

Javno dostupna rana defibrilacija – jučer, danas, sutra

Public Access Early Defibrillation – Past, Present, and Future

 **Drago Rakić^{1*}**,
 **Leo Luetić²**,
 **Zrinka Jurišić³**,
 **Nina Berović³**,
 **Ivana Cvitković⁴**,
 **Zvonko Rumboldt⁵**

¹Poliklinika za internu medicinu i pedijatriju Dr Rakić, Split, Hrvatska

²Zavod za hitnu medicinu Splitsko-dalmatinske županije, Split, Hrvatska

³Klinički bolnički centar Split, Split, Hrvatska

⁴Kardiološka ordinacija Dr Cvitković, Split, Hrvatska

⁵Medicinski fakultet Sveučilišta u Splitu, Split, Hrvatska

¹Polyclinic for Internal Medicine and Pediatrics Dr Rakić, Split, Croatia

²Institute of Emergency Medicine of Split-Dalmatia County, Split, Croatia

³University Hospital of Split, Split, Croatia

⁴Cardiology Practice Dr Cvitković, Split, Croatia

⁵University of Split, School of Medicine, Split, Croatia

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SAŽETAK: Iznenađna srčana smrt ili iznenađan srčani zastoj (ISS/ISZ) velik je javnozdravstveni problem, diljem svijeta odgovoran za nekoliko milijuna smrtnih ishoda. Stope preživljavanja ISZ-a godinama su niske (5 – 10 %), uglavnom zbog kašnjenja kardiopulmonalne reanimacije i defibrilacije. Primjena automatskih vanjskih defibrilatora (AVD-a) omogućuje brzu i sigurnu laičku defibrilaciju na mjestu ISZ-a. Za to valja osigurati mnogo javno dostupnih uređaja (u SAD-u čak više od milijun na 350 000 000 stanovnika) na mjestima velike vjerojatnosti ISZ-a i što više podučениh i motiviranih očevidaca. Nažalost, u više od 30 proteklih godina uporaba AVD-a ostala je vrlo niska, s vrlo malim učinkom na preživljenje. Dosadašnji koncept javno dostupne rane defibrilacije usmjeren je na javna mjesta, na koja otpada tek petina ISZ-a, pa ih je većina (70 – 80 % u stambenim okruženjima) gotovo potpuno isključena iz takvih programa. Ovaj se prikaz zalaže za širenje mreže AVD-a, osobito u stambena i ruralna područja, te višestruko povećanje motiviranih i/ili educiranih volontera-spasilaca, kao i prihvaćanje novih tehnoloških dostignuća koja mogu bitno skratiti vrijeme do intervencije npr. upućivanjem promatrača spasilaca prema žrtvi i/ili najbližem defibrilatoru porukama s „pametnog“ mobitela te dostavljanjem AVD-a bespilotnom letjelicom na mjesto nesreće. Hrvatski program „Pokreni srce – spasi život“ široka je, nedovoljno iskorištena platforma za djelovanje pojedinaca, institucija i udruga, koju treba aktivirati i prilagoditi novim zahtjevima.

SUMMARY: Sudden cardiac death or sudden cardiac arrest (SCD/SCA) is a major public health problem, responsible for several million victims worldwide every year. SCA survival rates are still low, around 5-10%, mostly due to delayed cardiopulmonary resuscitation and defibrillation. The advent of automated external defibrillators (AED) has allowed for quick and effective lay resuscitation. To achieve the goals of Public Access Defibrillation (PAD) project, ensuring a large number of easily available AEDs (in the US there are one million AED per 350 million people) with a large, nation-wide pool of educated and motivated lay persons/bystanders is essential. Unfortunately, over the last three decades, the AED implementation rate has remained low, with only a marginal impact on survival, since the traditional PAD concept was focused on public places, where only a fifth of SCA/SCD happens, while the majority, some 70-80%, takes place in residential environments, which are currently almost excluded from such programs. This review makes the case for PAD extension to residential areas with prompt defibrillation even with no basic life support interventions. Indeed, recent technological advances may substantially shorten the accident-defibrillation time lag, e.g. using the smartphone of a victim-bystander/rescuer – the closest AED – or drone delivery of an AED to the victim's location. The Croatian "Restart a Heart – Save a Life" program is still an underused tool for the emergency response by individuals, organizations, and institutions, and should be reinforced and aligned with the best current evidence.

KLJUČNE RIJEČI: iznenađan srčani zastoj, iznenađna srčana smrt, automatski vanjski defibrilator, javno dostupna rana defibrilacija.

KEYWORDS: sudden cardiac arrest, sudden cardiac death, automated external defibrillator, public access to early defibrillation.

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***ADDRESS FOR CORRESPONDENCE:** Drago Rakić, Poliklinika za internu medicinu i pedijatriju dr Rakić, Roosveltova 54, HR-21000 Split, Croatia. / Phone: +385-91-5477-949 / E-mail: info@poliklinika-rakic.com

ORCID: Drago Rakić, <https://orcid.org/0000-0001-9064-2055> • Leo Luetić, <https://orcid.org/0000-0001-9907-0401>
 Zrinka Jurišić, <https://orcid.org/0000-0001-7583-9036> • Nina Berović, <https://orcid.org/0009-0007-1543-3270>
 Ivana Cvitković, <https://orcid.org/0000-0002-9445-9415> • Zvonko Rumboldt, <https://orcid.org/0000-0002-6811-275X>

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Iznenađan srčani zastoj (ISZ) trenutačni je prekid aktivnosti srca s hemodinamskim kolapsom, a iznenađna srčana smrt (ISS) prirodna smrt pretpostavljeno srčanog uzroka, koja

Sudden cardiac arrest (SCA) denotes instantaneous cessation of the activity of the heart with hemodynamic collapse, and sudden cardiac death (SCD) is a natural death assumed to

se dogodi unutar jednog sata od pojave simptoma u slučaju osvjedočenja ili unutar 24 sata od zadnjeg viđenja te žrtve, ako ISS nije osvjedočena.¹

ISS je velik javnozdravstveni problem koji godišnje pogodi oko 3,8 milijuna ljudi, oko 50 % svih smrtni srčanožilnog sustava i oko 20 % svih smrtnih slučajeva, pri čemu je prva manifestacija srčane bolesti u do 50% slučajeva. Većina, 60 do 80 %, događa ih se izvan bolnice, od kojih 65 – 80 % u stambenom okruženju, a oko 20 % na javnim mjestima.¹⁻³ Učestalost ISS-a znatno se povećava s dobi žrtve. U mlađih od 35 godina izrazio je niska, čineći <1 % svih ISS-a, od kojih bar 5 – 10 % ima normalnu strukturu srca pa genetsko testiranje može povećati identifikaciju uzroka ISS-a. Tijekom dojenačke dobi i djetinjstva incidencija je 1 – 2 na 100 000 stanovnika, pri čemu je, kao i u drugim dobnim skupinama, u muškaraca do 5 puta viša. U dobi od 15 do 35 godina učestalost je veća (oko 3,2/100 000), a uzroci u mlađih od 35 godina najčešće su hipertrofijska kardiomiopatija (HCM) i druge kardiomiopatije, te kanalopatije, a koronarna bolest srca (KBS) vodeći je uzrok ISS-a među starijima od 35 godina.⁴⁻⁶ U srednjoj dobi, u petom i u šestom desetljeću, incidencija doseže 50/100 000, a u osmom desetljeću premašuje 200/100 000, kada je najčešći uzrok KBS.^{7,8}

