

SUSTAINABLE HOSPITALS

Emergency Medical Services

WHITE PAPER



About this white paper

This white paper presents the Danish approach to a coherent Emergency Medical Service and includes a broad range of innovative solutions that contribute to providing life-saving emergency medical care to all citizens. It is part of a series of white papers that show how Danish solutions can contribute to increase efficiency in healthcare while empowering patients and staff.

Danish healthcare innovation is not exclusive for the Danes: many years of global presence show that our healthcare products and solutions create value internationally. Danish ideas and products are used every day in hospitals, medical clinics, ambulances, and nursing homes across the world.

We hope to inspire you and would like to invite you to Denmark to learn more about the Danish healthcare system.

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Executive summary

- **During the past few decades, Emergency Medical Services (EMS) have come to play an increasingly important role in the Danish healthcare system.**

The EMS has traditionally been regarded as a hospital 'support function', focused on ensuring safe and reliable transport from the scene of an emergency to the nearest hospital. Today, it offers high-quality prehospital care by specialized professionals and is tightly integrated with other healthcare services.

This white paper presents some of the key features of Denmark's EMS system, focusing on the transformation it has undergone in recent decades. It also describes some of the considerations and concerns that have shaped these changes – and remain in focus as the EMS continues to evolve.

Treatment begins in the ambulance

Today, emergency medical services provide much more than a means of transport and basic treatment of symptoms. Technological advances and enhanced skill levels of emergency staff allow for highly specialized treatment to begin at the scene of an emergency and continue during transport.

Emergency Medical Technicians (EMTs) and paramedics will often provide help, which would traditionally be considered 'hospital treatment'. Data analysis, telemedicine, and point-of-care technologies have become an integrated part of ambulance treatment.

Ambulance services are also supplemented by a number of other specialized emergency units. In the case of a life-threatening emergency, a physician-staffed Mobile Critical Care Unit (MCCU) will usually be dispatched. For time-critical emergencies the dispatch center can deploy the Helicopter Emergency Medical Services (HEMS). Other units are specialized in handling emergencies that involve infants, psychiatric patients or socially vulnerable citizens.

At the same time, digital technologies have made it possible to improve communication immensely, supporting seamless coordination and cooperation between ambulance staff, emergency departments, and hospital units.

Modern ambulance equipment ensures seamless communication, including real-time transmission of data between ambulances and hospital departments. This allows emergency medical staff, both in the ambulance and at the receiving hospital, to make the best possible use of data from hospital and prehospital patient records and from tests performed during transport. It ensures optimal patient treatment, both during transport and upon arrival at the hospital.

Mobilizing citizens has tripled survival rates

In many emergency situations, time is of critical importance. For a citizen suffering from cardiac arrest, for instance, survival chances will often depend on the actions of bystanders before medical staff arrives. This fact has triggered a nationwide effort to encourage and educate citizens to handle emergencies.

In 2005, Denmark launched a national program to train citizens in performing Cardiopulmonary Resuscitation (CPR). At the same time, about 19,000 Automated External Defibrillators (AED) – one for every 300 citizens – have been installed and registered, making them accessible to both healthcare professionals and citizens.

The results have been remarkable. Since 2001, citizen participation in CPR has increased from 19 percent to 67 percent, and survival rates have tripled.

Developing EMS for the future

This white paper describes some of the innovative solutions that the Danish healthcare sector has employed to increase the chance of successful outcomes in emergency situations.

But the EMS is constantly exploring new ways to further improve emergency care – in close collaboration with hospitals, municipalities and private companies as well as individual patients, their families, and the community.



• Ellen Trane Nørby
MINISTER FOR HEALTH

"All citizens in Denmark must feel secure and have access to the help they need in the event of an accident or acute illness. In many cases, it is a matter of life and death. This is why we maintain a high level of specialized prehospital care in emergency medical services (EMS)."

Foreword

"All citizens in Denmark must feel secure and have access to the help they need in the event of an accident or acute illness. In many cases, it is a matter of life and death. This is why we maintain a high level of specialized prehospital care in emergency medical services (EMS)."

Ellen Trane Nørby, Minister for Health

The sooner treatment is initiated, the better the chances of survival. Be it a myocardial infarct, a stroke or a serious accident, time is a crucial factor. This is why our ambulances are considered a crucial part of a comprehensive emergency effort outside the hospital. Staffed with paramedics and emergency medical technicians who are trained to deal with life-threatening illness and injuries, ambulances are the first to arrive on the scene. Along with well-equipped emergency vehicles and helicopter emergency medical services, they provide crucial help. More than 9 out of 10 ambulances arrive within 15 minutes, which is fast – but not always fast enough. If someone suffers a cardiac arrest, every minute counts. This is why Cardiopulmonary Resuscitation (CPR)

plays a crucial role. A national effort to train and encourage citizens to perform CPR has increased the chances of surviving a cardiac arrest immensely.

In Denmark, the distance between the scene of an emergency and the nearest hospital is not as important as it once was. Today, treatment is initiated as soon as the emergency staff arrives at the scene, by ambulance or helicopter, and continues on the way to the nearest emergency ward or specialized hospital department. Our innovative prehospital patient record system enables prehospital data to be transferred automatically to the hospital. This allows our doctors and nurses to prepare for the patient's continued treatment even before the ambulance arrives at the hospital.

Data analysis, telemedicine, and point-of-care technologies have become an integrated part of prehospital care, often co-developed with private partners. Denmark is also a front-runner when it comes to diagnosing heart conditions in the ambulance. This allows patients with suspected acute coronary syndrome to be transported directly to a specialized heart center.

A core value in Danish healthcare is free and

equal access to emergency medical services – irrespective of where you live, who you are, or what you earn. But even though Denmark is a relatively small country and new technologies enable us to improve prehospital care in our ambulances, it remains a challenge to ensure emergency services in remote areas far from hospitals.

In recent years, we have improved the EMS in a number of ways. Initiatives such as volunteer first responders, heart runners and a nationwide network of publically accessible defibrillators have created remarkable results. For instance, Denmark has doubled survival rates for out-of-hospital cardiac arrest during the last two decades.

