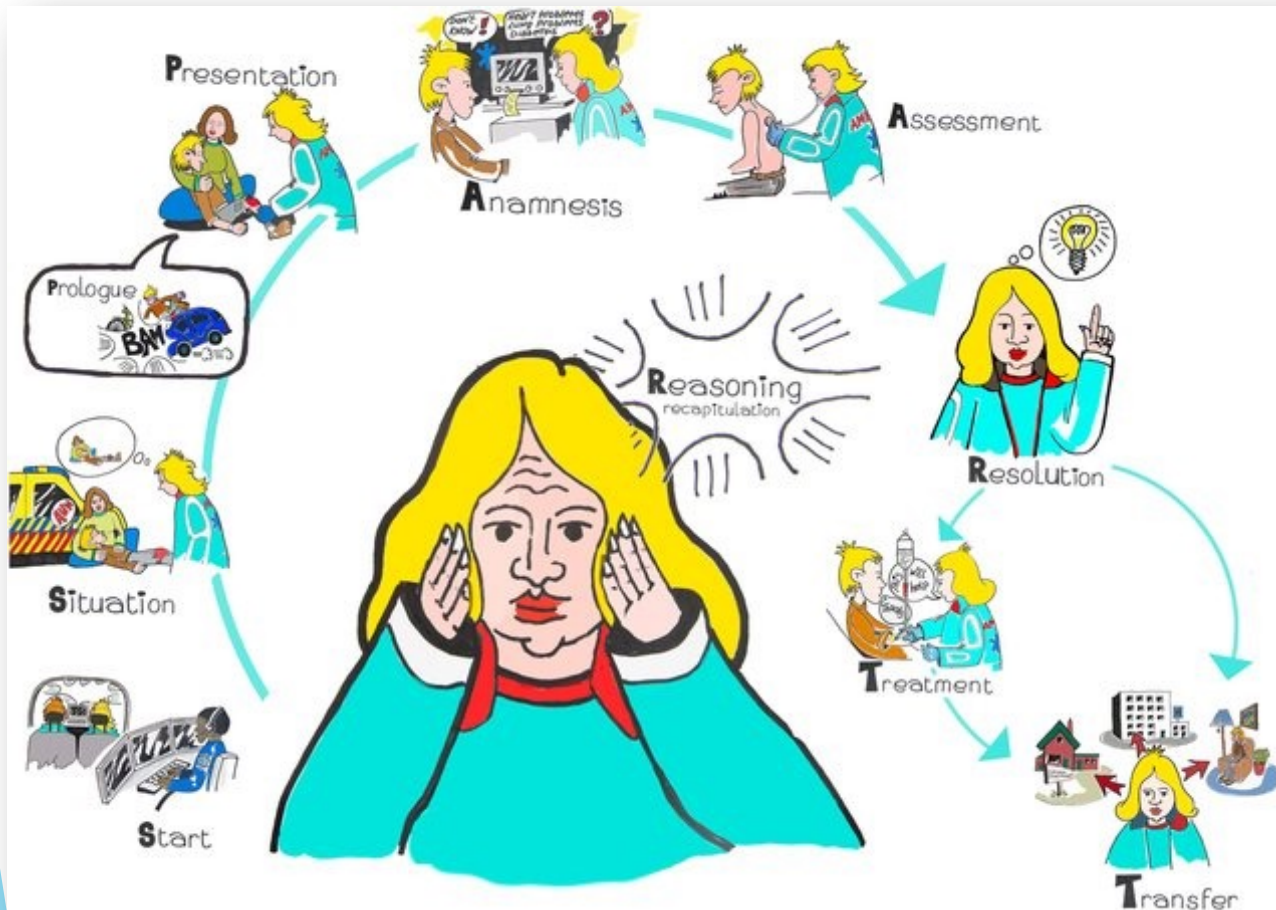
The implementation organization has been set up, theme working groups have been set up and each Regional Ambulance Service has an implementation coordinator.

The official kick-off of the implementation in the ambulance sector was on 30 March 2023.

	nieuwe of verbeterde urgentie-indeling ambulancezorg		vergelijking: huidige urgentie-indeling	vergelijking: HAP-NTS (benadering)
spoedeisende ambulancezorg	A0	directe inzet met grootst mogelijke spoed	A1	U0
	A1	directe inzet met spoed	A1	U1
	A2	zo spoedig mogelijke inzet	A2	U2
niet spoedeisende ambulancezorg	B1	gepland op bepaald tijdstip hoogcomplex	B	n.v.t.
	B2	gepland op bepaald tijdstip laag-/middencomplex	B	n.v.t.
meldkamerzorg	C1	doorverwijzing, eventueel met inzet zorgtaxi	informele meldkamerzorg	U3/U4
	C2	zelfzorgadvies	informele meldkamerzorg	U5

Triage MKA - A0 inzet NTS & AMPDS

AMPDS A0	NTS A0
alle codes vanuit overzichtsjijst A0: <ul style="list-style-type: none"> • 48 echo codes (10 groepen) • 42 delta codes (10 groepen) 	vanuit ABCD: <ul style="list-style-type: none"> • reanimatie • breathing (kortademig, ademt niet/nauwelijks)
context reden voor A0 (dispatch-driven)	context reden voor A0 (dispatch-driven)



SPART-model

Qualitative development and content validation of the “SPART” model; a focused ethnography study of observable diagnostic and therapeutic activities in the emergency medical services care process

Based on real-life observations, we were able to define and validate a model covering the distinct phases of an EMS deployment.