Hitna medicinska pomoć (HMP) zbrine samo dio, najčešće 50 – 60 % svih ISZ-a, pa su procjene incidencije i zbog toga nesigurne. U Europi HMP zbrine oko 300 000 žrtava ISZ, oko 38/100 000 stanovnika, s preživljenjem od oko 10,7 %⁹, a u *EuReCa* studiji oko 600 000 (84/100 000 stanovnika; u Hrvatskoj tada 62/100 000), uz 10,3 % preživjelih od otpusta iz bolnice.¹⁰ Prema malobrojnim istraživanjima i procjenama, u Hrvatskoj je incidencija ISZ-a mnogo veća nego u Europi, uz velike regionalne razlike.¹¹⁻¹⁵ U Splitsko-dalmatinskoj županiji npr. 2017. godine HMP je zbrinula 291 žrtvu ISZ-a (oko 65/100 000), od kojih je do otpusta iz bolnice preživjelo 21 (7,2 %).¹⁴ U Sjedinjenim Američkim Državama slični široki rasponi procjena pogođenih ISZ-om od 250 000 do 400 000 ili više različito se objašnjavaju.¹⁶

U sportaša je učestalost ISS-a oko 0,1 - 2 na 100 000 godišnje, u rasponu od 1 : 40 000 do 1 : 80 000 ili čak između 1 : 3000 i 1 : 1 000 000, ali dvostruko do trostruko viša nego u njihovih vršnjaka, nesportaša.¹⁷ Trenutačne stope ISS-a mogu biti mnogo veće, posebno u muškaraca, Afroamerikanaca i košarkaša, čemu pridonose, u njih češći, Marfanov sindrom i disekcija aorte.¹⁸ Paradoksalno, iako umjerena tjelesna aktivnost smanjuje srčanožilne čimbenike rizika, velika tjelesna opterećenja mogu biti „okidač“ za nastanak ISZ-a, posebno srčanom bolesniku. Oko 90 % ISS-a pojavljuje se tijekom ili neposredno nakon tjelesnog opterećenja, osobito uz HCM i nasljedne strukturne ili aritmogene abnormalnosti, većinom (oko 90 %) u asimptomatskih rekreativaca, a ne u sportaša natjecatelja.¹⁷⁻²⁰ Obdukcijski nalaz u 10 – 15 % ili više slučajeva ne može utvrditi strukturnu anomaliju kao uzrok smrti, a genetsko testiranje, tzv. molekularna obdukcija u njih, to može u do 30 % slučajeva, kada je najčešće posrijedi kanalopatija.²¹ Za razliku od opće populacije, Međunarodni olimpijski odbor, Europsko i Američko kardiološko društvo podržavaju provođenje probira sportaša, koji se sastoje od anamneze, kliničkoga pregleda i EKG-a, a, prema potrebi, još i holter EKG-a, ehokardiografiju, ergometriju i dr.²²⁻²⁴ Takav probir može smanjiti učestalost ISS-a, prije svega otkrivanjem kardiomiopatija, kao u talijanskoj regiji Veneto, gdje je smrtnost smanjena za 90 % nakon uvođenja preventivnog pregleda sportaša koji je uključivao i snimanje EKG-a.²⁵

be caused by the heart that takes place within one hour of initial symptoms if witnessed or within 24 hours of the last time the victim was observed if SCD was not witnessed directly.¹

SCD is a major public health issue that affects approximately 3.8 million people every year, representing 50% of all cardiovascular deaths and approximately 20% of all deaths, with it being the first manifestation of heart disease in 50% of cases. Most SCDs, 60% to 80%, take place outside the hospital, of which 65-80% take place in a residential setting and 20% in public places.¹⁻³ The incidence of SCD significantly increases with patient age. It is very low in those aged less than 35 years, comprising <1% of all SCD, of whom at least 5-10% have a normal heart structure, so genetic testing can improve identification of SCD causes. During infancy and childhood, the incidence is 1-2 per 100 000 inhabitants, with the incidence in men being up to 5 times higher, as in other age groups. The incidence is higher at the ages between 15 and 35 (approximately 3.2/100 000), and causes in persons younger than 35 are usually hypertrophic cardiomyopathy (HCM) and other cardiomyopathies, as well as cardiac channelopathies, with coronary heart disease (CHD) being the leading cause of SCD among patients older than 35.⁴⁻⁶ In middle age, the fifth and sixth decades of life, incidence reaches 50/100 000, and the incidence surpasses 200/100 000 in the eighth decade of life, when CHD is the most common cause of SCD.^{7,8}

Emergency medical services (EMS) usually successfully treat 50-60% of all SCAs, consequently making incidence assessments uncertain. In Europe, the incidence of SCA is approximately 300 000 patients treated by EMS, i.e. 30/100 000 inhabitants, with a survival rate of 10.7%,⁹ whereas in the *EuReCa* study the incidence was approximately 600 000 (84/100 000 inhabitants, 62/100 000 in Croatia at the time), with 10.3% surviving until hospital discharge.¹⁰ According to the few studies and assessments performed in Croatia, the incidence of SCA is significantly higher than in Europe, with large regional differences.¹¹⁻¹⁵ In the Split-Dalmatia County, for example, EMS treated 291 patients with SCA (approximately 65/100 000), of whom 21 (7.2%) survived until hospital discharge.¹⁴ In the United States, different explanations have been offered for similar wide ranges in SCA assessments ranging from 250 000 to 400 000 or more.¹⁶

In athletes, the incidence of SCD is approximately 0.1-2 per 100 000 annually, with a range between 1:40 000 to 1:80 000 or even between 1:3000 and 1:1 000 000, but twice to three times higher than in other non-athlete members of their age group.¹⁷ Current rates of SCD can be significantly higher, especially in men, African-Americans, and basketball players, in part due to Marfan syndrome and aortic dissection, which are more common in these populations.¹⁸ Paradoxically, although moderate physical activity reduces cardiovascular risk factors, strenuous physical activity can be a trigger for SCA, especially in patients with heart diseases. Approximately 90% of SCDs occur during or immediately after strenuous physical activity, especially with HCM or hereditary structural or arrhythmogenic abnormalities, mostly (approximately 90%) in asymptomatic persons engaging in sports recreationally, and not in competitive athletes.¹⁷⁻²⁰ In 10-15% or more cases, autopsy fails to identify any structural defect as the cause of death, and genetic testing, e.g. molecular obduction, identifies a cause in up to 30% of cases, usually due to channelopathy.²¹ In contrast to screening in the general population, the International Olympic Committee and European and US cardiological societies recommend performing screening in athletes, consisting of taking a medical history, performing a clinical examination, performing an ECG and if needed also a Holter ECG, echocardiography, ergometry, etc.²²⁻²⁴ This screen-

Reverzibilni uzroci srčanog zastoja, fibrilacija klijetki (VF) i postojana ventrikulska tahikardija (pVT), zahtijevaju žurno obnavljanje srčane i cerebralne cirkulacije. Rana defibrilacija u tom je slučaju najučinkovitija te bitno povećava preživljenje nakon ISZ-a, ali gotovo isključivo u bolesnika s VF/pVT-om, u kojih najčešće i nastupi ISZ (60 – 85 %), da bi se u sljedećih nekoliko minuta transformirale u asistoliju. Očekivano preživljenje žrtve ISZ s VF/pVT, koju se može uspješno defibrilirati, do 10 puta je veće nego u slučaju asistolije. Niske stope preživljenja posljedica su kašnjenja djelotvorne defibrilacije jer se svakom minutom kašnjenja smanjuje preživljenje za 10 – 12 %.²⁶⁻²⁸ Kardiopulmonalna reanimacija (KPR) most je do defibrilacije: usporuje smanjenje amplitude VF-a i njezinu pretvorbu u asistoliju te povećava preživljenje za dva do tri puta, čak i ako je, prije dolaska HMP-a, provode očevidci samo kompresijom prsnog koša. Korist od ventilacije tijekom KPR-a upitna je i nije dio preporučene poduke za netrenirane spasioci u Smjernicama ESC-a 2021.^{29,30} Štoviše, rezultati KPR-a koji izvode medicinski profesionalci često su lošiji zbog prekidanja kompresije davanjem injekcije, intubacije i slično. Nema dokaza ni da bi preživljenje bilo veće uz napredno održavanje života nego uz osnovno održavanje.³¹