But our efforts to improve the EMS do not stop here. In 2018, Denmark has already prioritized resources for a fourth emergency medical helicopter and introduced emergency medicine as a new specialty in the education of doctors. Going forward, we will continue to introduce new initiatives that strengthen prehospital care.

Ellen Trane Nørby

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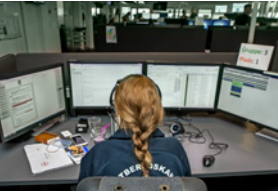



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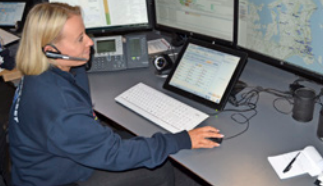



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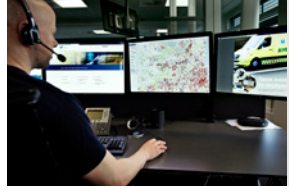


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It takes a system to save lives

Emergencies require fast and resolute action from both citizens and healthcare professionals. But the success of these efforts ultimately depends on an effective emergency management system. Over the past few decades, Denmark has built a healthcare system where Emergency Medical Services play an important role.

Denmark's Emergency Medical Services (EMS) have changed substantially during the last two decades. Traditionally, the EMS was focused on safe and comfortable transport to the nearest hospital. Today, the EMS provides highly specialized prehospital care and is increasingly integrated with other healthcare services.

The Emergency Medical Dispatch Center is the 'gatekeeper' to emergency care, providing citizens with instructions to begin care, such as telephone-assisted CPR, until healthcare professionals arrive. It is also an important

clinical hub, which identifies, prioritizes and dispatches the right resources.

It ensures effective coordination and seamless cooperation between the dispatch center, the ambulance services, and the emergency department.

The chain of survival

Critical emergencies trigger a 'chain of survival', which includes a number of time-sensitive, coordinated steps that need to be taken to establish the best possible chance of success. If even one link is weak or missing, the chances of survival are significantly reduced. Therefore, Denmark uses new, innovative, potentially life-saving approaches to save critical time in emergencies.

Picture a man collapsing in central Copenhagen due to cardiac arrest. A bystander, who is also a 'heart runner', is alerted through a smartphone application and rushes to the man to begin resuscitation efforts as quickly

as possible. The bystander is in contact with the EMS dispatch center the whole time. The EMS dispatches an emergency physician and a paramedic while guiding the bystander until the emergency team arrives.

When the physician and the paramedic arrive, they provide advanced life support and rush the patient to the emergency department for treatment.

Everyone in this 'chain of survival' can take pride in saving the man's life. But it was made possible by a well-coordinated system that supports life-saving actions and links the individual efforts of the multiple people and departments involved.

Building on Denmark's strengths

The transformation of the EMS in Denmark reflects a general shift in healthcare delivery nationwide – namely the concentration of medical care at fewer, highly specialized hospitals and emergency departments.



Denmark and the Danish healthcare system

- Denmark has a population of about 5.8 million people and an area of 43,094 km².
- The Danish healthcare system is a public system, based on the principle of equal and free access to healthcare for all citizens. The majority of the Danish healthcare services are financed by taxes.

The Danish healthcare system operates on three levels:

- National level. The Parliament and the Government set the regulatory framework.
- Regional level. Five regions are responsible for operating the hospitals in their respective geographies.
- Local level. 98 municipalities are responsible for population health, prevention initiatives, rehabilitation, home care, and elderly care.

Danish Emergency Medical Services

The Danish prehospital services encompass a number of cross-disciplinary emergency functions, collectively referred to as the EMS. These functions include:

- Emergency Medical Dispatch Centers (112)
- Dispatch and control centers for ambulances and Helicopter Emergency Medical Services (HEMS)
- Mobile critical care units (MCCU)
- Medical call centers for referral and admission to emergency departments, admission to hospitals, and medical advice services for all citizens.
- Out-of-hours primary care services, including home visits by physicians.
- Prehospital psychiatric care units.

In 2017, there were:

- 1.7 million acute cases in Danish hospitals
- more than 3 million calls to regional medical helplines
- over 700,000 ambulance and hospitalized transports

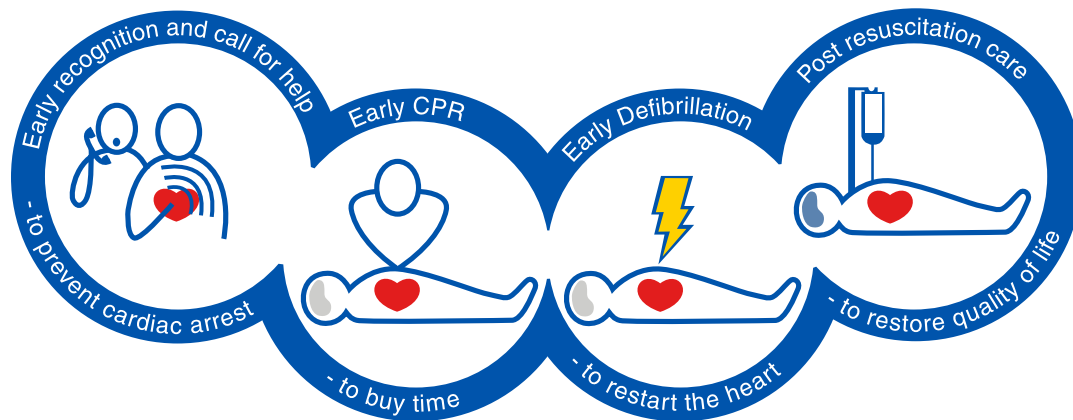
This new hospital landscape has paved the way for a new emergency structure, which reduces the number of emergency departments from 40 to 21. The new joint emergency departments will ensure that all citizens get the same high-quality treatment.

Due to demographic changes and the increasing prevalence of lifestyle diseases and chronic conditions, Denmark has had an increased focus on data-driven and evidence-based solutions that enhance the quality of prehospital treatment.

Denmark has the advantage of being a highly digitalized country. Public institutions are generally fast movers when it comes to exploring new digital possibilities, and citizens tend to embrace digital solutions and integrate them effortlessly into their everyday lives.

The unique Danish Personal Identification Number, which was introduced in 1968, further supports the ambitious approach to digitalizing the EMS.

A uniform prehospital system across the country ensures that experience and data gathered over many years are drawn upon to determine the best possible solution for each patient.