We have introduced the acronym “SPART” to describe ten different phases: Start, Situation, Prologue, Presentation, Anamnesis, Assessment, Reasoning, Resolution, Treatment, and Transfer





Heartbeat Now December 2022

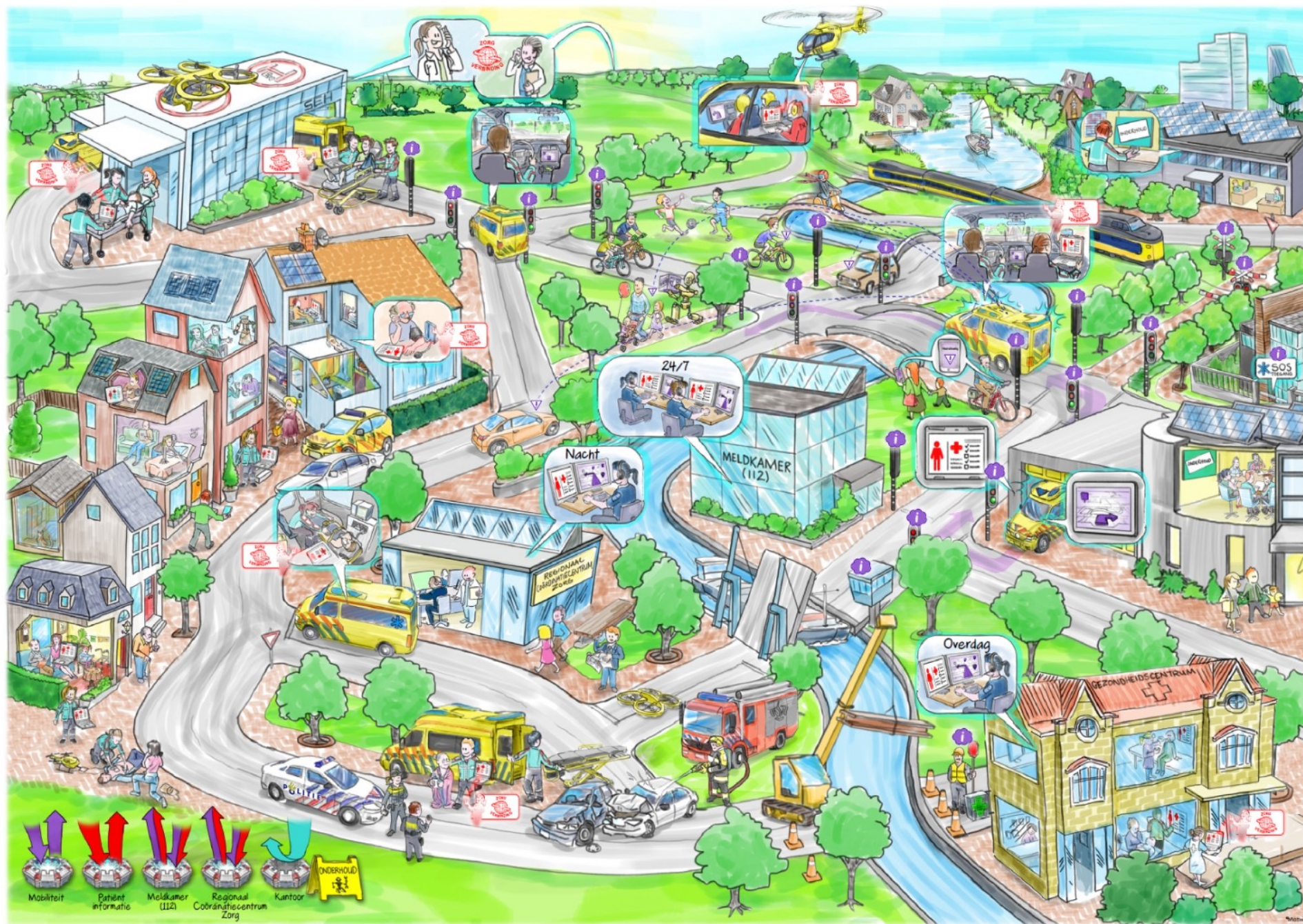
The Netherlands is the first country in the world with a national resuscitation network of civilian aid workers.

Civilian emergency responders are on average 2.5 minutes faster on the scene than an ambulance.

There has been a significant increase in the number of civilian aid workers in the past 4 years.

The number of AEDs has also increased enormously.







The Acute Care Directive

In acute care, it is vital that healthcare providers can view relevant medical data and information about a patient's acute situation at a glance.

