

Hvornår skal forsøg på genoplivning stoppes?

Mathias J. Holmberg
MD, MPH, PhD



Betydningen af at indstille forsøg på genoplivning

	Return of spontaneous circulation*			Survival to discharge†		
	Adjusted risk ratio (95% CI)	Adjusted rate	p value	Adjusted risk ratio (95% CI)	Adjusted rate	p value
Quartile 1 (13 994 patients at 113 hospitals)	1.00	45.3%	..	1.00	14.5%	..
Quartile 2 (18 783 patients at 121 hospitals)	1.04 (0.99–1.09)	47.0%	0.116	1.05 (0.96–1.14)	15.2%	0.304
Quartile 3 (19 106 patients at 107 hospitals)	1.08 (1.03–1.13)	48.8%	0.002	1.05 (0.96–1.14)	15.2%	0.280
Quartile 4 (12 456 patients at 94 hospitals)	1.12 (1.06–1.18)	50.7%	<0.0001	1.12 (1.02–1.23)	16.2%	0.021

*p for trend <0.0001. †p for trend 0.031.

Table 3: Return of spontaneous circulation and survival to discharge in all patients, by hospital quartile

Goldberger, Lancet, 2012

Behov for klare retningslinjer

Clinical factors	Physicians (n=104)		Nurses (n=204)	
	Yes	Undecided	Yes	Undecided
A will of life stating that the patient does not wish to be resuscitated	99 (95.2)	3 (2.9)	173 (84.8)	12 (5.9)
Asystole for >20 minutes, ongoing ACLS and hyperkalemia (corrected) as the cause of cardiac arrest	77 (74.0)	9 (8.7)	101 (49.5)	24 (11.8)
Witnessed arrest with no bystander CPR within 10 minutes	24 (23.1)	8 (7.7)	31 (15.2)	29 (14.2)
Older than 90 years	20 (19.2)	7 (6.7)	33 (16.2)	23 (11.3)
Cardiac standstill on echocardiography	19 (18.3)	17 (16.3)	40 (19.6)	39 (19.1)
Absence of a pupillary light reflex	18 (17.3)	6 (5.8)	45 (22.1)	34 (16.7)
Known cancer disease	15 (14.4)	7 (6.7)	18 (8.8)	25 (12.3)
Severe hyperkalemia (≥ 8 mM)	12 (11.5)	6 (5.8)	14 (6.9)	30 (14.7)
End-tidal CO ₂ <1.33 kPa	11 (10.6)	26 (25.0)	7 (3.4)	80 (39.2)
Prolonged CPR with persistent shockable rhythm	9 (8.7)	8 (7.7)	35 (17.2)	34 (16.7)
Older than 80 years	6 (5.8)	5 (4.8)	7 (3.4)	20 (9.8)
Non-witnessed cardiac arrest	5 (4.8)	10 (9.6)	9 (4.4)	27 (13.2)
Aspiration during resuscitation	4 (3.8)	6 (5.8)	4 (2.0)	25 (12.3)
Hypothermia below 30°	2 (1.9)	5 (4.8)	6 (2.9)	23 (11.3)

Hansen, Open Access Emergency Medicine, 2019

Genoplivningsregler uden for hospitaler

Table 3 TORRs evaluated by the included studies

TORR	Terminate resuscitation if the following criteria are met
BLS) also called 'Universal TOR guideline' ^{6 12-15 17 19 20 23 24 26}	No ROSC prior to transport, no defibrillation attempted prior to transport and arrest was not witnessed by EMS personnel
ALS ^{6 14 15 17 18 26}	No ROSC prior to transport, no defibrillation attempted prior to transport and arrest was not witnessed by EMS personnel or bystander, and bystander CPR was not initiated
Marsden ^{13 19}	Age ≥ 18 years, not poisoning or drowning, initial rhythm not VT/VF, no ROSC prior to transport, and no bystander CPR
Petrie ^{13 19}	Initial rhythm is asystole and call response time > 8 min
Goto ¹²	No prehospital ROSC, unshockable initial rhythm and arrest not witnessed by bystanders
Neuro ¹⁷	Arrest not witnessed by EMS personnel or bystander, age ≥ 78 years and asystole as initial cardiac rhythm
No ROSC ⁷	No ROSC obtained at the scene
Helsinki ¹⁸	(1) In asystole, if OHCA is unwitnessed or delay to arrival of ambulance > 10 min or if ROSC cannot be achieved despite 20 min of ALS, or (2) witnessed PEA if delay to arrival of ambulance > 15 min or ROSC cannot be achieved within 20 min or (3) unwitnessed PEA if ROSC cannot be achieved within 10 min of ALS
ERC ¹⁸	Non-shockable rhythm and ongoing asystole despite 20 min of ALS

Ebell, Emergency Medicine Journal, 2019

Genoplivningsregler på hospitaler

”UN-10 Rule”

(1) ikke bevidnet **(2)** ikke stødbar rytme **(3)** ≥ 10 min uden ROSC

Table 3 – Diagnostic performance for prediction of death across studies. 95% CI: 95% confidence interval.