Važno je upozoriti na dobru prognozu oboljelih od ISZ-a nakon što su uspješno spašeni od sigurne smrti. Naime, njihovo se očekivano trajanje života gotovo ne razlikuje od onoga u općoj populaciji. Tako je jedna metaanaliza švicarskih autora, na gotovo 17 000 reanimiranih osoba, pokazala da nakon tri godine preživi njih 82,8 %, nakon 5 godina 77,0 % te čak 57,5 % nakon 15 godina.³²

Zbog pandemije bolesti COVID-19 reanimacija se provodila bez umjetnog disanja jer žrtva možda ima COVID-19. Tijekom takve ili slične epidemije poželjno je da spasioci primjenjuju samo kompresiju i defibrilaciju. Zdravstveni se djelatnici trebaju koristiti osobnom zaštitnom opremom, a defibrilaciju valja razmotriti i prije postavljanja te opreme. Reanimator stavlja masku na bolesnikovo lice, a disanje provjerava praćenjem kretanja prsnog koša. Prije masaže prsnog koša bolesnikova usta valja pokriti komadom tkanine ili maskom, ne provoditi umjetno disanje usta na usta, nego samo masažom prsnog koša.³³

Javno dostupna rana defibrilacija

Vrijeme i mjesto pojave ISZ-a su nepredvidivi, pa nigdje u svijetu HMP ne može stići do većine žrtava ISZ-a i započeti oživljavanje unutar poželjnih 3 – 5 minuta, kada je reanimacija najuspješnija.³⁴ U Švedskoj HMP stigne prosječno za 11 minuta,²⁷ u Hrvatskoj je cilj „da u 80 % slučajeva to bude oko 10 minuta u urbanim, a oko 20 minuta u ruralnim sredinama”.³⁵ Uobičajeno je to vrijeme upola kraće u urbanim nego u ruralnim sredinama,³⁶ npr. prosječno vrijeme odziva HMP-a nakon telefonskog je poziva oko 7 minuta u gradskim uvjetima, a premašuje 14 minuta u ruralnim.³⁷ Stoga je važna pomoć očevidaca i dostupnost uređaja za prepoznavanje i zbrinjavanje pVT/VF-a. Automatski vanjski defibrilator (AVD) upravo je takav uređaj, siguran i jednostavan za rukovanje, gotovo 100 % osjetljiv i specifičan za pVT/VF, a glasom i tekstom, i na hrvatskom jeziku, omogućuje i neuvježbanoj osobi gotovo bezopasnu izvedbu defibrilacije. Nakon što uređaj otkrije pVT/VF, šok se isporučuje pritiskom na tipku uređaja ili, rjeđe, automatski.^{38,39}

ing can reduce the incidence of SCD, primarily by discovering cardiomyopathies, as in the Italian province of Veneto where mortality was reduced by 90% after the introduction of preventive examinations of athletes that included an ECG.²⁵

The reversible effects of cardiac arrest, namely ventricular fibrillation (VF) and pulseless ventricular tachycardia (pVT), require urgent reestablishment of cardiac and cerebral circulation. Early defibrillation is the most effective measure in such cases, and it significantly increases survival after SCA, but almost exclusively in patients with VF/pVT, the most prevalent cause of SCA (60-85%), with a transformation to asystole developing within several minutes. Expected survival in patients with SCA with VF/pVT who receive successful defibrillation is up to 10 times higher than in cases of asystole. The low survival rates are the consequence of late application of effective defibrillation, since every minute of delay reduced survival by 10-12%.²⁶⁻²⁸ Cardiopulmonary reanimation (CPR) is the bridge to defibrillation: it slows down the reduction of the VF amplitude and its transformation to asystole and increases survival by two to three times, even if performed by bystanders with chest compression only before the arrival of EMS. The effectiveness of ventilation in CPR is questionable and is not part of the recommended education for untrained rescuers in the ESC 2021 Guidelines.^{29,30} Furthermore, the results of CPR performed by medical professionals are often worse due to interruptions in compression in order to administer injections, intubate the patient, etc. There is no evidence that survival would be improved by advanced resuscitation in comparison with basic resuscitation.³¹

It is important to emphasize the favorable prognosis of patients with SCA after they have been successfully saved from certain death. Their expected lifespan is nearly identical to the general population. One metaanalysis conducted by Swiss authors on almost 17 000 resuscitated persons showed that survival after three years was 82.8%, 77.0% after 5 years, and as high as 57.5% after 15 years.³²

During the COVID-19 pandemic, resuscitation was performed without artificial respiration since the victim might potentially have COVID-19. In this or similar epidemics, rescuers should only apply compression and defibrillation. Health-care workers should use personal protective equipment, and defibrillation should be considered even before donning the protective equipment. The resuscitator places a mask on the face of the victim and monitors breathing by observing chest movements. Before administering chest compression, the victim's mouth should be covered by a piece of cloth or a mask, and the resuscitator should refrain from mouth-to-mouth artificial respiration, using chest compressions only.³³

Public access to early defibrillation

When and where SCA will happen is unpredictable, and, for most victims of SCA, nowhere in the world can EMS arrive and start the resuscitation within the ideal 3-5 minutes, when reanimation is most successful.³⁴ In Sweden, EMS arrive in an average of 11 minutes,²⁷ and in Croatia the goal is to achieve a response time of “approximately 10 minutes in 80% of cases in urban areas, and approximately 20 minutes in rural areas”.³⁵ It is common for the response time to be half as long in urban areas in comparison with rural areas,³⁶ e.g. the average EMS response time after the phone call is approximately 7 minutes in urban conditions and over 14 minutes in rural settings.³⁷ Assistance from bystanders is therefore important, as is the

Prvu je defibrilaciju na otvorenome prsnom košu, tijekom kirurškog zahvata, izveo Claude Beck 1947. godine,⁴⁰ a na zatvorenome prsnom košu Paul Zoll i kolege 1956.⁴¹ Prvu izvanbolničku defibrilaciju obavio je Frank Pantridge u vozilu hitne pomoći 1966. u Irskoj, od 80-ih godina 20. st. AVD je u širokoj primjeni medicinskog osoblja, a postupno, sve više i u općoj populaciji.

