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Electronic Documentation and Digital, IT Technology in Pre-Hospital Emergency Care

In recent years Hungarian healthcare including outpatient and inpatient medical institutions and the Emergency Medical Services providing emergency care have undergone numerous IT improvements. In addition to patient health documentation, electronic digital technology provides a telemedicine opportunity for at-the-scene care, helping and supporting care, diagnosis and patient path-related decisions. The National Emergency Services are involved in the development and implementation of mobile applications that assist at-the-scene first aid provided by non-professionals in cases where early intervention can be life-saving for the patient. By providing the possibility of requesting direct assistance in unexpected situations, not only can the request for assistance be made easier and simpler, but the scene of the medical emergency or injury can also be precisely determined without the assistance of the person who reports the emergency case.

Keywords: electronic documentation, electronic health service system, electronic case record, Heart City, life-saving application

1. Introduction

The use of information and digital technology that directly supports not only patient care, but also activities related to care is essential for the development of the quality of health care.

As a research objective, this paper presents the essential elements of health documentation, the advantages and disadvantages of electronic documentation together with its usability in everyday practice, and its additional services compared to paper-based documentation. The hypothesis assumes that electronic patient documentation and digital technology assist at-the-scene care for professionals and can

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also be used by non-professionals. The paper tends to support the hypothesis with international examples. A further aim is to draw attention not only to the present but also to potential applications in the future.

The outdated paper-based documentation, which also means storage, processing and archiving difficulty, has been replaced by electronic patient documentation in pre-hospital emergency care as well. In addition, safe patient care requires a decision-support system that also provides consultation opportunities. This system assists at-the-scene care for professionals and additionally mobile applications provide at-the-scene support from the Emergency Medical Services for non-professionals.

2. Documentation during emergency care

In any field of health care, including out-of-hospital emergency care, medical documentation is prepared on the examination and care of the patient during, after and in parallel with the treatment. According to the law, this documentation is a record or information or data recorded in any way, that contains health and personal information which have come to the knowledge of the person providing care in the course of treatment, regardless of its medium or form.²

In the course of documentation, health information is collected about the patient, i.e. all personal information about his or her physical or mental condition, including information on health services provided to the person that carries information about the person's condition, which also means the classified information mentioned above³ (GDPR Article 4, point 15).

The documentation applied during the emergency task contains the following as a mandatory element in accordance with the legal requirements (Health Act):

- the patients personal identification data
- medical history
- the result of the examination and the diagnosis
- the time of the performed interventions and their results
- medication and other therapies, as well as their results
- information about the patient's drug hypersensitivity
- the name of the healthcare professional who performed the registration and the time of the registration
- any other information and facts that may affect the patient's recovery⁴

The documentation by the Emergency Medical Services outside the hospital was recorded on rescue documentation and travel account before joining the Electronic Health Care System which contained information about the ambulance team, the rescue tasks and the given patient. Detailed information on patient care was recorded on the case record by the head of the ambulance team:

² 1997. évi XLVII. törvény az egészségügyi és a hozzájuk kapcsolódó személyes adatok kezeléséről és védelméről.

³ Általános adatvédelmi rendelet (GDPR), 4. cikk 15. pont.

⁴ 1997. évi CLIV. törvény az egészségügyről.

- the relevant time of the rescue task (reporting of the emergency case, departure, arrival at the scene)
- the history of the event and the conditions observed at the scene
- the patient's condition and the results of the examination
- the treatment provided to the patient, change in his/her condition
- additional treatment provided to the patient and the change in the patient's condition during the transportation
- the place and time of the patient transfer⁵

Additional medical documents, like the Declaration of the Refusal of Patient Care, Inventory of Valuables Police Force Claim Form, and other professional medical information forms (Utstein template, ACS, Intubation) as part of the patient documentation were prepared during the patient care as necessary annexes.

The difficulty of paper-based documentation was the necessary administration at the scene, during transportation, or at the transfer destination of the patient, thus they greatly affected the readability of the documents. In addition, the proper storage of patient records was an ongoing issue.⁶

3. Introduction of electronic documentation and the related IT system during the at-the-scene emergency care

In the emergency patient care outside the hospital the introduction and application of electronic patient documentation was implemented with the nationwide extension of the EESZT (Electronic Health Service System), involving healthcare providers in the system. Its deadline was 1 November 2018.