• The chain of survival.

Cooperation and coordination

- To handle emergencies successfully, the EMS must ensure a swift, efficient and coordinated response.

One day, 1-year old Elvira choked on a piece of apple; she could not breathe and had a sudden cardiac arrest.

Luckily, she was with her nanny, Lærke, a brave girl in her twenties, who immediately realized that this was an emergency and dialed 112. At the medical dispatch center, a nurse instructed Lærke to perform CPR, guiding her continually over the phone until the arrival of the ambulance and a critical-care physician. The emergency staff continued CPR on the way to the hospital, where a team of specialists, who had already been alerted in advance, took over Elvira's treatment.

Elvira's life was saved by a highly efficient EMS system where emergency medical technicians and paramedics collaborate closely with critical care physicians in a highly coordinated effort.

In serious or life-threatening emergencies such as this, a physician-staffed Mobile Critical Care Unit (MCCU) will often be dispatched simultaneously with the ambulance, meeting it at the patient's location. Close cooperation and interaction is essential: The ambulance staff must reach the patient quickly and initiate the proper treatment or tests until the MCCU arrives.

Today, Elvira is a fun-loving 8-year old girl with a passion for stuffed animals.

“...They can initiate high-quality intensive care therapy as well as minor, but often life-saving surgical procedures on location.”



Bringing the hospital to the patient

The Danish ambulance service is supplemented by a Mobile Critical Care Unit and a number of other emergency units, providing urgent care for infants, psychiatric patients and other groups who need highly specialized treatment.

Ambulances are the backbone of Denmark’s EMS system. They respond to a variety of calls, many of which are serious or life-threatening. They provide urgent care and transport for the sick and injured until they reach the hospital. More than 9 out of 10 ambulances arrive within 15 minutes.

Ambulances are staffed with paramedics and emergency medical technicians trained to deal with life-threatening illnesses and injuries. Prehospital physicians can perform invasive procedures, which may be required in serious medical emergencies.

Several specialized and innovative rapid response units supplement the ambulance service, providing medical expertise at the scene of the emergency.

In serious or life-threatening emergencies, a Mobile Critical Care Unit (MCCU) staffed with physicians and/or paramedics is dispatched simultaneously with the ambulance, meeting it at the patient’s location. The MCCU also functions as a transfer-and-retrieval service for critically ill patients, who need to be transferred between hospitals.

“Our specialized medical teams bring the hospital to the patient.”

“Our specialized medical teams bring the hospital to the patient. They can initiate high-quality intensive care therapy as well as minor, but often life-saving surgical procedures on location.”

- Dr. Peter Anthony Berlac, Medical Director at Emergency Medical Services Copenhagen

In larger urban areas, the MCCU is supplemented by a number of additional specialized units:

- A psychiatrist-staffed MCCU responds to mental health emergencies. The consultant psychiatrist provides qualified emergency mental healthcare on the scene or by phone and ensures that citizens with serious mental health issues get the expert emergency help they need ‘out-of-hours’.
- The Sociolance is staffed with a social worker and a paramedic. The unit operates in the city center, helping homeless, socially marginalized, or otherwise vulnerable citizens in need of urgent social care.
- The Babyulance is a specialized neonatal retrieval unit staffed with a paramedic and a neonatal doctor-nurse retrieval team. Its design allows the baby and the family to be transported safely in the same vehicle.
- In mass casualty incidents, EMS Copenhagen can deploy two Mobile Treatment Areas, providing a safe environment for up to 80 casualties at a time and optimal working conditions for front-line staff. The units also provide excellent medical facilities for large-scale planned events such as festivals or marathons.



Helicopters ensure equal access to healthcare

- Helicopter Emergency Medical Services enable equal access to healthcare across the country and rapid transport to specialized care facilities.

Quick visitation and transportation is a key element in a new emergency response system with fewer emergency departments. The Helicopter Emergency Medical Services (HEMS) have become an important part of Denmark’s emergency care for critically-ill patients, enabling equal access to high-quality treatment for all citizens.

The Emergency Dispatch Centers will send helicopters along with ambulances and MCCUs in time-critical emergencies, i.e. when urgent medical care is needed on location, or when flying the patient to a highly specialized hospital can save critical time.

Facts

- Denmark’s five regions share four helicopters under a joint emergency management system.
- In 2017, the helicopters were dispatched 3,658 times.
- The HEMS operates day and night, all year round.

This ensures equal access to healthcare in remote and/or sparsely populated parts of the country, where the nearest hospital for specialized care might be far away.

“Helicopters ensure access to specialized treatment, no matter where you live, and thereby support equality in healthcare.”

For instance, if a citizen in Western Denmark collapses from acute coronary syndrome and needs treatment in one of the large university hospitals, a helicopter can make a lifesaving difference.

“It is important, that patients in all parts of Denmark can receive immediate care in time-critical cases such as a stroke or acute coronary syndrome. Helicopters ensure access to specialized treatment, no matter where you live, and thereby support equality in healthcare.”
– Svend Hartling, Chairman of the National Emergency Medical Helicopter Organization.

1813: A gateway to urgent medical help

● In the Capital Region of Denmark, the Medical Helpline (1813) and the EMS (112) collaborate in a fully digitalized dispatch center. Doctors and nurses help citizens who have become acutely ill or suffered an accident.

A father dials 1813 because his child has a high fever. At the same time, a husband calls the emergency medical service 112 because his wife has been in an accident and is not breathing.

Both calls are answered by doctors, nurses, and paramedics at the EMS Copenhagen. The nurses receive special training in order to ensure a high level of expertise and skills when answering emergency calls. Since 2014, when the Medical Helpline was set up, healthcare professionals have been collaborating and coordinating the triage: The Medical Helpline and the Emergency Medical Service can direct calls from one unit to another in order to clarify

the patient's need for help and determine the proper course of action. If a patient's situation becomes more severe (or improves), the level of help can be adjusted in order to prioritize resources in the best possible way.

“The Medical Helpline 1813 provides important and accessible help to citizens who feel ill or have minor injuries.”

“The Medical Helpline 1813 provides important and accessible help to citizens who feel ill or have minor injuries. Healthcare professionals will find the right response; sending an ambulance, referring to a doctor or sometimes just recommending that the patient stay at home and get some rest.”