Program Javni pristup ranoj defibrilaciji (PAD; prema engl. *Public Access Defibrillation*) pokrenut je 1990. godine u SAD-u s naglaskom na ranu KPR i ranu defibrilaciju s pomoću AVD-a, od educiranih ili needuciranih očevidaca ISZ, prije dolaska HMP-a. Pokazalo se da je preživljenje oboljelih od ISZ-a gotovo dvostruko veće u skupinama kojima je pružena KPR i defibrilacija nego u onih kojih je pružena samo KPR. Prethodni trening s AVD-om rezultira češćom uporabom AVD-a i kraćim vremenom do potvrde šokabilnosti ritma (prosječno, 2,7 minuta brže) i do defibrilacije.⁴²

Definirane su četiri razine PAD-a:

- tradicionalno prvi reagiraju policija ili vatrogasci opremljeni AVD-om, koje dispečer HMP-a, pri sumnji na ISZ, može uz HMP usmjeriti u teže dostupne, npr. u ruralne, sredine.
- drugu razinu PAD-a predstavljaju netradicionalni prvi reaktori, osobe s „dužnošću reagiranja“ (zaštitari, stjuardese), osobito u zatvorenim prostorima (kockarnice, avioni, zračne luke).
- treću razinu PAD-a čine, najčešće minimalno, podučene osobe za KPR i defibrilaciju s AVD-om, koji je dostupan, obično u obitelji s visokorizičnim članom.
- četvrta i najčešća razina jesu očevidci na javnim mjestima, s podukom za primjenu AVD-a ili bez nje.⁴³⁻⁴⁶

Mnogi PAD programi s mnogo podučениh volontera i dostupno razmještenih AVD-a, pružanjem pomoći prije dolaska HMP-a, omogućuju dvostruko i trostruko veće preživljenje pogođenih od ISZ-a od onog koje postiže HMP.⁴⁷⁻⁴⁹ Stoga Europsko vijeće za reanimatologiju svojim smjernicama potiče PAD programe u kojima očevidac, nakon procjene stanja (ne dulje od 10 sekundi), bolesnikov gubitak svijesti i izostanak ili nepravilno disanje označi kao ISZ, odmah pozove HMP i započne KPR vanjskom masažom srca utiskujući sternum za 5 – 6 cm, ritmom od 100 - 120/min. Smjernice iz 2021. za osnovno održavanje života ne preporučuju ventilaciju za nepodučene volontere i za podučene koji to ne žele. Takva se KPR lakše nauči i izvodi, pa su stope reanimiranja i preživljenja od ISZ-a veće, a nuspojave rjeđe.^{30,50,51} Stoga Europsko kardiološko društvo preporučuje primjenu AVD-a,³⁹ a Europski parlament deklaracijom poziva članice da ustanove programe javno dostupne defibrilacije i žurno donesu zakone o uvjetima pružanja javno dostupne laičke reanimacije.⁵²

Hrvatski nacionalni program „Pokreni srce – spasi život“

Sukladno tim preporukama, Ministarstvo zdravstva (MZ) Republike Hrvatske 2013. (i ponovo 2020.) donosi Pravilnik o provođenju programa javno dostupne rane defibrilacije, uvjete za kupovanje, postavljanje i uporabu AVD-a, obvezu registracije i vođenja registra AVD-a, kao i registar oživljavanja primjenom AVD-a od osposobljenih osoba, te način osposobljavanja volontera.^{53,54} Iste godine tadašnje MZ, zajedno s Hrvatskim zavodom za hitnu medicinu (HZHM) i Hrvatskim zavodom za javno zdravstvo pokreće program javno dostupne rane defib-

availability of devices for identifying and treating pVT/VF. An automated external defibrillator (AED) is just such a device, with an almost 100% sensitivity and specificity for pVT/VF, and uses speech and text, including the Croatian language, to allow even an untrained person to perform almost risk-free defibrillation. After the device identifies pVT/VF, a shock is delivered either by pressing a button or automatically, although the latter is rarer.^{38,39}

The first defibrillation was performed during surgery on an open chest by Claude Beck in 1947,⁴⁰ whereas the first closed-chest defibrillation was performed by Paul Zoll and colleagues in 1956.⁴¹ The first defibrillation outside the hospital was performed by Frank Pantridge in an ambulance vehicle in 1966 in Ireland, and AEDs have been widely used by medical staff since the 1980s, gradually becoming more and more accepted by the general population as well.

The Public Access Defibrillation (PAD) program was started in 1990 in the United States with an emphasis on early CPR and early defibrillation using an AED, performed by educated or uneducated bystanders to an SCA before the arrival of EMS. It has been shown that survival of victims of SCA was almost twice as high in groups that received CPR and defibrillation in comparison with those who received only CPR. Previous training in the use of AEDs results in more frequent AED use and a shorter shockable rhythm confirmation time (on average 2.7 minutes faster) and a shorter time to defibrillation.⁴²

Four levels of PAD have been defined:

- The traditional first responders are police or firefighters equipped by AEDs, who can be directed to less accessible, e.g. rural, areas together with EMS by an EMS dispatcher when SCA is suspected.
- The second level of PAD comprises non-traditional first responders, persons with a “duty to respond” (security guards, flight attendants), especially in enclosed spaces (casinos, airplanes, airports).
- The third level of PAD comprises persons with training, usually only minimal, in applying CPR and defibrillation, with an AED being available, usually in the family home of an at-risk individual.
- The fourth and most common level are bystanders in public places, with or without training in using AEDs.⁴³⁻⁴⁶

Numerous PAD programs with many trained volunteers and AEDs distributed so that they are available can provide assistance before the arrival of EMS, thus leading to a twice or three times higher survival rate for victims of SCA compared with that achieved by EMS alone.⁴⁷⁻⁴⁹ The guidelines of the European Resuscitation Council therefore encourage PAD programs in which bystanders, after assessing the patient’s state (not longer than 10 seconds), identifies their loss of consciousness and the lack or irregularity of their breathing as SCA, immediately calls EMS, and begins CPR by employing external heart compression, depressing the sternum by 5-6 cm at a rhythm of 100-120/min. The guidelines from 2021 for basic resuscitation do not recommend artificial ventilation for untrained volunteers and for trained practitioners who do not want to perform it. This kind of CPR is easier to learn and perform, leading to higher resuscitation and survival rates for SCA and less common side-effects.^{30,50,51} Therefore, the European Society of Cardiology recommends the use of AEDs,³⁹ and the European Parliament has issued a declaration calling on member states to establish programs for publicly available defibrillation and urgently pass laws on the conditions for providing publicly available lay resuscitation.⁵²

rilacije „Pokreni srce – spasi život“ koji će, u suradnji s drugim ministarstvima i Hrvatskim crvenim križem, Hrvatskim društvom za reanimatologiju Hrvatskog liječničkog zbora, udrugama i javnim medijima provoditi javnozdravstvenu edukaciju građana u svrhu podizanja svijesti o ISZ-u te o važnosti rane KPR i rane defibrilacije uz povećanje dostupnosti AVD-a na mjestima okupljanja građana i osposobljavanje što više sugrađana za provođenje KPR-a i defibrilacije.⁵⁵

Tada je u sustav HZHM umreženo 195 AVD-a, a HZHM od tada je organizirao više od 600 tečajeva i osposobio više od 5000 volontera za pomoć žrtvama ISZ-a uz primjenu AVD-a, a na svojim je stranicama objavljivalo videomaterijale za edukaciju potencijalnih reanimatora. Osim toga, HZHM u suradnji s MZ-om, cijelo desetljeće kontinuirano provodi i druge sastavnice programa „Pokreni srce – spasi život“, uključujući vođenje registra AVD-a na Mreži AVD-a Hrvatske, a obilježavanjem Svjetskog dana oživljavanja i drugih jubileja postavljanjem, pokatkad prvog, javnog AVD-a u stanovitom naselju uz istovremenu edukaciju volontera.⁵⁶

Hrvatsko kardiološko društvo, uz pomoć studentske udruge StEPP i Grada Zagreba, preko Zaklade „Hrvatska kuća srca“ od 2014. u projektu „Oživi me“, podučilo je do sada više od 7500 sugrađana u suvremenom zbrinjavanju žrtava ISZ-a. Naglašavajući važnost brzoga prepoznavanja srčanoga zastoja i javnoga pristupa ranoj defibrilaciji HKD-a, zalaže se za postavljanje što većega broja defibrilatora i za uvođenje nacionalnoga programa edukacije oživljavanja u obrazovne institucije, čime bi, kao na sjeveru Europe, bar polovica odraslih građana ovladala vještinom KPR-a.⁵⁷