A dispatcher IT system has been operated by the National Emergency Medical Services since 2014. With the help of this system different information of the incoming emergency calls, e.g. the exact location of the emergency case, contact information of the person reporting the medical emergency, the patient's name, his or her current complaint, etc. are stored on an electronic rescue documentation, which can immediately be transmitted to the Intelligent On-Board Terminal (IFT) of the given ambulance team.

An important part of the dispatcher system is the electronic rescue documentation opened by the dispatcher at the time of reporting the medical emergency. It contains all the important information from information gathered from the person reporting the medical emergency (Figure 1). The dispatcher is assisted by the protocol of questions, which, when it is opened in parallel with the rescue documentation, follows the individual steps of the at-the-scene patient examination, so that in a short time sufficient information can be obtained about the patient's condition and adverse health effects.

⁵ 37/2011. (VI. 28.) NEFMI rendelet a mentésről szóló 5/2006. (II. 7.) EüM rendelet és a betegszállításról szóló 19/1998. (VI. 3.) NM rendelet módosításáról.

⁶ Gábor Csató, 'Modernitás a mentőszolgálatban: Mitől lesz modern egy egészségügyi intézmény?', *Interdiszciplináris Magyar Egészségügy* 16, no 5 (2017), 6–7.

If a patient requires immediate intervention (e.g. resuscitation, provision for an unconscious patient, hemostasis, foreign body in the respiratory system), the dispatcher stays on the phone and provides first aid advice to the person who is reporting the medical emergency and who is still at the scene until professional help arrives. Protocols for telephone assistance are also available which can be used during first aid counselling (Figure 2).⁷

Figure 1

Electronic rescue documentation

Source: http://demin.hu/files/userfiles/DEMIN_XV/DEMIN-XV-E/2-1-2-DEMIN-XV-PGY-1.pdf

Figure 2

Protocol for dispatchers to ask questions

Source: http://demin.hu/files/userfiles/DEMIN_XV/DEMIN-XV-E/2-1-2-DEMIN-XV-PGY-1.pdf

⁷ György Pápai, Új minőségbiztosítási feladatok az OMSZ-nál 2, s. a.

Within the dispatcher system, the GIS (Geographic Information System) application supports the identification of the scene. It helps the arriving ambulance team to reduce the arrival time, and the GPS transmitter in the ambulance identifies the current location of the ambulances, alerting the deployable ambulance team closest to the reporting location (Figure 3).

The primary goal of the development of the dispatcher system, the introduction of the CAD (computer aided dispatch system), is to increase efficiency. One of its objective measures is the arrival time, i.e. the arrival time of the rescue units from the report of the medical emergency.

Optimally, the European goal is to meet the arrival time of 15 minutes at least 90% of the time.⁸ Prior to the development of the IT system this goal was reached between 60 and 70% of the time.⁹ In 2018 it rose to 78% and in 2019 to 82%.¹⁰

Even with the Covid pandemic which increased the number of patients and additional tasks that weighed heavily on the National Emergency Service, a small improvement, 1–2% was achieved in meeting the European goal. This was primarily due to the development of additional ambulance teams, to the increase in the number of those participating in the rescue process, as well as to the opening new ambulance station.