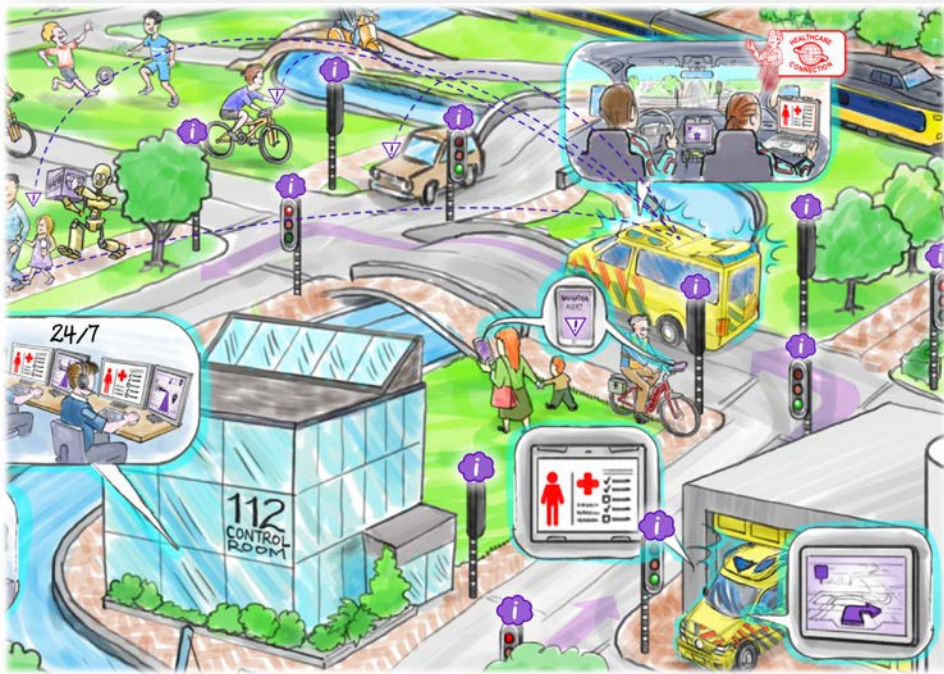
The Acute Care Directive describes which data are important to exchange digitally. Implementing the Acute Care Directive is an obligation for emergency care with a deadline of **August 2023**.



Electronic Data Exchange in Healthcare Act

This bill is aimed at achieving full interoperability in the electronic exchange of data between healthcare providers.

By making the electronic exchange of data **mandatory**, with the aim of **standardizing requirements for language and technology**, exchange can take place independently of a specific electronic infrastructure.



Talking Traffic

Thanks to this innovation, smart traffic lights (iVRIs) can give ambulances a green light, allowing them safe passage when driving through an intersection.

This is safer for both the ambulance team and the patient, and for other road users. They are also warned in time that an ambulance is approaching and can anticipate the situation.

At the end of October 2020, the decision was made to connect all ambulance regions to Talking Traffic via the national ICT systems of the sector.



SOS Toegang (Access)

SOS access is a very affordable low-threshold access system that allows emergency services such as access to your site.

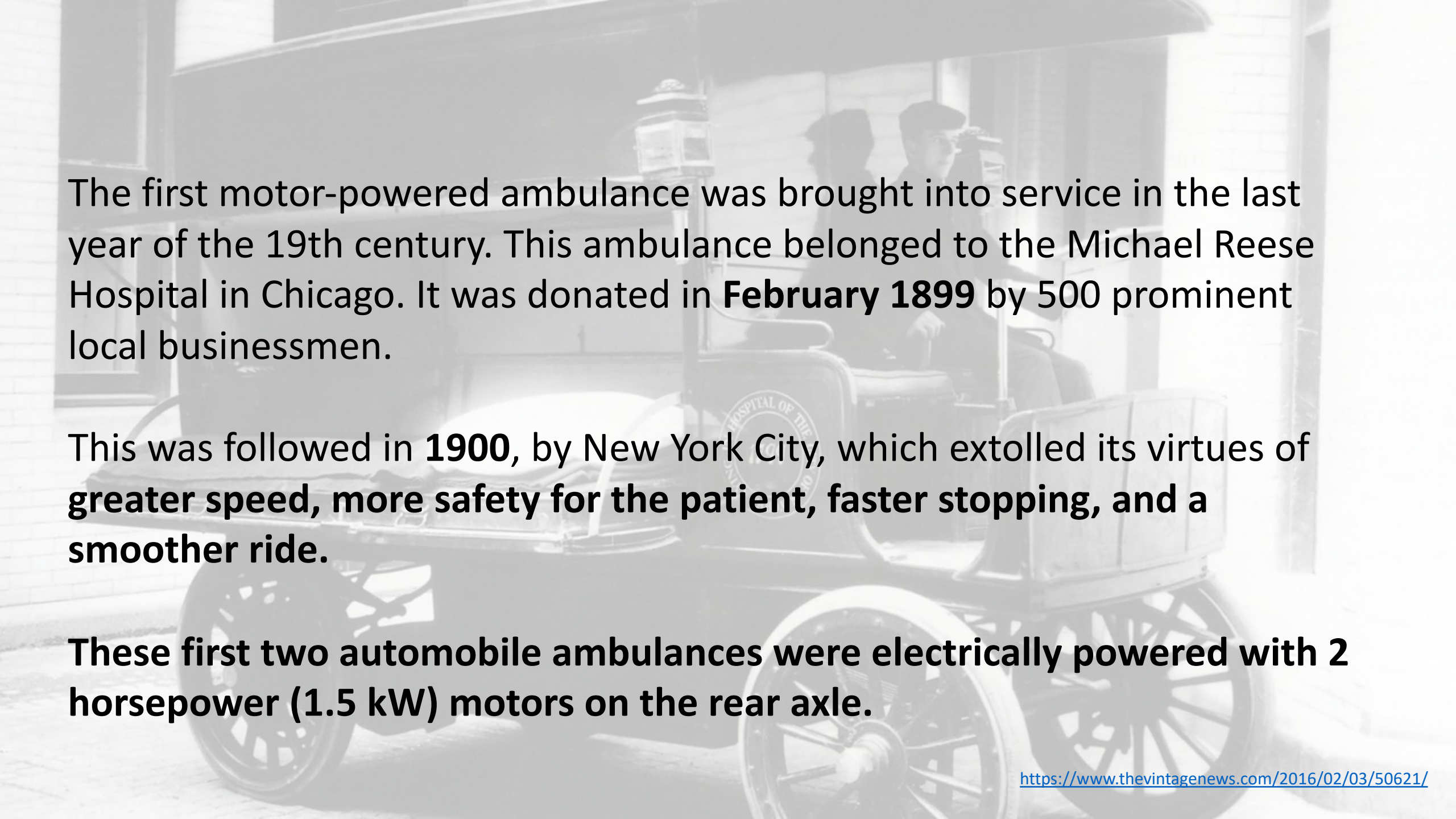
SOS access can be used in combination with all types of access systems such as gates, bollards, speed gates, barriers.