Udruga reanimiranih „Živi bili“ u Splitu još je 2009. prijavila Ministarstvu znanosti, obrazovanja i sporta sličan PAD projekt, po uzoru na prvi europski projekt rane defibrilacije „Piacenza progetto vita“ iz 1998. godine. Nakon jedne pozitivne recenzije projekt se „zagubio“ prema Zakladi za znanost RH. Udruga je, uz podršku gradske uprave Splita, unatoč slabom odzivu sugrađana, u desetak godina osposobila za KPR i defibrilaciju 220 dobrovoljaca (vatrogasci, zaštitari i volonteri), osvježujući, preko medija, sugrađane o javnozdravstvenoj važnosti ISZ-a i laičke reanimacije.¹⁵

Slabosti i moguća poboljšanja programa javno dostupne rane defibrilacije

Nakon više od 30 godina postojanja PAD programa, defibrilacija prije dolaska HMP-a diljem svijeta, uz velike regionalne razlike, stagnira na nekoliko postotaka s vrlo malim učinkom na preživljenje. Glavni su razlozi za to: većina ISZ-a događa se u stambenim okruženjima neprikladnim za defibrilaciju, motivirani i osposobljeni volonteri su rijetki, AVD uređaja je vrlo malo, a postojeći često nedostupni, AVD registri su nepotpuni, a PAD programi često nisu uključeni u lokalnu HMP nego ih vode regionalne vlasti, vatrogasne službe ili druge organizacije.⁵⁸⁻⁶³ U Hrvatskoj je podrška provedbi programa „Pokreni srce – spasi život“ nedostatna pa je osposobljenih za KPR i defibrilaciju malo, a broj dostupnih AVD-a nedostatan. Stoga se i KPR koju provedu promatrači prije dolaska HMP rijetko događaju (4 do 25 %, iznimno više), a defibrilacija još rjeđe, najčešće 0 do 14,5 %. Preživjeli do otpusta iz bolnice malokad se navode, pogotovo one koje su defibrilirali promatrači, a češće su to postotci povratka spontane cirkulacije do prijema u bolnicu.^{12-15,64} „Preživljenja se ne bi trebala temeljiti samo na

The “Restart a Heart – Save a Life” Croatian national program

Based on these recommendation, in 2013 and 2020 the Ministry of Health (MH) of the Republic of Croatia passed two Ordinances that addressed the implementation of the public access defibrillation program, conditions for the requisition of devices and for placement and use of the AEDs, mandatory registration and registry maintenance for AEDs as well as a registry for resuscitation involving use of AEDs by trained persons, and methods for training volunteers.^{53,54} In the same year, together with the Croatian Institute of Emergency Medicine (CIEM) and the Croatian Institute of Public Health, the MH started a program for public access early defibrillation named “Restart a Heart – Save a Life”, which will, in cooperation with other ministries and the Croatian Red Cross, the Croatian Society for Reanimatology of the Croatian Medical Association, other associations, and the media, conduct a public health education program for citizens, with the goal of improving awareness on SCA and the importance of early CPR and early defibrillation, while also improving access to AEDs in public meeting spaces and training as many citizens in CPR and defibrillation as possible.⁵⁵

At that time, the MH integrated 195 AEDs into the EMS system, and the CIEM has since organized more than 600 courses, training over 5000 volunteers to assist victims of SCA using AED. Additionally, the organization has disseminated educational video materials on its website for the training of potential rescuers. Furthermore, in collaboration with the MH, CIEM has consistently implemented various components of the “Restart a Heart – Save a Life” program for a decade, including maintaining a registry of AED placements on the Croatian AED Network and marking occasions such as World Restart a Heart Day and other anniversaries by installing, at times, the first public AED in various communities, accompanied by volunteer education efforts.⁵⁶

The Croatian Cardiac Society, with the assistance of the StEPP student association and the City of Zagreb, has been implementing the project “Revive Me” through the “Croatian Heart House” foundation since 2014, and this initiative has to date successfully trained over 7500 citizens in modern cardiopulmonary resuscitation for victims of SCA. In addition to emphasizing the importance of swift identification of cardiac arrest and public access to early defibrillation, the Croatian Cardiac Society advocates for the widespread placement of defibrillators and the introduction of a national resuscitation education program into educational institutions, which would, as in northern Europe, allow at least half of the adult population to acquire proficiency in CPR skills.⁵⁷

“Živi bili” (i.e. “Stay Alive”), an association for resuscitated individuals in Split, submitted a similar PAD project to the Ministry of Science, Education, and Sports as early as 2009, modeled after the first European early defibrillation project “Piacenza progetto vita” from 1998. Following a positive review, the project seems to have “vanished”, according to the Croatian Science Foundation. Despite limited response from citizens, the association, with the support of the municipal administration of the City of Split, has trained approximately 220 volunteers (firefighters, security personnel, and volunteers) in CPR and defibrillation over the course of a decade, raising public awareness through media channels on the public health significance SCA and lay resuscitation.¹⁵

postotcima preživljenja već i na broju preživjelih iz te populacije jer pristranost uključivanja može utjecati na ishode preživljavanja.⁶⁵ Prema procjeni, primjena AVD-a od promatrača u SAD-u i Kanadi godišnje spašava 474 života,⁴⁶ a u Hrvatskoj bi takvih moglo biti malo, do pet godišnje. Toliko mali broj spašenih žrtava srčanog zastoja dovodi u sumnju isplativost i svrsishodnost PAD-a. Naime, razina isplativosti takvog programa procjenjuje se na 30 000 - 50 000 USD za kvalitetnu godinu spašenog života. Ipak, čini se da su ti troškovi u skladu s drugim, podjednako učinkovitim zdravstvenim intervencijama.⁶⁶⁻⁶⁸ Nove strategije i oprema PAD programa vjerojatno će češćom primjenom AVD-a povećati preživljenje oboljelih od ISZ-a i tako sniziti omjer troškova i preživjelih.⁶⁹ Za bolji ishod srčanog zastoja nužna je nova tehnologija, usmjerena na poboljšanje svih razina, od prevencije srčanog zastoja do rane defibrilacije. Kako se većina ISZ-a događa u stambenim prostorima, gdje je provedba PAD programa osobito loša, baš u tim i ruralnim, ali i u ostalim sredinama, valja PAD osnažiti novostima kao što su identifikacija i slanje najbližega promatrača i obližnjeg AVD-a na mjesto srčanog zastoja, uporabu dronova i helikoptera za dopremu AVD-a te sve ostale pogodnosti nove tehnologije, koje su već stekli veliku pozornost diljem Europe i svijeta.⁶⁹⁻⁷¹