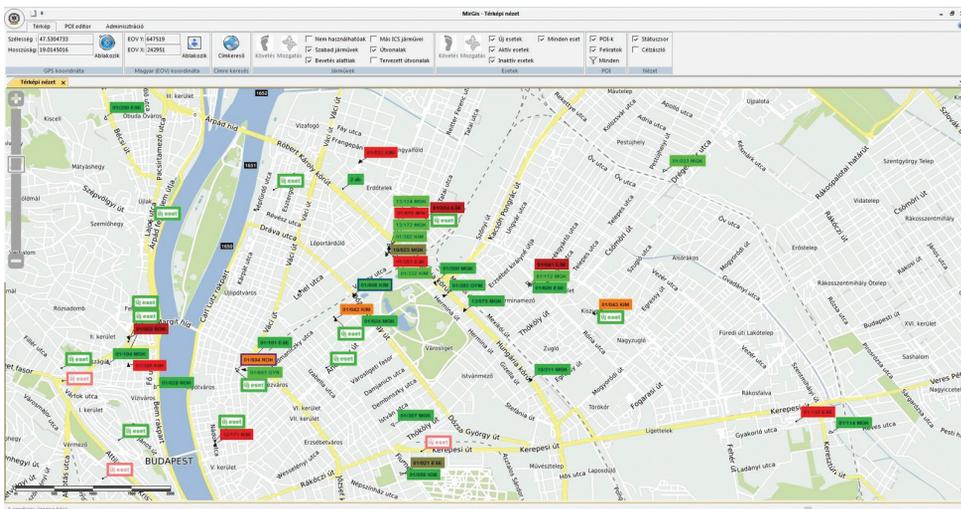


Figure 3

GIS application of the dispatcher system

Source: <http://obsz.njszt.hu/ifi/images/2015/21.pdf>

⁸ Eric Lucas dos Santos Cabral et al., 'Response time in the emergency services. Systematic review', Acta Cirúrgica Brasileira 33, no 12 (2018), 1110–1121.

⁹ László Domokos, 'A „vészhelyzeti” betegellátás rendszerének ellenőrzése', Állami Számvevőszéki jelentés, 2019. lkt sz.: EL-1599-001/2019.

¹⁰ Bence Rétvári, 'Miként alakul a mentők kéréskezési ideje megyénként?' Emberi Erőforrások Minisztériumának Államtitkára, 2020. lkt.: III/101-1/2020/PARL.

The dispatcher system includes an IT terminal assigned to the ambulance team (IFT). Its purpose is to transmit the electronic rescue documentation to the alerted ambulance team, furthermore, the at-the-scene patient documentation can also be implemented.

Tablets placed on the ambulance receive the information of the emergency call about the scene of the accident in parallel with the alerted dispatcher. The rescue team complete the electronic case report documentation on the tablet, too. This report contains all the details they notice at the scene as well as the patient care they perform at the scene. The case record software, as an electronic patient documentation, contains all the requirements that are determined by the law, replacing the paper-based documentation (Figure 4).

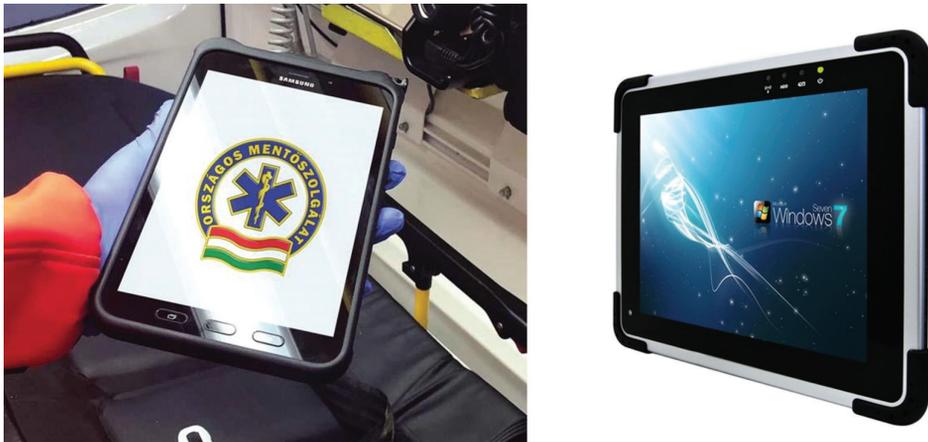


Figure 4

Intelligent On-Board Terminal (IFT)

Source: <http://docplayer.hu/159559890-Veddeszreamentot-orszagos-mentoszolgalat.html>; http://demin.hu/files/userfiles/DEMIN_XV/DEMIN-XV-E/2-1-2-DEMIN-XV-PGY-1.pdf

The electronic application of the rescue documentation and travel account, as well as the case record is opened by sending the details of the rescue task to the tablet.

With completing the forms, the information of the ambulance team, the distance and time emergency run kilometre and time, and the patient's personal information and information about patient care is uniform. The electronic patient documentation is completed by recording the patient's transfer to the medical institution and the care performed at the scene (Figures 5, 6).