The receiver is built into a plastic housing and, due to its limited dimensions, can in many cases be built into the existing control box of the barrier, bollard, sliding gate, speedgate



000000

Zero from the grid
ambulance station

A vintage motor-powered ambulance, likely the one from Michael Reese Hospital in Chicago. It is a dark-colored vehicle with a canopy top, large spoked wheels, and a prominent front lamp. Two men are visible inside the vehicle, one in the driver's seat and another standing behind it. The vehicle is parked on a street in front of a building.

The first motor-powered ambulance was brought into service in the last year of the 19th century. This ambulance belonged to the Michael Reese Hospital in Chicago. It was donated in **February 1899** by 500 prominent local businessmen.

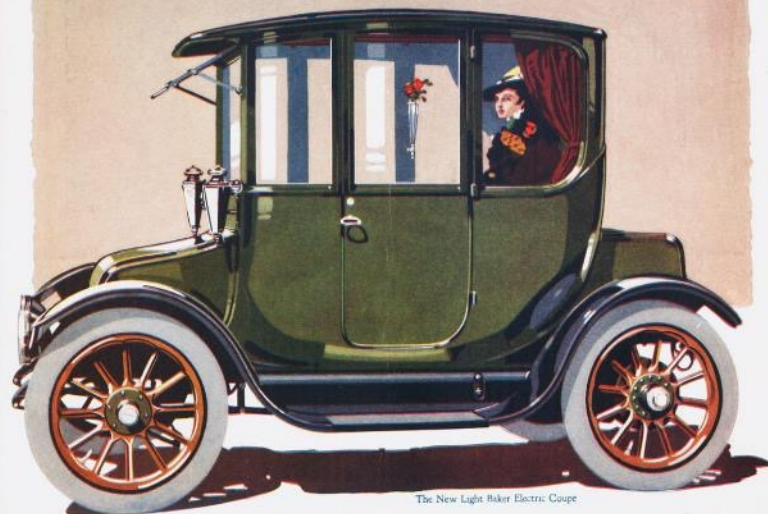
This was followed in **1900**, by New York City, which extolled its virtues of **greater speed, more safety for the patient, faster stopping, and a smoother ride.**

These first two automobile ambulances were electrically powered with 2 horsepower (1.5 kW) motors on the rear axle.

A LIGHT WEIGHT ELECTRIC OF THE VERY
HIGHEST QUALITY THAT WILL RUN AS FAR ON
A BATTERY CHARGE AS ANY OTHER ELECTRIC
AND AT BETTER SPEED IS CERTAINLY A NICER
CAR TO DRIVE THAN ANY OF THE BIG HEAVY
ELECTRICS THAT WEIGH A HALFTON MORE. THE
NEW LIGHT BAKER ELECTRIC COUPE IS THE ONLY
CAR MADE THAT ANSWERS THIS DESCRIPTION