Poticanje ranoga otkrivanja srčanog zastoja

Prepoznavanje ISZ-a prvi je korak prema KPR-u i ranoj defibrilaciji, osobito u stambenom okruženju, gdje se ISZ događa često bez očevidca i rane reanimacije, pa je smrt kudikamo najčešći ishod. Zato članove bolesnikove obitelji, česte svjedoke ISZ-a, treba podučiti kako prepoznati ISZ, odmah izravno nazvati broj HMP-a i započeti KPR i što prije ga defibrilirati te suzbiti strah od moguće štete, pravne odgovornosti ili osjećaja krivnje ako reanimacija ne uspije.⁷²⁻⁷⁴ Rano prepoznavanje srčanog zastoja, ili prijetjećeg ISZ-a, mogu olakšati mobilni uređaji kao što su pametni sat, mobilni telefon, videozapis ili telemedicinski holter EKG-om. Te naprave mogu otkriti poremećaj ritma i frekvencije srca kod prijetjećeg ili već nastalog ISZ-a, daljinski upozoriti promatrača ili HMP kada senzori upućuju na malignu aritmiju, a prikaz sigurnosne kamere bolesnikova stereotipnoga ponašanja, npr. dodirivanje lica prije nego će pasti. Neki sustavi mogu automatski obavijestiti prolaznike i HMP.⁷⁵ Beskontaktno je moguće mobilnim aplikacijama gotovo nepogrešivo utvrditi agonalno disanje, tešku hipoksiju, hrkanje, hipopneju te centralnu i opstruktivnu apneju tijekom spavanja.⁷⁶

Bolja dostupnost, pouzdanost i uporabljivost automatskoga vanjskog defibrilatora

Za uspješan PAD potrebno je mnogo AVD-a javno dostupnih 24 sata na mjestu dobre vidljivosti kao što su npr. kafići i bankomati i sl. Jednako su važni registri tih AVD-a u koje treba uključiti i privatne radi pomoći dispečeru HMP pri traženju, žrtvi ISZ-a, najbližeg AVD-a. U Istarskoj županiji postoji npr. aplikacija *Staying Alive* koja, preuzeta na mobilni telefon, pronalazi lokaciju najbližeg AVD uređaja. U Hrvatskoj ne postoji točan broj registriranih AVD-a. Prema Pravilniku,^{53,54} prije postavljanja AVD-a, vlasnik je obavezan osposobiti potencijalne reanimatore, a HZHM-u prijaviti datum i mjesto postavljanja AVD-a i oživljavanja uporabom tog AVD-a, radi formiranja

Weaknesses and possible improvements of the public access early defibrillation program

After more than 30 years of the existence of PAD programs, defibrillation before the arrival of EMS has been, despite large regional differences, stagnating at several percentage points worldwide, with a very low effect of survival. The main reasons for this are as follows: most SCA take place in residential settings that are not suited for defibrillation, motivated and trained volunteers are rare, AEDs are very few in number, with existing devices often being unavailable, AED registries are incomplete, and PAD programs are often not included in the local EMS network but are instead run by regional governments, firefighting services, or other organizations.⁵⁸⁻⁶³ In Croatia, support for the "Restart a Heart – Save a Life" has been insufficient, which has resulted in a low number of persons trained in CPR and defibrillation, and the number of available AEDs remains insufficient. Consequently, CPR before the arrival of EMS is rarely applied by bystanders (in 4% to 25% of cases, very rarely more than that), and cases in which defibrillation is applied are even rarer, usually 0% to 14.5%. Data on survival until hospital discharge, particularly data on defibrillation by bystanders, are infrequently reported; more commonly documented are the rates of return of spontaneous circulation prior to hospital admission.^{12-15,64} "Survival data should not be based only on survival rates, but also on the number of survivors in a given population, because inclusion bias can influence the survival outcomes".⁶⁵ Based on the estimate that the application of AEDs by bystanders saves 474 lives annually in the USA and Canada⁴⁶, in Croatia there would be only up to five such cases per year. Such a low number of lives saved among victims of cardiac arrest raises doubt about the cost-effectiveness and purposefulness of PAD programs. The cost-effectiveness of such programs is estimated at 30 000-50 000 USD per quality-adjusted life year saved. Nevertheless, these costs appear to be in line with other similarly effective healthcare interventions.⁶⁶⁻⁶⁸ New strategies and equipment for PAD programs will likely improve survival in victims of SCA through more frequent utilization of AEDs, thereby reducing the cost-survival ratio.⁶⁹ Improving SCA outcome requires new technologies focusing on improvement across all levels, from preventing cardiac arrest to early defibrillation. Since the majority of SCAs occur in residential settings, where the implementation of PAD programs is particularly deficient, PAD programs must be enhanced primarily in these environments, as well as in rural and other areas, with innovations such as identification and dispatch of the nearest bystander and nearby AED to the location of the cardiac arrest, the use of drones and helicopters for AED delivery, and all other conveniences of new technology, which have already received significant attention across Europe and worldwide.⁶⁹⁻⁷¹

Encouraging early detection of cardiac arrest

Identifying SCA is the first step towards CPR and early defibrillation, especially in residential settings, where SCAs often occur without bystanders and early resuscitation, with death consequently being by far the most frequent outcome. Family members of the victim, who often witness the SCA, should therefore be trained to recognize SCA and immediately call the EMS number directly as well as initiate CPR and defibrillation as soon as possible, with preventing fear from possible harm,

registra AVD-a i registra provedenih oživljavanja primjenom AVD-a. Trenutačno se navodi 647 AVD uređaja, od čega 45 u Splitsko-dalmatinskoj županiji.⁷⁷ Međutim, ima ih više jer dio vlasnika svoje uređaja ne prijavljuje HZH-u, a prema podacima dobavljača AVD-a u RH, koji distribuira Zollove AVD-ove, u laičkoj primjeni tih AVD-a ima 764.⁷⁸ Tomu treba dodati oko 200 (osobna komunikacija) instaliranih uređaja drugih proizvođača, što ukupno iznosi gotovo 1000 ili jedan uređaj na oko 3800 hrvatskih stanovnika. U SAD-u primjerice jedan AVD dolazi na oko 300 stanovnika,⁴⁶ što je bar deseterostruko više nego u Hrvatskoj. Dakle, Hrvatskoj treba kudikamo veći broj AVD-a, dostupnih svaki dan 24 sata, osobito u ruralnim i stambenim dijelovima! Naime, oboljele od ISZ-a u blizini takvog AVD-a triput češće defibriliraju očevidci, a preživljenje im se udvostručuje.⁵⁹ Iskoristivost AVD uređaja prije dolaska HMP-a vrlo je mala unutar 500 ili čak 100 m od žrtve ISZ-a, često manja od 3 % ISZ-a.^{59,79,80} Prijavljivanje mjesta postavljenog uređaja i reanimacije AVD-om u Hrvatskoj je vrlo loše jer vlasnici AVD-a nisu motivirani ni poticani, a održavanjem AVD-a, sukladno uputama proizvođača, tijekom 10 godina „kupe“ još jedan uređaj u nadi da će se njime bar jednom koristiti. To treba promijeniti. U Hrvatskoj se oživljavanja primjenom AVD-a vrlo rijetko događaju, a još rjeđe prijavljuju pa su i registri nepotpuni. Uskoro će defibrilacija biti jednostavnija i učinkovitija, jer neke tvrtke razvijaju manji i jeftiniji defibrilator koji će se moći uključiti u kućište mobilnog telefona.⁶⁹

Podizanje javne svijesti i spremnosti većine stanovnika za uporabu automatskoga vanjskog defibrilatora