Figure 5

Electronic case record interface 1

Source: <http://obsz.njszt.hu/ifi/images/2015/21.pdf>

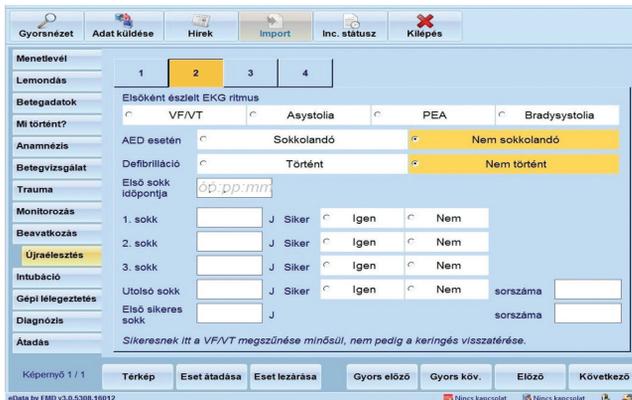


Figure 6

Electronic case record interface 2

Source: <http://obsz.njszt.hu/ifi/images/2015/21.pdf>

The advantage of the electronic documentation is its simple and permanent data storage, easy access for those who have permission to use it, the possibility to create and quickly access to various databases, statistical and operational data, and the possibility of adding or changing data if necessary.

Its disadvantage is the continuous use of the right quality and quantity of equipment, which, in terms of the number of ambulances means 1,000 Intelligent On-Board Terminals, as well as the operation of the entire IT and digital equipment of the country's 20 dispatcher groups 24 hours a day.

Continuous availability and adequate security protection as a critical aspect of infrastructure require priority resources, quick replacement in case of failure, continuous

IT support and stable internet connection provided availability in a moving ambulance anywhere in the country.

A further improvement opportunity could be the introduction of the uploading function of the paper-based documents (e.g. results of ECG, Code summary, Declaration, Inventory of Valuables) that are completed during the at-the-scene care and their attachment to the electronic case record.

4. Emergency and dispatcher systems in Europe

The IT-based deployment dispatcher system was developed and implemented by the older EU member states between 2005 and 2008. In some places this same system is also integrated with the fire brigade and the police (e.g. the Weserbergland Cooperative Regional Command Center in Hameln-Pyrmont in Lower Saxony, Germany).

With slight differences but following the same principle, the following system works in different places: emergency calls are processed with computer support, the dispatcher can usually visually follow the location of the call/event using the advanced location GIS. The nature of the event is determined by a carefully developed software including algorithms.

The algorithm categorises the event according to the degree of urgency and severity, then it offers to alert the free ambulance capacity recorded online. The scene, the nature of the emergency case, the accessibility, and other information from the person who reports the case are transmitted to the ambulance team via audio or digital signals. Feedback on at-the-scene activity, patient data, diagnostic and examination results is received by both the dispatcher and the institution that is supposed to treat the patient.

All data related to the performance of an emergency case (from the beginning of the emergency call to the end of the case) is time-stamped and recorded online in the IT system. IT systems include similar systems, like the Advanced Medical Priority Dispatch System (AMPDS) commonly used in the U.K. and in Germany.

The AMPDS includes systematised call answering, advice to the person who reports the case, and protocols for coordinating the type and severity of the injury or illness with the alerted ambulance. Additionally it has an Advanced Quality Assurance (AQUA) software tool to measure the performance of the dispatcher.¹¹

Zenit system, used in the SOS Alarm centres in Sweden, operates similarly. It controls and coordinates the entire chain of emergency activities, and makes it possible to perform statistics and assessments, similar to the SITREM (full solution for emergencies treatment) system used in Spain.

European systems show significant similarities with the later introduced and launched domestic system, which also includes GIS, electronic documentation and communication applications, supplemented by the protocol of questions and consultation as well as the alert protocol that the dispatcher is expected to apply.¹²

¹¹ Az EU tagországok mentési rendszereinek jellemzői (Budapest: Informatikai és Rendszerelemzési Főigazgatóság, Rendszerelemzési Főosztály, 2014), 36–37.

¹² Gyula Kincses et al., Mentési- és mentésirányítási rendszerek Európában (Budapest: Egészségügyi Stratégiai Kutatóintézet, 2009), 4–5.

5. Joining the EESZT system

The National Emergency Medical Services also joined the Electronic Health Service System from 1 November 2018, thus the at-the-scene electronic patient documentation is available to the medical institution via an IT network, and it is also uploaded to the patient's medical documents.

The new system allows all healthcare institutions (GPs, outpatient and inpatient institutions, pharmacies) to upload patient health records to the system as well as to access their previous documents.

Patients can track and check their own medical history and take their electronically completed prescriptions at the pharmacy.