– Freddy Lippert, CEO at the Emergency Medical Services Copenhagen.

Facts

- The Medical Helpline is part of the public health system and is free of charge.
- It provides acute help when GPs are unavailable; from 4 p.m. until 8 a.m., during weekends and public holidays.
- It covers 1.8 million citizens in the Capital Region of Denmark, including the remote island of Bornholm, and takes 1 million calls per year.
- From 2019, a new national emergency number (113) will include the services of the Medical Helpline.





Artificial intelligence helps medical dispatchers identify cardiac arrest patients

- In Copenhagen, the EMS has applied artificial intelligence to recognize cardiac arrest and support real-time decision making at the dispatch center.

When a person collapses from cardiac arrest, it is critical to quickly identify and diagnose the cardiac arrest in order to provide the correct emergency service. However, it can be difficult for a bystander to identify

the severity of the situation. One time out of three, the bystander has not identified the cardiac arrest at the time of the call to the emergency medical services. Bystanders often mistake cardiac arrest for other conditions or misinterpret the patient's condition and breathing.

In Copenhagen, the EMS has taken a unique approach to increase the recognition of cardiac arrests. An innovative device based

on artificial intelligence is trained to identify cardiac arrest from the ongoing calls to 112. By analyzing the call, 'listening' for patterns in the dialogue referring to cardiac arrest, it can alert the medical dispatcher who is handling the call. When analyzing the call in real-time, the solution compares the ongoing call to the history of calls and calculates the probability of a cardiac arrest.

Currently, the artificial intelligence solution can correctly identify approximately 85 percent of cardiac arrests – compared to approximately 75 percent recognized by medical dispatchers. This translates into 150 more patients now being recognized prior to the ambulance arriving.

The artificial intelligence solution has been developed in a cooperation between EMS Copenhagen and the Danish company, Corti.

Facts

- Artificial Intelligence can support the decision-making process for the dispatchers.
- The solution has been trained on more than 100,000 calls.
- A randomized clinical trial using artificial intelligence began in September 2018.
- Artificial intelligence can also play an important role as a decision support tool for medical dispatchers, in other time-critical conditions such as a stroke, acute myocardial infarct or sepsis.



The first emergency room is in the ambulance

● In the past, ambulances were mainly regarded as emergency transport to a hospital. Today, they are considered the first part of a comprehensive emergency effort outside the hospital.

In Denmark, the distance between the scene of an emergency and the nearest hospital is not as important as it once was. Highly specialized ambulance staff, adequately equipped emergency vehicles and the availability of helicopter emergency medical services mean that treatment will often begin at the scene and continue during transportation.

At the same time, technological advances have improved communication between ambulances and hospitals. This enables doctors and nurses to continue appropriate treat-

ment as soon as the ambulance arrives at the hospital.

“Data analysis, telemedicine, and point-of-care technologies have become an integrated part of ambulance treatment”

The visitation at the dispatch center is followed by a healthcare evaluation and visitation in the patient’s own home in order for the patient to be either fully treated or transported to the right treatment facility as early as possible.

The systematic use of protocols, increased skill levels of ambulance staff and new tele-

medicine solutions have made it easier to initiate correct medical treatment as soon as possible. Emergency Medical Technicians (EMTs) and paramedics will often be able to provide help, which would traditionally be considered ‘hospital treatment’.

Today, ambulance staff provides much more than a means of transport and basic treatment of symptoms. Data analysis, telemedicine, and point-of-care technologies have become an integrated part of ambulance treatment, making EMS professionals ‘the extended arm’ of the hospital. Screening and diagnostics can take place in the ambulance itself, which is significant as it allows the paramedics to transport the patient directly to a specialized hospital.

Electronic patient records in Danish ambulances

● All ambulances in Denmark use prehospital records, collecting and storing data in one central database. Denmark's unique collection of prehospital data has improved cooperation and coordination between ambulances and hospitals.

In serious emergencies, quick initial treatment at the scene is crucial. But the patient's prospects of recovering, or even surviving, also rely on the quality and accuracy of the prehospital documentation and information given to the emergency department when the patient is admitted.

Denmark has an innovative prehospital record system, developed by amPHI Systems, which automatically transfers crucial prehospital data directly to the hospital's electronic records. This enables doctors and nurses to prepare for the patient's continued treatment even before the ambulance arrives at the hospital. Similarly, the EMS system has access to the patient's medical history to ensure the optimal treatment of the patient on site and in the ambulance.

All ambulances are equipped with a touch-screen computer, and patient information is transmitted between the ambulance and the emergency department through the mobile network.

Pioneer work in the North Denmark Region has created the basis for a comprehensive national solution across all formal, publicly funded prehospital systems in Denmark's five regions.

The prehospital record gives a unique opportunity to collect data for prehospital research. It is now possible to follow a group of patients with specific symptoms, from the first call to 112 until the ambulance arrives at the address. The data includes symptoms, treatment provided by the EMTs, and vital indicators registered on arrival at the hospital.

"The national prehospital record system has been and still is a unifying factor in the Danish EMS system and may today be regarded as a unique tool for ongoing improvements to EMS, knowledge sharing, research, supervision and training of paramedics."

– Peter Larsen, CEO, MSc, Emergency Medical Services, North Denmark Region.

A public-private innovation partnership

The amPHI solution stems from a public-private partnership between the North Denmark Region and a small group of private Danish companies. Judex, an IT company specializing in healthcare, has delivered the software and the technical setup, while Falck Ambulance provided knowledge and experience on optimizing interaction and registration in the ambulances. The North Denmark Region is responsible for the server setup and the workflow in the emergency department.

The solution is being continuously developed and improved to ensure integration with other systems, point-of-care devices, and logistics systems and to optimize the transfer of live data.





Heart patients are diagnosed in the ambulance

● Denmark is a front-runner in the treatment of acute coronary syndrome (ACS). As part of a national research project, patients with suspected ACS are transported directly to a specialized heart center instead of the local hospital.

If an emergency patient complains about chest pains, ambulance staff will prepare an electrocardiogram (ECG) and perform a blood test in order to detect possible acute coronary syndrome at an early stage.