Žrtvi ISZ-a hitno je potrebna reanimacija jer se svakom minutom kašnjenja vjerojatnost preživljenja smanjuje za 10-ak %.^{26,27} Međutim, svijest javnosti o važnosti KPR-a i defibrilacije, kao i spremnost laika za korištenje AVD-om u slučaju ISZ-a, izrazito je niska. Glavni su razlozi za to medijsko zanemarivanje, nedostatak poduke o reanimaciji te strah od nanošenja štete i od pravne odgovornosti. Bolja informiranost o AVD-u i podučenosť u reanimaciji povećala bi svijest promatrača o važnoj ulozi AVD-a u zbrinjavanju ISZ-a, zajedno sa spremnošću da ga se primjenjuje. Primjerice, medijski obilježen Svjetski dan oživljavanja s porukom „Svi građani svijeta mogu spasiti život“, učinkovito skreće pozornost velikom broju stanovnika, na važnost oživljavanja prije dolaska HMP.⁸¹ Većina njih treba biti motivirana i podučena za pružanje KPR-a i defibrilacije s AVD-om, a za to su nužni obrazovni programi, po mogućnosti obvezni, koji će obuhvatiti veći dio populacije. Edukacija učenika može znatno povećati stope KPR-a / defibrilacije promatrača, jer djeca su dugoročno potencijalni spašavatelji dostupni organiziranom učenju i sposobna usvajati nove vještine i nova znanja. Poduka u reanimaciji, najčešće samo kompresija prsnog koša, počevši s edukacijom učenika od 10. do 11. godine, može pozitivno utjecati na njihove stavove prema oživljavanju i spremnosti za reanimaciju.^{82,83} Svjetska je zdravstvena organizacija, prije nekoliko godina, odobrila program osposobljavanja školske djece (i nastavnika) za KPR pod nazivom „Djeca spašavaju živote“. Na temelju tog odobrenja u Europi je učenje KPR-a uključeno u nastavni plan i program osnovnih i srednjih škola u samo pet zemalja kao zakonska obveza, a kao prijedlog u 23 zemlje.^{84,85} U Hrvatskoj je od 2019. godine na snazi Odluka o donošenju kurikuluma za međupredmetnu temu zdravlje za osnovne i

legal responsibility, or a feeling of guilt in case of failed resuscitation also being an important factor in the education.⁷²⁻⁷⁴ Early identification of cardiac arrest or imminent SCA can be facilitated by mobile devices such as smartwatches, mobile phones, video devices, or a telemedicine Holter ECG. These devices can discover rhythm and heart frequency disorders for imminent or already present SCA or remotely alert a bystander or EMS when sensors indicate malignant arrhythmia, and security cameras can detect stereotypical behaviors of victims of SCA, such as touching the face before falling. Some systems can automatically alert bystanders and EMS.⁷⁵ Mobile applications can almost infallibly perform contactless identification of agonal breathing, severe hypoxia, snoring, hypopnea, and central and obstructive apnea during sleep.⁷⁶

Better availability, reliability, and usability of automatic external defibrillators

Successful implementation of a PAD plan requires many AEDs to be publicly available 24 hours a day in visible locations such as cafes, ATMs, etc. Creating a registry for these AEDs is equally important, and this registry should also include private AEDs, in order to assist EMS dispatchers in finding the closest AED to the victim. For example, the Istria County in Croatia provides the Staying Alive mobile phone application that identifies the location of the closest AED. The exact number of registered AEDs in Croatia is not known. Based on the government Ordinances,^{53,54} prior to deploying an AED, owners are obligated to train potential rescuers, and they must send a report to the CIEM detailing the date and location of AED placement as well as instances of resuscitation employing the AED, with the goal of forming an AED registry and the registry of resuscitations performed using AEDs. Currently, there are reportedly 647 AED devices, with 45 located in the Split-Dalmatia County.⁷⁷ However, the actual number is likely higher due to some owners failing to report their devices to CIEM, and according to AED suppliers in Croatia, which distribute Zoll AEDs, there are currently 764 devices in lay use.⁷⁸ Furthermore, approximately an additional 200 installed devices from other manufacturers should be added to this tally, bringing the total to nearly 1000 AEDs or one device per approximately 3800 inhabitants in Croatia. In comparison, the United States has approximately one AED per 300 residents,⁴⁶ which is at least ten times more than in Croatia. Therefore, Croatia requires a significantly higher number of available AEDs accessible at all times, especially in the rural and residential areas of our country! This is because SCA victims near an AED are three times more likely to be defibrillated by bystanders, resulting in a doubling of survival rates.⁵⁹ The utilization rate of AEDs prior to the arrival of EMS is poor, often below 3% of SCAs even when the AED is within 500 meters or as little as 100 meters away from a victim of SCA.^{59,79,80} Reporting rates on the locations of deployed devices and AED resuscitations in Croatia is very poor, as AED owners lack motivation and incentives, and maintenance of AEDs according to manufacturer instructions often leads to owners “buying” an additional device over a ten-year period in the hope of using it at least once. This must be changed. Resuscitations with an AED are rare and are even more rarely reported, so the registries are incomplete. Defibrillation will soon become simpler and more effective, since some companies are developing smaller and cheaper defibrillators that users will be able to plug as their mobile phones.⁶⁹

srednje škole (NN 10/19). U okviru teme predviđeno je usvajanje vještina prve pomoći za učenike 6. i 7. razreda osnovnih škola te 1. i 2. razreda srednjih škola. Ministarstvo zdravstva u sklopu projekta „Javne ustanove – Prijatelji zdravlja“ također uvodi edukaciju o KPR-u u obrazovne ustanove. Ima i prijedloga da se, zbog „dramatičnog porasta ISZ i alarmantno niskog preživljavanja ISZ“, sve studente dodiplomskih studija svih fakulteta uključi u obvezne tečajeve o KPR-u.⁸⁶

Ubrzan pronalazak (lociranje) potencijalnih spasilaca i defibrilatora

Sustavom za pozicioniranje educirani dispečer HMP-a može trenutačno locirati registrirane korisnike mobilnih telefona, koji su educirani ili needucirani dobrovoljni spasioци ili zdravstveni radnici izvan dužnosti, pa ih usmjeriti prema žrtvi ISZ-a ili, s pomoću registra AVD-a i prema najbližem AVD-u. Neke aplikacije uz videovezu sa spasiocem omogućuju i dispečersko vođenje KPR-a. Aplikacija za pametne mobitele, koju aktivira dispečer, dobrovoljce i vlasnike mobitela upozorava na sumnjivi ISZ blizu njih (najčešće unutar 500 m), s uputama za KPR, dohvat najbližeg AVD-a i defibrilaciju. Takav je sustav vrlo učinkovit, znatno skraćuje vrijeme do intervencije prije dolaska tima KPR-a i povećava stope preživljenja.⁸⁷⁻⁸⁹ Vrijeme do promatračke defibrilacije može se dodatno skratiti, osobito u stambenim i ruralnim područjima, dispečerovim porukama mobitelom koje usmjeruju najbliže volontere prema žrtvi ISZ-a.^{90,91}

Brža dostava automatskoga vanjskog defibrilatora do žrtve iznenadnoga srčanog zastoja

Vrijeme od nastanka ISZ-a do defibrilacije ključno je za uspješnu reanimaciju. Nova, obećavajuća strategija za ranu defibrilaciju jest doprema AVD-a dronom do žrtve povećavajući vjerojatnost promatračke defibrilacije prije dolaska HMP-a i stope preživljenja tih žrtava. U ruralnim i planinskim područjima, gdje HMP najviše kasni, potencijalna je korist od takve letjelice najveća, jer dron tamo stiže do žrtve mnogo prije hitne pomoći, uz prosječnu uštedu vremena od 20-ak minuta. Helikopterska hitna medicinska pomoć također može biti od koristiti u zbrinjavanju ISZ-a i sličnih hitnih situacija, npr. dostava epinefrina za anafilaksiju, podveze za kontrolu krvarenja, naloksona za predoziranje opioidima i slično.⁹²⁻⁹⁵

Prevenција iznenadne srčane smrti sprječavanjem i liječenjem koronarne bolesti srca, kardiomiopatija, kanalopatija i drugih uzroka iznenadnoga srčanog zastoja