During the at-the-scene emergency care, the patient's known medical history can sometimes be of great help in making the diagnosis and performing certain interventions, as known diseases, medications taken by the patient, previous ECG abnormalities and other findings help to recognise a new or changed condition.

Health records stored by the EESZT system can be easily accessed with the help of IFTs used by ambulance teams. Currently it means an area under development.¹³

6. Telemedicine at the Emergency Medical Services

A decision support tool and system were introduced in the Northern Great Plain region of the National Emergency Medical Services in 2007. It helps to screen for cardiological diseases requiring acute care, to provide patients with at-the-scene care and to transport them to a medical institution providing definitive care.

From 2014, each Hungarian ambulance team has TTEKG, i.e. transphone telephony ECG (Figure 7).

The ECG image taken by this transphone telephony ECG can be transmitted in the form of a digital signal via the TETRA system of the ambulance team to the nearest Cardiology Centre where the cardiologist evaluating the Electrocardiogram on the computer can consult the ambulance team treating the patient at the scene.¹⁴

During the consultation, the cardiological diagnosis can be confirmed on the basis of the patient's complaints and the transmitted image, thus the therapy, and the patient's path can also be determined (Figure 8).

Overall, the TTEKG system enables faster patient admission to the medical institution providing final care, that is, it optimises the patient path, significantly reduces infarct mortality, provides ongoing consultation, and increases patient safety and the quality of care.

The improvement of digital and IT technology has made it possible for the new digital TTEKG device to send the image to the tablet of the ambulance team or to the cardiology centre via the Internet.

¹³ Gábor Csató, 'Digitalizáció a sürgősségi betegellátásban', *Interdiszciplináris Magyar Egészségügy* 18, no 3 (2019), 4–6.

¹⁴ György Papai et al., 'Transtelephonic electrocardiography in the management of patients with acute coronary syndrome', *Journal of Electrocardiology* 47, no 3 (2014), 294–299.

The image is also uploaded as an attachment to the patient's electronic documentation via the EESZT system and additionally previous ECG recordings can also be displayed at the scene.

From 2019 the introduction of a new generation of the devices has been improving the quality of the recording and has been strengthening the connection of the devices in order to improve evaluation and consultation.¹⁵



Figure 7
TTEKG device

Source: http://sumegmento.ucoz.hu/news/uj_tt_ekg_allt_rendszerbe_az_allomason/2019-06-28-388



Figure 8

ECG image recorded by TTEKG on the Intelligent On-Board Terminal

Source: http://medicalonline.hu/gyogyitas/cikk/kuloneges_magyar_ujitas_segithet_tulelni_az_infarktust

7. Mobile applications to support at-the-scene emergency medical care

By operating and supporting mobile phone applications, the National Emergency Medical Services assist in providing at-the-scene first aid assistance prior to the arrival of the ambulance team and additionally the users are provided the opportunity to request direct assistance.

Szív (Heart) City mobile application has been available since October 2017. With the help of this application first aid providers who download, register and log in to the application on their phone can be sent to the public areas as soon as possible to treat medical emergencies and start resuscitation.¹⁶

The application operates like this: after reporting the medical case, in parallel with the alerted ambulance team, voluntary users – professional or non-professional

¹⁵ György Pápai, 'Az Országos Mentőszolgálat Észak-alföldi régiójában kidolgozott betegút modellt és cardiobeeperes, prehospitalis döntéstámogató rendszer hatása az akut coronaria syndromás betegek morbiditási és mortalitási mutatóinak változására' (Laki Kálmán Doktori Iskola, Doktori [PhD] értekezés tézisei, 2018).

¹⁶ György Tóth, 'Tömeges káresemények és katasztrófák következményeinek egészségügyi felszámolását végző és támogató szervezetek tevékenysége', *Hadmérnök* 15, no 3 (2020), 233–234.

first aid providers – who are within 500 meters of the scene, receive a message from the dispatcher of the Emergency Medical Services about the exact location of the medical emergency, thus the care for patients can begin before the arrival of the ambulance. With the help of the application, the steps of resuscitation can be mastered. Additionally, the first aid provider can be informed about the availability of a nearby defibrillator, which is essential for care.