As the first country in the world, Denmark has extensively researched the use of devices that can measure the levels of cardiac biomarkers from a blood sample. While major coronary infarctions will often be revealed by an ECG, this is not always the case with minor ones. But elevated levels of cardiac biomarkers will often indicate a high probability of ACS.

In the case of high ACS risk, the patient will be transported directly to a specialized heart center.

"...patients are diagnosed faster, and treatment such as percutaneous coronary intervention can be performed at an early stage. On average, ACS patients diagnosed in the ambulance are discharged two days earlier from the hospital."

"With the combination of blood tests and ECG, we detect far more instances of increased ACS risk in the ambulance. This

means that patients are diagnosed faster, and treatment such as percutaneous coronary intervention can be performed at an early stage. On average, ACS patients diagnosed in the ambulance are discharged two days earlier from the hospital."

- Christian Juhl Terkelsen, MD, DmSc, PhD, Associate Professor, Aarhus University Hospital, Department of Cardiology, Central Denmark Region.

The procedure is an example of a 'Point of Care Test' introduced to assure that the patient is given the appropriate treatment as early as possible.

Based on favorable results in clinical trials, it is expected to be introduced in all Danish regions.



Ensuring optimal care for stroke patients

- **The Danish healthcare system focuses on prompt and systematic screening of stroke patients in the ambulance to ensure that they receive qualified care immediately.**

Rapid diagnosis of stroke patients is often critical to their survival and future mobility. Detecting the location of a blood clot and assessing the severity of the patient's condition will allow for subsequent visitation to the relevant specialized hospital department.

Therefore, the five Danish Regions and the Danish Health Authority have initiated a national effort to improve the quality of care for stroke patients. In close collaboration with professional experts, they have developed a joint national model for screening in ambulances.

"With a joint national tool for screening of stroke, we can ensure fast and correct visita-

tion and treatment. This will save the life and mobility of many patients."

- Per Sabro Nielsen, Ph.D, MPM, Medical Director, Emergency Medical Services, Central Denmark Region.

Correct visitation is critical

All Danish regions have implemented new screening tools and tests in the ambulances to support paramedics in the early detection of stroke symptoms, enabling them to bring the patient to the appropriate treatment facility.

The paramedics will report the results to a neurologist at the hospital. If the results indicate a minor stroke, the patient will usually be transported to the local hospital for medical treatment. In the case of a major stroke, the patient will immediately be transported to a highly specialized department for surgery.

"With a joint national tool for screening of stroke, we can ensure fast and correct visitation and treatment. This will save the life and mobility of many patients."

Big data enables quick emergency response

- Time is crucial when technical dispatchers coordinate emergency calls across an entire region.
- A business intelligence solution provides a real-time overview of the resources at hand, ensuring that help arrives as quickly as possible.

The Danish healthcare sector continuously produces huge amounts of data. By processing and analyzing data from ambulances, emergency dispatch centers and hospitals, an innovative business intelligence solution can optimize planning and improve prioritization. This enables the dispatchers to get a real-time overview in their daily workflow and allocate their resources accordingly to ensure a quick response in an emergency situation.

As such, the solution has helped improve the quality of data and thereby contributed

to a reduction in the average response time – the elapsed time from an ambulance is

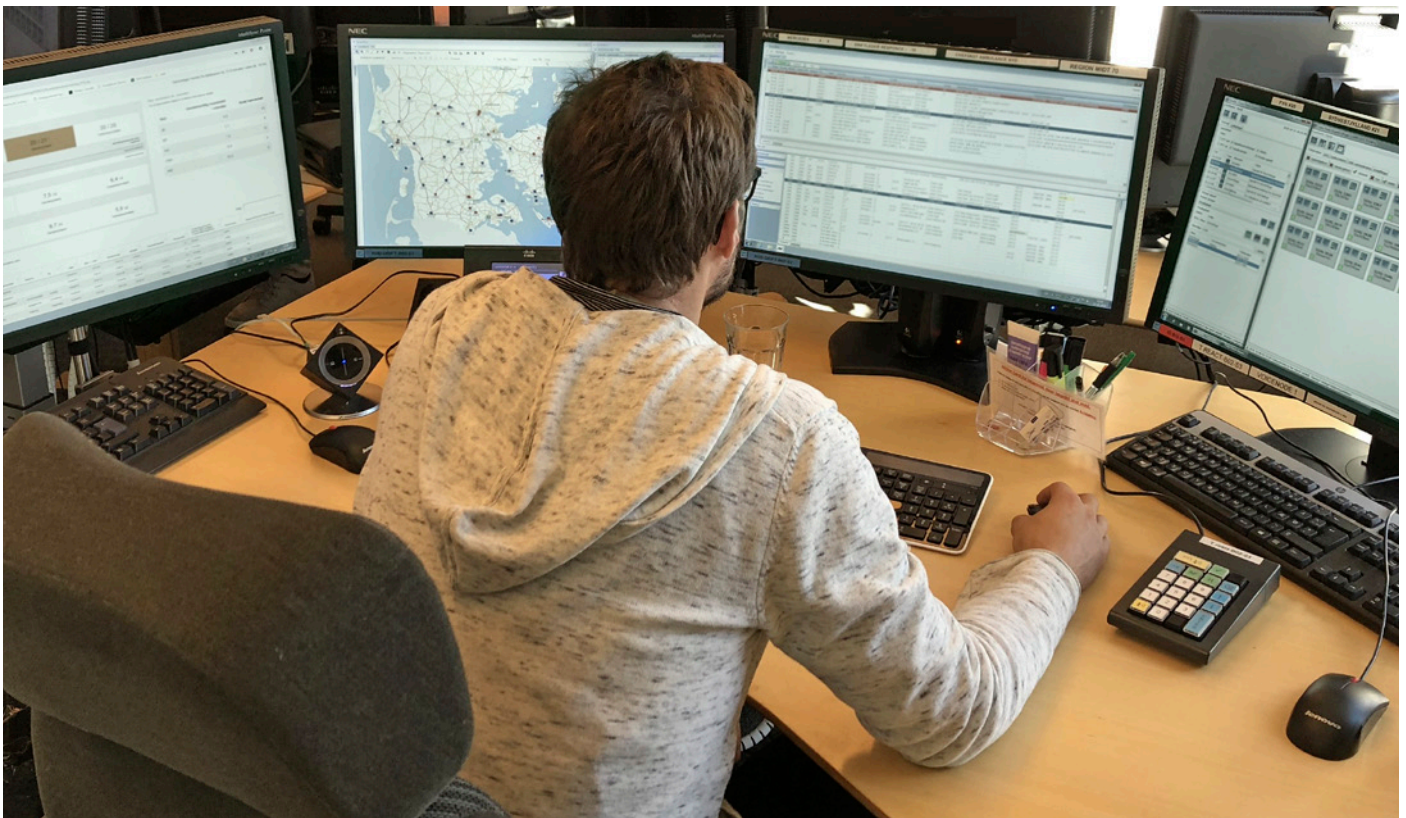
“We use big data to make optimal use of resources. To do so, we need a tool that can provide an overview of our operation in real time. Such a tool has been successfully developed in close collaboration with the company KMD.”