Iznenadan srčani zastoj vodeći je uzrok smrti i najhitnije stanje koje godišnje u svijetu doživi oko 3,8 milijuna ljudi.⁶⁹ Najčešći je uzrok KBS, ali se još od 1950. godine ukupna smrtnost od KBS-a znatno smanjuje uz nešto manje smanjenje incidencije ISS-a. Prevencijom i liječenjem koronarne i drugih srčanožilnih bolesti posljednjih 30 godina incidencija ISS-a i dalje se smanjuje.^{96,97} U Hrvatskoj se u to vrijeme bilježi manja smrtnost od akutnog infarkta miokarda i drugih srčanožilnih bolesti, prije svega boljim liječenjem bolesnika s akutnim in-

Increasing public awareness and the willingness of the majority of the population to use an automatic external defibrillator

Victims of SCA urgently require resuscitation, as every minute of delay reduces the probability of survival by approximately 10%.^{26,27} However, public awareness on the importance of CPR and defibrillation, and the willingness of lay bystanders to use AEDs in case of SCA is extremely low. The main reasons for this are neglect of the topic in the media, lack of resuscitation training, and fear of causing harm and suffering legal consequences. Better knowledge on AEDs and resuscitation training would improve bystander awareness on the role of AEDs in treating SCA, while also increasing willingness to employ AEDs in such situations. For example, media coverage of the World Restart a Heart Day with the message “All citizens of the world can save a life” is effective in increasing awareness of a large number of inhabitants on the importance of resuscitation before the arrival of EMS.⁸¹ Most of them need to be motivated and trained in CPR and AED use, which requires educational programs, preferably mandatory, that will involve the majority of the population. Education in schools can significantly increase CPR/defibrillation rates in bystanders, since children are potential rescuers in the long term who are poised to engage in organized learning and capable of acquiring new skills and knowledge. Resuscitation training starting with school education at ages 10 to 11, usually just in chest compression, can have a positive influence on student attitudes towards resuscitation and willingness to resuscitate.^{82,83} Several years ago, the World Health Organization approved a training program for schoolchildren (and their teachers) in CPR named “Children Save Lives”. Based on this approval, CPR training has been included in education plans in European primary and secondary schools as a legal obligation in five countries, and as a recommendation in 23 countries.^{84,85} In Croatia, the Decision on the Adoption of the Curriculum for the Interdisciplinary Topic of Health in Primary and Secondary Schools (Official Gazette 10/19) has been in effect since 2019. Within this framework, the acquisition of first aid skills is envisioned for students in the 6th and 7th grades of primary schools, as well as the 1st and 2nd grades of secondary schools. Additionally, as part of the “Public Institutions – Friends of Health” project, the Ministry of Health has introduced CPR education into educational institutions. It has also been proposed that, due to the “dramatic increase in SCA and alarmingly low SCA survival rates”, all undergraduate students from all faculties also be enrolled in mandatory CPR courses.⁸⁶

Rapid location of potential rescuers and defibrillators

Utilizing a positioning system, a trained EMS dispatcher can instantaneously locate registered users of mobile phones, whether they are trained or untrained voluntary rescuers or off-duty healthcare professionals, and the dispatcher can then direct them towards the victim of SCA using the AED registry to find the nearest AED, with some smartphone applications, complemented by a video connection with the rescuer, even enabling dispatcher-guided CPR. The smartphone application, activated by the dispatcher, warns its volunteer users of suspected SCA in their vicinity (usually within 500 m) and provides instruction for performing CPR, acquiring the nearest AED, and performing defibrillation. Such a system is very effective, significantly reducing time to intervention before the arrival of the EMS team and thus

farktom miokarda kroz mrežu primarne perkutane koronarne intervencije i suvremenim liječenjem aritmija.⁹⁸ Međutim, i dalje će se događati velik broj ISS-a, često kao prvi znak KBS-a, kardiomiopatije, kanalopatije ili drugog uzroka. Stoga će i ubuduće, u svrhu suzbijanja ISZ-a, vrlo važnu ulogu imati prevencija i liječenje tih bolesti u Hrvatskoj, poput genetskih testiranja koja, osobi u riziku, mogu kvantificirati rizik od ISS-a. Ako se ISZ ipak dogodi, uloga javno dostupne rane defibrilacije, primjenom suvremene tehnologije, postat će još važnija i učinkovitija.⁹⁹ Stoga je nužno obveznom podukom osposobiti za KPR i defibrilaciju bar 50 % odraslih: učenike, studente, zaposlenike, vatrogasce, policiju, a zašto ne i navijačke skupine, te višestruko povećati javno dostupne, sve učinkovitije, jeftinije i manje AVD-e. Sve to je i razlog za što skorije aktiviranje Nacionalnoga programa „Pokreni srce - spasi život”, koji će navedeno pokušati provesti u Hrvatskoj, što će unaprijediti PAD i, nadamo se, znatno povećati preživljenje nakon ISZ-a.

increasing survival rates.⁸⁷⁻⁸⁹ Time to bystander defibrillation can also be additionally reduced, especially in residential and rural areas, by having dispatchers send mobile phone messages to guide the nearest volunteers towards the victim of SCA.^{90,91}

Faster delivery of automatic external defibrillators to victims of sudden cardiac arrest

The time from the onset of SCA to defibrillation is crucial for successful resuscitation. A new, promising strategy for early defibrillation involves delivering AEDs to the victim via drone, increasing the likelihood of bystander defibrillation before the arrival of EMS and thus improving the survival rates of these victims. In rural and mountainous areas, where EMS response is most often delayed, the potential benefit of such air transportation is the greatest, as the drone reaches the victim significantly before emergency assistance, saving an average of about 20 minutes. Transportation of emergency medical services by helicopter can also be beneficial in managing SCAs and similar emergencies, for instance by delivering epinephrine for anaphylaxis, tourniquets for bleeding control, naloxone for opioid overdose, etc.⁹²⁻⁹⁵

Prevention of sudden cardiac death by preventing and treating coronary heart disease, cardiomyopathies, cardiac channelopathies, and other causes of sudden cardiac arrest

Sudden cardiac arrest (SCA) is the leading cause of death and the most urgent medical condition that affects around 3.8 million people worldwide every year.⁶⁹ Its most common cause is CAD, but overall mortality from CAD has been falling significantly since 1950, with a slightly lower decrease in the incidence of SCA. Over the last 30 years, the incidence of SCA has continued to decline due to the prevention and treatment of coronary and other cardiovascular diseases.^{96,97} During this period, mortality rates from myocardial infarction and other cardiovascular diseases in Croatia have also been reduced, primarily due to improved treatment of patients with acute myocardial infarction through the network of primary percutaneous coronary interventions and modern arrhythmia management.⁹⁸ However, a large number of SCDs still take place, often as the first sign of CHD, cardiomyopathy, cardiac channelopathy, or other causes. Prevention and treatment of these diseases will continue to have a very important role in preventing SCD, in which genetic testing plays a significant role both globally and in Croatia, as it can quantify the risk of SCD for at-risk persons. If SCA still takes place, the role of public access to early defibrillation with the application of more effective, novel technologies will be even more important and effective.⁹⁹ It is therefore crucial to introduce mandatory training in CPR and defibrillation in order to achieve proficiency in at least 50% of the adult population: schoolchildren, students, employees, firefighters, police, and potentially also in other groups such as football fans, while also greatly increasing the number of publicly available, increasingly effective, and ever cheaper and smaller AEDs. All of this is a reason for activating the “Restart a Heart – Save a Life” national program as soon as possible, as this program aims to implement all this in Croatia, thus improving PAD and, hopefully, also significantly improving survival after SCA.

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