	Positive predictive value	Specificity	Sensitivity	Negative predictive value
van Walraven et al. ¹⁶	100% (95% CI: 97.1%–100%)	100% (95% CI: 97.1%–100%)	12.2% (95% CI: 10.3%–14.4%)	10.8% (95% CI: 8.9%–12.8%)
van Walraven et al. ¹⁷	98.9% (95% CI: 96.5%–99.7%)	99.1% (95% CI: 97.1%–99.8%)	14.4% (95% CI: 12.4%–16.0%)	17.0% (95% CI: 15.3–18.7)
Petek et al. ¹⁸	93.7% (95% CI: 93.3%–94.0%)	94.6% (95% CI: 94.3%–94.9%)	19.1% (95% CI: 18.8%–19.3%)	22.0% (95% CI: 21.9%–22.0%)

Lauridsen, Resuscitation, 2021

ERC Guidelines 2021

”Persistent asystole despite 20 minutes of advanced life support (ALS)
in the absence of any reversible causes”

Vores tilgang

At udvikle og validere en genoplivningsregel for hjertestop på hospital med følgende kriterier:

- 1 Lav falsk positiv rate ($< 1\%$ anbefalet af ERC og AHA)
- 2 Rimelig positiv rate ($> 10\%$)
- 3 Simpel regel med få variabler

Data fra Danmark, Sverige og Norge

	Danmark	Sverige	Norge
Register	DANARREST	Svenska HLR-registret	Norsk hjertestansregister
Formål	Udvikling	Validering	Validering
År	2017 – 2022	2007 – 2021	2021 – 2022
Antal hjertestop	9450	12 782	2452

Potentielle variabler

Alder

Lokalisation (intensiv vs. ikke intensiv)

Bevidnet

Monitoreret

Første rytme

Tid med genoplivning

Præliminære resultater

25 ud af 26 000 regler med falsk positiv rate < 1% og positiv rate > 10%

	Model 1		Model 2		"UN-10 Rule"		"ERC Guidelines"	
	Ikke bevidnet Ikke monitoreret Asystoli Tid > 5 min		Ikke bevidnet Ikke monitoreret Asystoli		Ikke bevidnet Ikke stødbar rytme Tid > 10 min		Asystoli Tid > 20 min	
	Danmark	Sverige	Danmark	Sverige	Danmark	Sverige	Danmark	Sverige
Positiv rate	13.9%	11.8%	14.2%	12.2%	17.2%	14.4%	11.8%	14.3%
Falsk positiv rate	0.8%	1.0%	1.0%	1.4%	1.5%	1.8%	2.7%	4.0%
Positiv prædiktiv værdi	99.2%	99.0%	99.0%	98.6%	98.5%	98.2%	97.3%	96.0%
Negativ prædiktiv værdi	26.2%	35.2%	26.3%	35.3%	27.1%	36.1%	25.4%	35.7%
Specificitet	99.5%	99.6%	99.4%	99.5%	98.8%	99.2%	98.6%	98.2%
Sensitivitet	17.8%	17.0%	18.2%	17.4%	21.9%	20.5%	14.9%	20.0%

Begrænsninger

Selvopfyldende profeti

Regel kun valideret med data fra nordiske lande

Yderligere faktorer kunne eventuelt forbedre reglens forudsigelsesevne

TOR Rule Criteria %, (95% CI)	Sensitivity	Specificity	PPV	NPV
ALS-TOR rule	27.3 (15.0–42.8)	83.3 (68.6–93.0)	63.2 (42.8–79.7)	52.2 (46.6–57.8)
Extended TOR Rule at t_5	13.6 (5.2–27.4)	88.6 (73.2–96.8)	60.0 (31.5–83.1)	44.9 (40.8–49.1)
Extended TOR Rule at t_{10}	22.7 (11.5–37.8)	93.3 (77.9–99.1)	83.3 (54.1–95.5)	45.1 (40.6–49.8)
Extended TOR Rule at t_{20}	20.0 (9.1–35.7)	100.0 (63.1–100.0)	100.0	20.0 (17.6–22.6)

Kudo, Heliyon, 2023

Opsummering

Beslutningsregler skal ikke anvendes alene til at indstille genoplivning

Høj falsk positiv rate for "UN-10 Rule" og "ERC Guidelines" i nordisk data

Ikke-monitoreret, ikke-bevidnet, asystoli og genoplivningstid over 5 min havde lav falsk positiv rate i præliminære analyser

De endelige resultater bliver valideret i norsk data og publiceret i 2024

Tak!

mathias.holmberg@clin.au.dk