requested until it reaches its destination – which is a vital performance indicator for the dispatchers who coordinate emergency requests.

“We use big data to make optimal use of resources. To do so, we need a tool that can provide an overview of our operation in real time. Such a tool has been successfully developed in close collaboration with the company KMD.”

- Kim Ahlers, Head of the Emergency Dispatch Center, the Region of Southern Denmark.

The solution can also be used for a number of other optimization purposes: ensuring the best placement of emergency stations, adjusting the number of ambulances, and setting relevant performance targets for emergency personnel. In this way, it not only enhances coordination and assures data quality in real time, but also supports long-term decision-making.



Integrated solution improves emergency care

● All Danish regions have implemented a computer aided dispatch (CAD) solution developed in close public-private partnerships. In the Capital Region, an integrated digital platform allows EMS staff to seamlessly manage a wide variety of services.

EMS Copenhagen has integrated all outpatient services into one single computer aided dispatch (CAD) solution developed jointly by EMS Copenhagen and the Danish company Logis Solutions.

It includes workflows that allow call takers and dispatchers to seamlessly manage a wide range of services: Traditional emergency and non-emergency dispatching; allocation of nurses, paramedics, physicians or

psychiatrists out of hours; hospital admissions; and scheduling appointments with emergency departments, emergency dentists or general practitioners.

Besides the emergency number (112), Copenhagen citizens can call a medical hotline (1813) at all times, if they need medical help or advice.

Both numbers are handled by the EMS Copenhagen call centre and use the same integrated IT system.

If a nurse takes an 1813 call, and the patient's condition deteriorates while on the phone, a simple click of a button will allow her to switch from the hotline to the emergency system and quickly arrange for

an ambulance or any other emergency response.

If the patient needs to visit an emergency department, she can check for available times at emergency departments nearby and schedule an appointment immediately. This dramatically reduces waiting times and improves overall patient care.

Referral or discharge notes are automatically collected from the patient charter and sent to the appropriate recipient, ensuring that no information is lost in transition between healthcare departments. In cases of emergency response, all relevant information is automatically sent in real time to a mobile unit in the ambulance.





“Denmark has become a prime example of implementing best resuscitation practice in Europe and has achieved a remarkable tripling of survival rates from Out-of-Hospital Cardiac Arrests over the past ten years.”

Mobilizing citizens has tripled survival rates

● If a citizen suffers a cardiac arrest in Denmark today, he is three times more likely to survive than he would have been a decade ago. This is due to the national effort to educate and encourage bystanders to perform Cardiopulmonary Resuscitation (CPR).

Every year, 4,000 people suffer Out of Hospital Cardiac Arrests (OHCA) in Denmark. Since 2001, survival rates have tripled from 4 percent to 12 percent. This extraordinary improvement is the result of a concentrated effort from many parties.

“Denmark has become a prime example of implementing best resuscitation practice in Europe and has achieved a remarkable tripling of survival rates from Out-of-Hospital Cardiac Arrests over the past ten years.”
– Freddy Lippert, CEO at the Emergency Medical Services Copenhagen.

In 2005, Denmark launched a national program aimed at teaching its citizens to perform CPR. It included mandatory training for drivers and elementary school students, the distribution of instructional training kits, a telephone guidance service for bystanders, and a comprehensive effort to make Automated External Defibrillators (AED) read-

ily available in public places. Since 2006, more than 19,000 AEDs have been installed throughout the community.

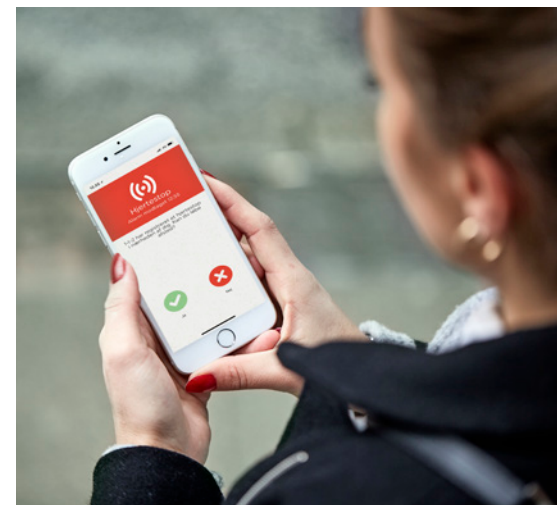
As a result, the number of incidents, in which bystanders perform CPR, increased from 19 percent to 67 percent.