THE BAKER MOTOR VEHICLE COMPANY CLEVELAND
BROUGHAMS · COUPES · ROADSTERS · COMMERCIAL TRUCKS

**Baker
Electrics**



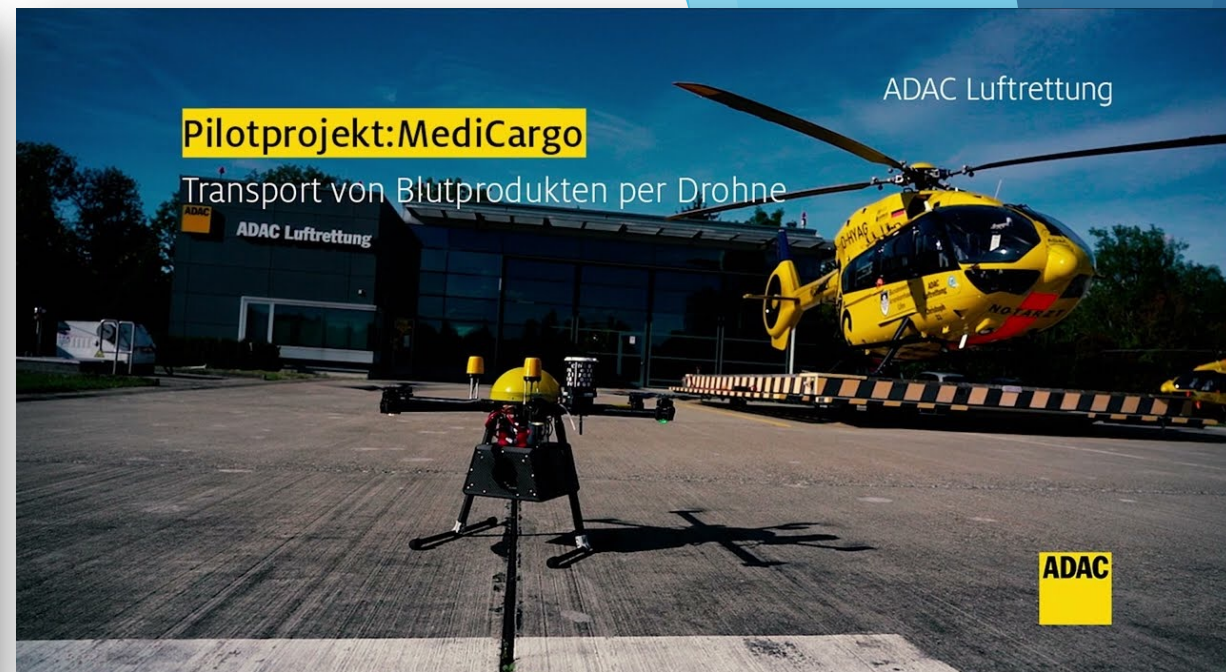
The New Light Baker Electric Coupe



My Baker Electric dates back nearly 100 years — and it's a late model. By then, the company had been selling electrics for more than a decade. Unlike other early cars, the Baker Electric needed no cranking, had no gasoline smell and was essentially maintenance-free.









CityAirbus NextGen

Safe, sustainable, and integrated urban air mobility

URBAN AIR MOBILITY

Certifiable to the highest safety standards according to the EASA SC-VTOL Enhanced category



Cruise speed of **120 km/h**



80 km operational range



Covering up to **95%** of highly requested journeys in and around cities

V-shaped tail

Fixed Wings

8 electrically powered propellers

4-seater aircraft

Sustainability



Noise-friendly design

- Below **65dB(A)** on flyover
- Below **70dB(A)** during landing



Zero-emission flight operations (CO₂, NO_x)





EVTOLS CAN REDUCE EMERGENCY RESPONSE TIMES

Theresa Degel explores the role of eVTOLs in improving the accessibility of EMS, in regions with poorer or congested road infrastructures and limited resources

Emergency medical services (EMS) play a crucial role in healthcare systems. Their main goal is to reduce mortality and morbidity during emergencies. Within the scope of EMS is providing adequate prehospital care, including the transportation of patients, physicians or urgent supplies. Thereby, an important performance measure is the response time of calls (i.e. the period between an incoming emergency call and the arrival of medical staff at the scene). In recent years, it has become increasingly difficult for EMS systems to meet strict performance requirements, since demand has increased

in many countries, due in part to ageing populations. Additionally, most EMS systems in developed countries encounter staff shortages. To maintain a high service level with limited resources, EMS systems must enhance productivity.

Electric vertical take-off and landing (eVTOLs) vehicles are a recent innovation in aviation, offering a novel means of transport for EMS systems (Figure 1). Those aircraft share the vertical take-off and landing capability with conventional helicopters, while using a distributed electric powertrain system. This has various advantages in terms of operational costs,

noise and sustainability when compared with helicopters. Hence, the implications may be significant for EMS systems.



Figure 1

Netherlands EMS transportation

An EMS provider in the north of the Netherlands researched the potential of eVTOLs to improve the performance of their existing EMS system. Most providers use ground ambulances and helicopters as primary modes of transport. Ground vehicles are flexible, inexpensive and widely used on land. However, their performance is highly dependent on road networks and traffic. Helicopters are operated under exceptional circumstances to reduce travel times in severe cases, or when the ground infrastructure does not allow vehicles. However, they are expensive to operate and cause high emissions in the form of noise and CO₂ pollution.

EMS in the Netherlands are operated by 25 regional ambulance services (RAVs).

More than 800 ground ambulances are in service at 240 locations, with over 6,500 employees. The system provides a variety of healthcare transportation services between two main uses: urgent (A) and planned (B) transport of patients. Urgent transports are further divided into life-threatening (A1) and not life-threatening (A2). Dutch law stipulates that response times for A1 and A2 calls must not exceed 15 and 30 minutes, respectively, for 95 per cent of calls.

In addition to the ground ambulance network, helicopters are stationed throughout the country. Four trauma helicopters are deployed in very severe cases, and one ambulance helicopter is used to transport patients from the Dutch islands to the mainland. The helicopter network operates in parallel to the ground ambulances – a hybrid system is not in operation.

Case study: Frisian Lakes

The Frisian Lakes area is a sparsely populated, rural region in the northwest of the Netherlands. The EMS system includes five evenly distributed ground stations. Four of these are equipped with one ambulance and one station (in Sneek) has two ambulances; the region becomes vulnerable

emergency services in the Frisian Lakes area has been inadequate, at around 90 per cent. This is due to the difficult geography (bridges and few highways), while demand has increased and staffing levels are short.