If more than one first aid providers are close to the patient, through the application the dispatcher can also request assistance in taking the available defibrillator to the scene of the medical emergency (Figure 9).¹⁷

It allows for both early resuscitation and the at-the-scene use of the defibrillator before the ambulance arrives. From October 2017, more than 50,000 users have downloaded the application, more than 2,200 alarms have been received by first aid providers, and more than 40 successful resuscitation assistance have been provided in several parts of the country.¹⁸

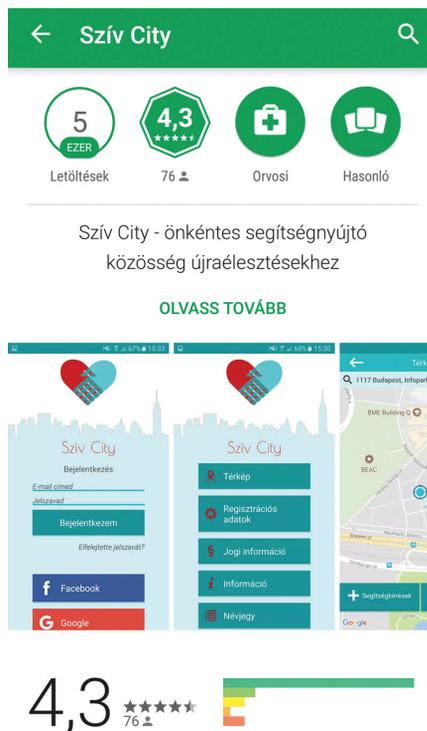


Figure 9

Interface of Szív (Heart) City application

Source: <http://8200.hu/index.php/hirek/belfold/item/2929-elindult-a-sziv-city-életmentő-mobilalkalmazás>

¹⁷ 'Szív City: Életmentő mobilalkalmazás', 17 October 2017.

¹⁸ 'Szív City application'.

With the help of the *Életmentő* (Life Saving) application, the person reporting the medical emergency can contact the Dispatcher group of the National Emergency Medical Services without dialling the emergency centre. It is enough to use the Alarm function and in parallel with the call the location and other pre-recorded health information are transmitted in the form of a message.¹⁹

The advantage of the application is the direct contact, the determination of the location of the person reporting the medical emergency with the help of GPS coordinates, which is especially important if the reporting person cannot determine the exact location. In addition to the telephone connection, a message is also sent to the dispatcher group, so even in case of communication difficulties, the request for help can be realised together with the exact location and the connection can be established even by exchanging SMS messages.

Basic first aid knowledge can also be obtained from the application, as well as public information on hospitals, clinics, pharmacies and information about defibrillators placed in public areas is also available. The application also works in Austria and in the Czech Republic, as well as in certain areas of Slovakia, thus help is available even from abroad (Figure 10).



Figure 10

Lifesaving mobile application interface

Source: <https://motorrevu.hu/cikkek/az-a%E2%80%B0letmenta-app-minden-motorosnak-ajánlott/>

¹⁹ 'Életmentő application'.

8. Summary, conclusions

In recent years, Hungarian healthcare including outpatient and inpatient medical institutions and also the Emergency Medical Services providing emergency care have undergone numerous IT improvements.

The electronic documentation has been introduced as part of the IT support for pre-hospital emergency care, which, together with the digital technology for dispatcher service, has become a modern system that increases patient safety.

The aim of this paper was to introduce and study the essential elements of electronic documentation. Easy data storage, easy access and management, the possibility of changing data and the introduction of additional applications can be mentioned as the advantages of electronic documentation. However, it has some disadvantages as well: setting portable devices which require a permanent, continuously available, stable internet connection.

Electronic, digital technology increases efficiency, which is clearly reflected in the continuous improvement of the at-the-scene arrival rates within 15 minutes, which is also relevant in Europe.²⁰ Telemedicine facilities improve at-the-scene care, support patient care, diagnosis and patient path decisions, and increase patient safety. This evidence supports my hypothesis.

The National Emergency Medical Services are also involved in the improvement and implementation of mobile applications that assist at-the-scene first aid for non-professionals in cases where early intervention can be life-saving for the patient.

In parallel with the possibility of requesting direct assistance in unexpected situations, the scene of the medical emergency or injury may be more easily accessible.

In summary, IT and digital technology increase patient safety, facilitate access to and transmission of health records, and provide support to both non-professionals and health care professionals.

The introduction of Electronic death certificate and the support of uploading health documents during the at-the-scene care (ECG, Code summary, other paper-based documents) to the patients' electronic documentation are expected to be introduced in the near future.

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