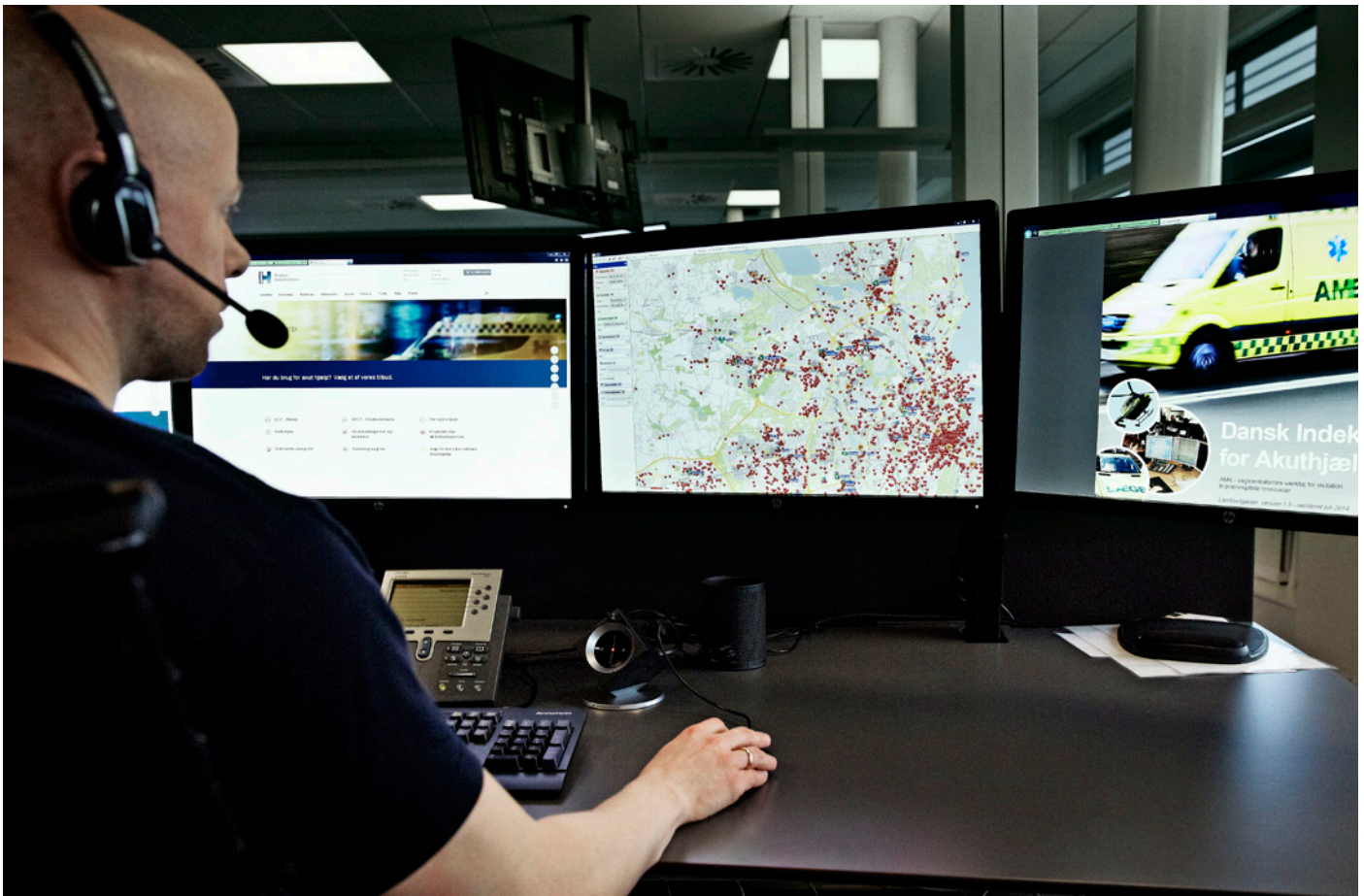
In addition to the improved survival rates, the percentage of survivors returning to work has increased significantly. 76.6 percent of 30-day survivors (who were employed before the incident), returned to work.

This reflects that neurological outcomes have generally become more favorable, due to a more efficient EMS system.

Acknowledging that all systems can perform smarter and better, Denmark’s five regions have taken action to implement the Resuscitation Academy.

Denmark is one of the founding members of the Global Resuscitation Alliance. The alliance seeks to advance resuscitation by accelerating community implementation of effective programs. These programs build on the Resuscitation Academy model and follow a quality improvement strategy of measuring and improving.





An AED in every town and every community

Facts

- The AED Network is maintained by the non-profit foundation TrygFonden.
- Owners of AED equipment can register it on the website hjertestarter.dk. This will make it visible on an online map and potentially available to citizens as well as EMS professionals.
- As of September 2018, approximately 19,000 AEDs had been registered across the nation – one for every 300 citizens.
- Since the implementation of the AED Network, the reported instances of bystanders performing defibrillation has increased from 2,1 percent in 2008 to 13,4 percent in 2016.

- **The Danish AED Network has made thousands of AEDs accessible to EMS professionals and citizens and succeeded in raising awareness of CPR.**

The Danish AED Network comprises several thousand AEDs, which are available to everyone; citizens as well as the EMS. All AED owners – private citizens, corporations and public institutions – are encouraged to register their devices with the AED Network, making them visible on an online map.

In the event of a suspected cardiac arrest, citizens or EMS professionals can access the website hjertestarter.dk to locate the nearest AED.

All emergency dispatch centers have integrated their systems with the AED Network.

“In the case of a cardiac arrest, the chances of survival increase by up to 50 percent if an AED is used before ambulance arrival.

Therefore, TrygFonden saw a great potential in activating citizens to use AEDs.”

- Grethe Thomas, Project Director at the Danish foundation TrygFonden.

“In the case of a cardiac arrest, the chances of survival increase by up to 50 percent if an AED is used before ambulance arrival. Therefore, TrygFonden saw a great potential in activating citizens to use AEDs.”

The map is updated several times a day, so dispatchers will always be able to guide bystanders directly to the nearest available AED. When an AED is in use, the call center will automatically receive a message to deactivate it on the network’s website.



“In recent years, Danish citizens have provided invaluable assistance to the emergency services, especially in areas with higher ambulance response times. Increased citizen participation makes it realistic to further improve rates of survival from sudden illness and cardiac arrest.”

Volunteers save lives

- Denmark uses innovative, potentially life-saving approaches to mobilize volunteers.

The chances of survival after an out-of-hospital cardiac arrest depend heavily on early CPR and/or the use of an AED. Time is critical. Every minute matters, and bystanders’ actions before the arrival of EMS personnel could often mean the difference between life and death.

This fact has prompted the EMS to explore new ways of engaging citizens in handling cardiac arrests and other time-critical emergencies and offering critical first aid and basic life support until professional medical care is available.

“In recent years, Danish citizens have provided invaluable assistance to the emergency services, especially in areas with higher ambulance response times. Increased citizen participation makes it realistic to further improve rates of survival from sudden illness and cardiac arrest.”