Extension of EMS network

In terms of transportation, there are three different options that can address response performance in the Frisian Lake area. Firstly, increasing the number of ground vehicles that can be added to the network. This boosts availability, but utilization could be low, so it might not be cost efficient. Secondly, a helicopter can take over some emergency calls to decrease response times when it is exceeded by ground ambulances. On one hand, this helps performance, but helicopters are costly and cause high CO₂ emissions and noise.

The third option is to consider eVTOLs as an alternative method of transport in the system, as they are not dependent on road networks and expected to travel at speeds comparable with conventional helicopters. Therefore, eVTOLs can lead to shorter response times than ground vehicles, especially in such cases where ground units have lengthy travel times and, additionally, eVTOLs are expected to produce fewer pollutants, powered



Figure 2

when one vehicle is occupied, since the area around it can barely be covered by another station within 15 minutes. As shown on the right-hand-side of Figure 2, the region is characterized by numerous lakes and water channels that severely affect the road network and make some parts difficult to access.

In recent years, the response time of

by an all-electric propulsion system – making the operation of these vehicles more convenient for communities.

Nevertheless, eVTOLs currently have a decisive disadvantage compared with helicopters: the capacity of the current generation of eVTOLs is not able to transport patients. Instead, eVTOLs would benefit EMS systems by bringing medical

staff to emergency locations faster, acting as doctor/paramedic shuttle. In cases where patient transportation is required, a ground vehicle would then have to be called for

In recent years, it has become increasingly difficult for EMS systems to meet strict performance requirements

support. In this rapid responder role, more patients can be reached within the mandated target response time, increasing the EMS performance. The crucial 15-minute coverage area of an eVTOL is significantly larger than the

one of ground ambulances, see Figure 3. This leads to the advantage that almost the entire Frisian Lakes area is covered twice. In this way, the eVTOL provides support to all ambulance stations when multiple incidents occur in the same area.

Simulation study
As eVTOLs have not yet entered the market, real-life experiments are not possible. Therefore, a simulation study was conducted to determine the value of an eVTOL in the current Frisian Lakes EMS system. The first step included building a simulation model of the current EMS network. It contains activities during the entire EMS process with corresponding time periods. Real-life input data of 2021 from the EMS system was used to validate the model.
Secondly, an eVTOL station was added in the middle of the area with the following specifications, as outlined in Table 1.
With only ground ambulances currently, the closest available vehicle is dispatched

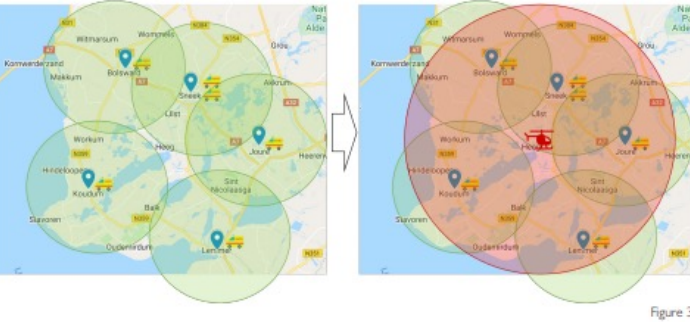


Figure 3

Table 1. eVTOL specification in simulation model

Number of eVTOLs	One
Average cruise speed of eVTOL	180km/h
Average take-off time	Two minutes
Average landing time at scene	Three minutes
Charging time (80 per cent)	15 minutes
Operation mode	Operation only during daylight hours
Bad weather conditions (where eVTOLs cannot take-off)	One per cent of cases



© Joby Aviation

to the emergency. To account for the possibility of sending different resources (ambulances or eVTOLs) to an incident, protocols had to be developed in the model: firstly, eVTOLs should be used when their expected response time is shorter than that of the nearest available vehicle; secondly, eVTOLs should only be dispatched if the expected response time of the closest available ambulance is higher than 12 minutes. In this way, the eVTOL is used only for long-distance missions, which leads to high availability and a decrease in lengthy response times.
To test the system and find the parameters with the highest impact, experiments were conducted. Data from all 2021 missions was used to run the experiments. All listed eVTOL specifications, as well as the location of its station and different dispatching rules, were experimental variables.
As an output parameter, the EMS performance level was measured: the percentage of emergencies that were served within a 15-minute response.

The aim of the system was to reach a performance level of 95 per cent.
Simulation results – EMS performance with eVTOLs
To assess whether eVTOLs are of value for the EMS system in the Frisian Lakes area,

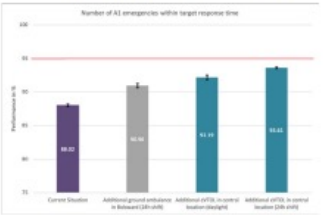
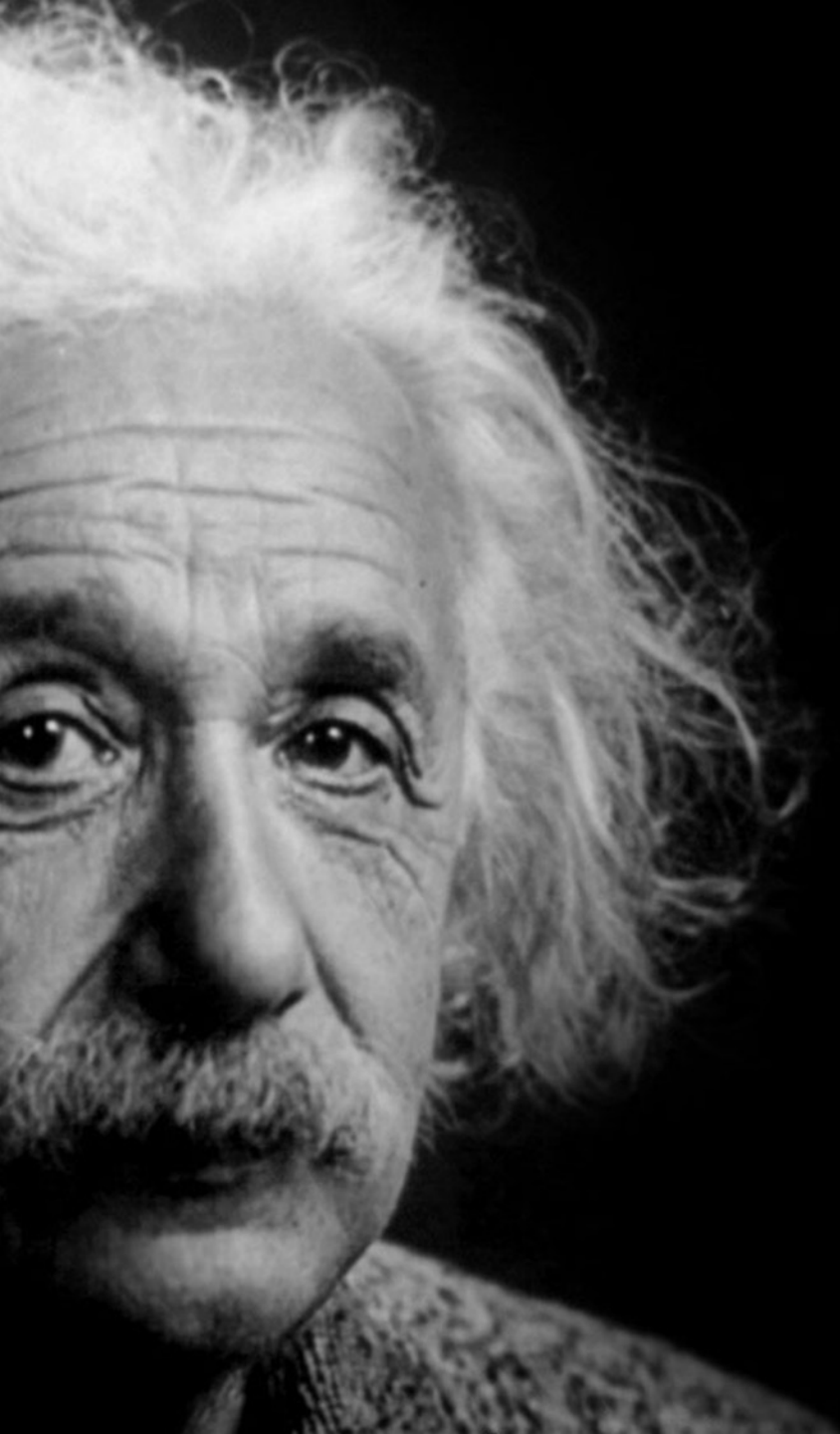


Figure 4

the performance level of different set-ups was measured and compared.
Figure 4 shows the current performance (data of 2021) and compares it with the situation with one additional ground ambulance (24hr shift), as well as the performance with an eVTOL (during

daylight and in a 24hr shift). It is clear to see that eVTOLs provide a higher value than additional ground vehicles. However, the target performance of 95 per cent still cannot be reached with the used eVTOL specifications. The performance increase is mainly limited by eVTOL transport capacity, as the follow-up transport of patients to hospitals must be supported through ground ambulances.
To identify the most influential parameters of the eVTOL operation, sensitivity analyses were conducted. Factors that directly relate to the response time of a call, such as the average cruise speed or the take-off and landing time, show high impact on the overall performance. When the average time for take-off or landing is reduced or the speed is increased, more emergencies can be served within 15 minutes, as the response time for eVTOL-operated calls decreases. On the other hand, poor weather conditions, charging times or the exact location of the eVTOL station have less impact on the network performance.
These results depend on many

assumptions and simplifications that had to be made to simulate the eVTOLs in EMS systems. For instance, eVTOL operation was assumed to be possible in terms of necessary infrastructure, regulations and personnel.
Future of eVTOLs in EMS
Hybrid systems with ground ambulances and air transportation via eVTOLs could help to overcome performance pressures on EMS systems. Especially in rural areas, eVTOLs can serve farther acute emergencies faster than ground ambulances, because they are not dependent on road infrastructure and can travel at high speeds. This leads to decreasing response times for the overall system. However, the performance increase is limited by the eVTOL transport capacity, as the follow-up transport of patients to hospitals must still be supported by the use of ground ambulances. Nevertheless, eVTOLs do show a higher performance increase when compared with additional ground units. ■