- Benny Jørgensen, CEO at the Emergency Medical Services, Region Zealand.

All Danish regions have integrated citizen participation with the general emergency response system.

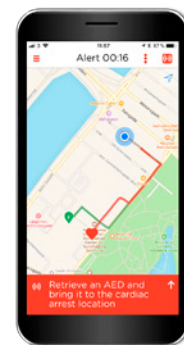
The two initiatives below illustrate some of the innovative and life-saving approaches.

- In the Capital Region of Denmark and the Central Denmark Region, the dispatch centers now have the option of activating ‘heart runners’ – volunteer citizens trained in resuscitation – through a smartphone application. The application is integrated with the Danish AED Network. If the EMS staff suspect a cardiac arrest when they take an emergency call, a geolocation system is used to automatically locate and alert nearby heart runners, directing them to the closest publicly accessible AED and the scene of the incident as quickly as possible.

- In the Region of Southern Denmark, the overall emergency response system includes a volunteer network of ‘first responders’ – volunteers trained in first aid and basic life support, including the use of AEDs. When an ambulance is dispatched,

the three first responders closest to the event automatically receive a notification on their mobile phone.

At all times, the EMS knows which resources are on their way and will be able to guide and instruct emergency professionals, volunteers, and bystanders accordingly.



Facts

- The heart runner concept was implemented in the Capital Region of Denmark in 2017. It was developed in collaboration with the non-profit foundation, TrygFonden, cardiac arrest researchers, and the regional EMS unit. In the first year, 25,000 citizens registered as heart runners, and 6,500 of them have been involved in over 800 resuscitation attempts. The Central Denmark Region implemented the concept in 2018 and within the first two months, 10,000 citizens registered as heart runners.
- The first responders concept builds on an application-based technology provided by the Danish company, First AED. It is an integrated part of the dispatch system in the Region of Southern Denmark. First responders are deployed in cases of out-of-hospital cardiac arrests and other serious emergencies.

The future of Emergency Medical Services in Denmark

- Emergency medical services play an important part in meeting global healthcare challenges.
- Denmark has fostered a number of new initiatives to improve future emergency care.

Across the world, demographic changes and increasing expectations from citizens pose a great challenge to healthcare providers.

Emergency medical services can play an important part in meeting this challenge.

It is not just a matter of deploying more ambulances or reducing response times. It is about creating innovative solutions and integrating new technologies to ensure appropriate early treatment and to facilitate the best possible collaboration and coordination between emergency wards, specialized hospital departments, municipalities, fire and rescue services, community volunteers, and local healthcare providers.

Denmark strives to be a frontrunner in the transition of the EMS along these lines.

The EMS is usually the initial, if not the only, point of contact for patients with acute illness and injuries. As such, the EMS is not only responsible for initiating care, but also operates as a gatekeeper to the entire healthcare system.

The transition is supported by a strong tradition of data-driven research and evidence-based care in the Danish healthcare sector.



This white paper has presented some of the innovative solutions already used to ensure highly specialized pre-hospital care and to increase the chance of successful outcomes in emergency situations. But this is just the beginning. Denmark continues to explore new ways to improve emergency care.

This task requires close collaboration with hospitals, municipalities and private companies. However, individual patients, their families, and the community remain the most important partners in this transition.

To learn more about the Emergency Medical Services in Denmark, feel free to contact Healthcare DENMARK. If you want to visit Denmark to study its innovative solutions in detail, you can request a delegation visit through the Healthcare DENMARK website.

Facts

The EMS is constantly exploring new ways to further improve emergency care. Current initiatives and research projects include:

- The application of artificial intelligence to support decision making in emergency calls and emergency care.
- Video consultations with citizens to support early diagnostics and treatment at home.
- Digital assessment and triage supported by app- or internet-based communication with citizens.
- Utilizing data and new technology to promote the use of AEDs (Automated External Defibrillators) in events of cardiac arrest.
- Point-of-care tests in prehospital settings, allowing for early diagnostics and treatment.
- The use of paramedic practitioners or community paramedics to provide patient care in local communities.
- Exploring the potential of drones (for example, live-stream video transmission to dispatch centers) in accidents, search and rescue operations and other major incidents.

About Healthcare DENMARK

Healthcare DENMARK is the international gateway to Danish healthcare expertise and innovation. Our aim as a non-profit public-private partnership is to internationally benchmark Danish best practices within healthcare.

The goal of Healthcare DENMARK is not to sell or promote any specific products or solutions, but to communicate the strongholds of Danish healthcare. We do this by attracting health politicians, decision-makers, and journalists to experience Danish healthcare solutions in practice and meet the people behind. Our network is an extensive pool of public sector, private companies, and other actors in the area of healthcare – all dedicated to providing excellent and efficient healthcare as well as sharing best practices across borders and professions.



• Hans Erik Henriksen
Chief Executive Officer

Our network is an extensive pool of public sector, private companies, and other actors in the area of healthcare – all dedicated to providing excellent and efficient healthcare as well as sharing best practices across borders and professions.

“In Denmark our focus on putting the patient first – combined with efforts to improve efficiency and quality – has resulted in a wide array of innovative solutions. I sincerely believe Danish solutions and expertise can have a positive impact on global health.” - Her Royal Highness Crown Princess Mary of Denmark

If you would like to learn more about our world-renowned healthcare, we can assist you with tailoring a visiting program, setting up meetings, and arranging access to otherwise off-limits areas and people within both the public and private sectors, as well as assist



• HRH Crown Princess Mary of Denmark
patron of Healthcare DENMARK


you with local accommodation and transportation.

Healthcare DENMARK has a national and political mandate to provide this service to politicians, relevant top and management level professionals, and journalists working with healthcare.

Backing this public-private initiative is a partner group of both public and private key actors within Danish healthcare, including the Ministry of Health, the Ministry of Foreign Affairs of Denmark, the Ministry of Industry, Business & Financial Affairs, Danish Regions, Region of Southern Denmark, the Confederation of Danish Industry, the Confederation of Danish Enterprise, Falck, KMD, Systematic, OpenTele-Health, Intelligent Systems, Danish Export Association, Lyngsoe Systems, Wavecare, Danish.Care, and PDC.

Her Royal Highness Mary, Crown Princess of Denmark is patron of Healthcare DENMARK.

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