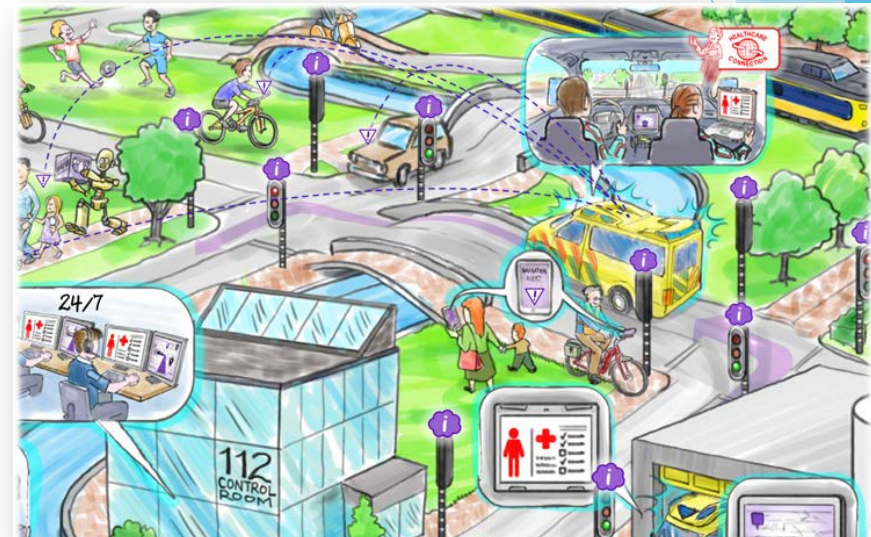
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Albert Einstein



David Hollingworth. Chair, Environment and Climate Change Committee Ambulance Paramedics of BC

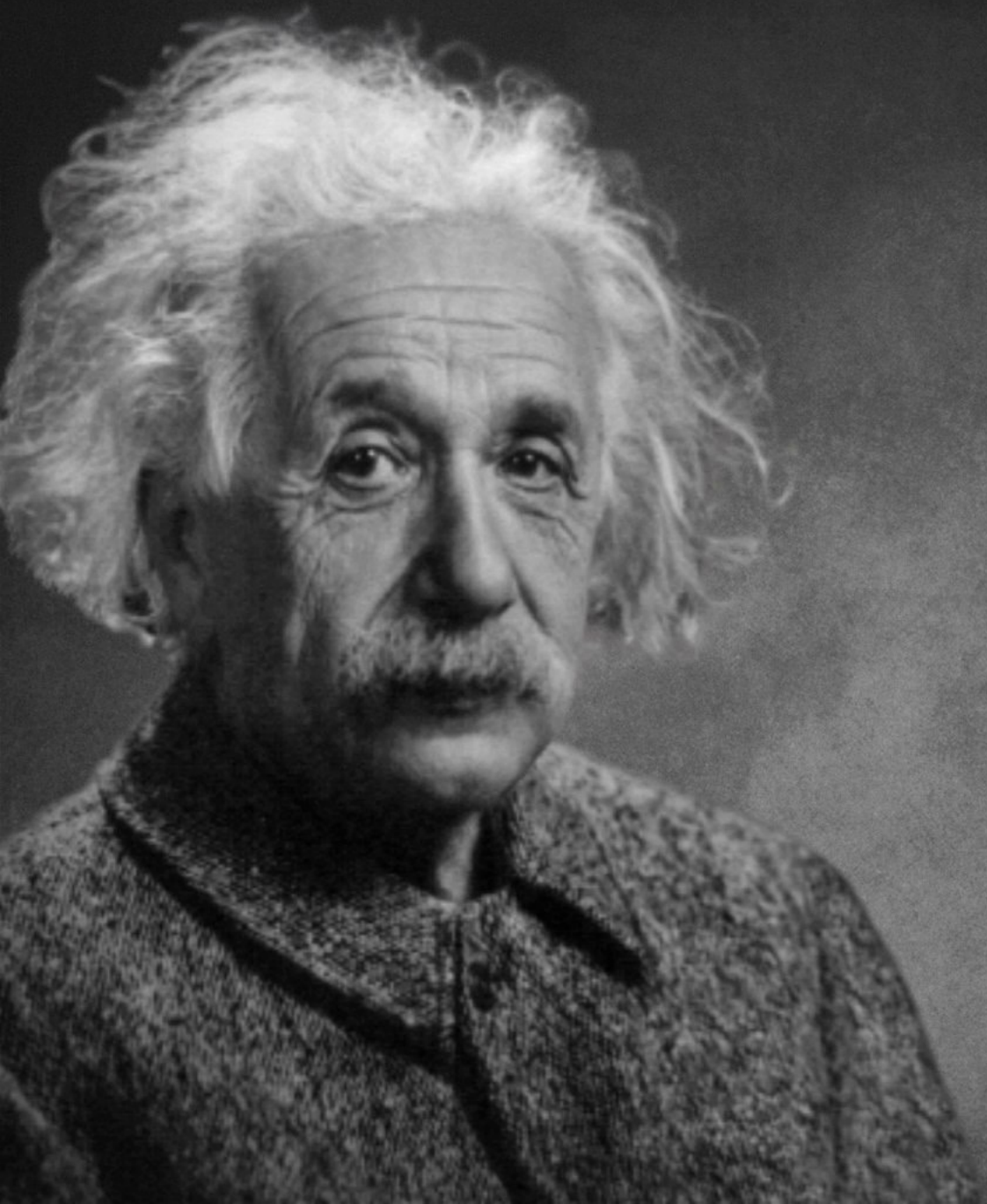




REAL
ENGINEERING

RWANDA BUILT A DRONE DELIVERY SERVICE





“Learn from yesterday, live for today, hope for tomorrow. The important thing is not to stop questioning”

Albert Einstein

1879-1955