CanROC
Canadian Resuscitation Outcomes Consortium
Consortium Canadien de Recherche en Réanimation

CanROC:

Reducing the devastation of cardiac arrest

2025 Report of the Canadian Resuscitation Outcomes Consortium

Contents

CanROC is generously funded by Heart & Stroke

1. What is CanROC?

CanROC is a national registry of public health data of people who have experienced sudden cardiac arrest. It is supported by a network of over 100 partners in communities across Canada. Established in 2015 through a partnered grant from Heart & Stroke and the Canadian Institutes for Health Research, this registry now covers 12.5 million people in Canada, with continuing efforts from all provinces to further increase participation.

Approximately **60,000** out-of-hospital **cardiac arrests** occur in Canada each year.

Data from CanROC has substantially improved our knowledge of sudden cardiac arrest in Canada. For example:

- We now know that there are almost 60,000 out-of-hospital cardiac arrests every year — substantially higher than the previous estimate of 35,000. That's one every nine minutes.
- Research shows that for every minute that passes until high-quality CPR is started, the probability of survival with intact neurological function decreases by 13%.

Sudden cardiac arrest can happen to anyone, anytime, anywhere. And fewer than one person in 10 who receives treatment survives an arrest that occurs outside a hospital. It is a major public health concern.

The best chance of survival requires a system that can respond within minutes with the right therapies, engaging both members of the public and professional emergency services.

CanROC's Vision: Every person in Canada who experiences sudden cardiac arrest will receive rapid, effective care and the best possible chance of survival.

CanROC's Mission: To inform and enable the strongest professional and community response across Canada to achieve this vision. We believe this is possible through robust data and collaboration.

2. Why does it matter?

Sudden cardiac arrest is when the heart suddenly and unexpectedly stops beating. Blood stops flowing to vital organs, and brain injury can begin within five minutes. It is a life-threatening emergency.

To understand the burden of cardiac arrest and further improve our response time and treatments, it is essential to understand who has sudden cardiac arrest, where it occurs, what care is provided, and whether the person survives. This data can help healthcare providers, researchers and systems leaders pinpoint areas for improvement and reduce the devastation faced every day by families, workplaces and communities as a result of cardiac arrest.

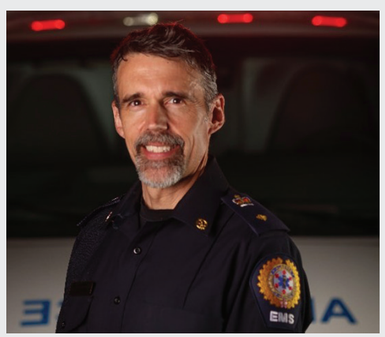
In many countries, tracking sudden cardiac arrest is required by law. In Canada, we are required to track diseases such as leprosy and malaria but not sudden cardiac arrest, despite its substantial cost and many preventable deaths. The CanROC registry aims to fill this gap.

But CanROC is more than a data collection initiative — it's a powerful tool for improving patient outcomes and public health in Canada.

The experience of the North American Resuscitation Outcomes Consortium (2005–2015), which included British Columbia and southern and eastern Ontario, demonstrated that tracking and sharing data on key factors like response times, bystander CPR, and CPR quality significantly improved survival rates. No clinical trial intervention tested during that period matched the impact of simply measuring and addressing gaps in care.

By implementing this national data collection effort across all provinces, we can drive similar improvements across Canada. Shining a light on the quality of care and systemic challenges has the potential to enhance survival rates, identify shared opportunities for improvement, and create a robust foundation for evaluating new interventions.

"CanROC provides the foundation from which paramedic systems can support their people in aligning practice with the latest science, which means better outcomes for patients and support for families."
– Dr. Ian Blanchard, Alberta Health Services EMS



3. The findings so far

CanROC data, and the research based on it, has already generated important learning about the impact of sudden cardiac arrest, including the following:

- **Sudden cardiac arrest is responsible for more deaths each year than COVID-19 and the opioid crisis combined** — even at the height of the pandemic[1,2]. This makes it a severely underestimated public health issue. The tragedy is that more than 90% of people experiencing out-of-hospital cardiac arrest do not survive. But we can save many more lives by implementing existing effective treatments and discovering new ones.
- **Survival increases dramatically if a sudden cardiac arrest happens in public instead of at home.** CanROC data demonstrates that the chance of survival for those who experience cardiac arrest in a public place and/or with witnesses present is many times higher than for those who arrest at home. Since 80% of arrests occur in home settings, we need new ideas to improve survival rates.
- **AED use is low, despite increasing availability.** Rapid CPR and defibrillation by lay responders dramatically increases survival, but automated external defibrillators (AEDs) are only used in about 4% of cases currently, despite their increased availability. We need to increase public access to defibrillation for the 20% of sudden cardiac arrests that occur in public places. There is even greater potential if we can deliver that same rapid action to the 80% of people who experience sudden cardiac arrest at home.
- **Witnesses improve outcomes.** Cardiac arrest survival is much more likely when there's someone present who sees it happen, because both lay and professional response happens more quickly. Modeling studies using CanROC data suggest that for cardiac arrests that are unwitnessed, technology — in a smartwatch, for example — could fill the gap by monitoring 24/7 and calling 9-1-1 with GPS coordinates in the event of a cardiac arrest[3].
- **Long-term outcomes are encouraging for patients who survive to be discharged from hospital.** A recent study demonstrated that, of those discharged from hospital after cardiac arrest, 86% were still alive after three years. Within CanROC, we plan to examine in more detail the long-term journey through recovery and survivorship[4].

Only **1 in 10** people treated for out-of-hospital **cardiac arrest** survives.

- **But not even half of those whose heart is restarted will survive to leave hospital.** By reducing the time to resuscitation using the strategies above, the brain injury caused by prolonged cardiac arrest can be reduced and more patients will survive. We have found that overall, the longer a patient requires CPR, the lower the probability of survival. However, some patients, even with prolonged periods of CPR, will survive with minimal injury. CanROC researchers are working with EMS agencies and hospital teams from across Canada to test new clinical and system-level treatments and therefore reduce the devastating impact of cardiac arrest[5].

4. Exciting discoveries ahead

CanROC brings together care providers and researchers — along with people whose lives have been touched by cardiac arrest — to facilitate quality improvement initiatives and generate and implement new solutions. Researchers use the collected data to better understand the relationships between our treatments or patient characteristics and survival. They also use the data collected to study new techniques or drugs in rigorous, safe and ethical clinical trials. The outcomes of this research can then be used to improve the care provided by professionals and community responders.

Here are some examples of current research with potential to save many more lives:

- **Improving bystander CPR rates (EduCATe study):** Agonal breathing (where an unconscious person gasps and moans) can fool 9-1-1 callers and 9-1-1 communications officers into thinking sudden cardiac arrest victims are breathing and still alive. CanROC researchers are conducting educational studies to improve accurate recognition of sudden cardiac arrest so bystanders can be coached to start CPR. This study should allow us to improve the sudden cardiac arrest care performance for 9-1-1 communications officers across Canada and save hundreds of lives.
- **Improving layperson AED usage rates (Neighbours Saving Neighbours):** The strategy of broad public education and placing more AEDs in communities has had modest success in increasing defibrillation prior to EMS arrival. Based on some international experience, the concept of identifying, training and potentially equipping community volunteers is being explored in Frontenac and Peel counties in Ontario. These programs, generically referred to as Neighbours Saving Neighbours, are complex and require community support and commitments but may be the answer to rapid CPR and defibrillation in arrests at home and in more remote settings. This study uses CanROC data to measure the impact of increasing AEDs in these communities.
- **Using biosensing technology to detect cardiac arrest:** Treatment of cardiac arrest is highly time-sensitive; the single most predictive factor in survival is being witnessed by a bystander, who can call 9-1-1 to activate emergency medical services. Unfortunately, 75% of sudden cardiac arrest cases are unwitnessed. New approaches are needed to rapidly detect sudden cardiac arrest and facilitate a timely professional response. Wearable technologies with continuous cardiac monitoring may be able to "witness" sudden cardiac arrest and call 9-1-1. Modeling using CanROC data has demonstrated that if all previously unwitnessed cardiac arrest cases were detected by technology, overall survival could triple, translating to an additional 6,300 survivors per year in Canada[4]. The overall goal is to develop systems to detect sudden cardiac arrest using wearable devices.

Above: A 9-1-1 communications officer participates in the EduCATe study. Right and above right: Drones (shown carrying AEDs) could improve response time in remote communities.

- **Understanding cardiac arrest due to opioid drug toxicity:** Death from opioid overdoses is a public health crisis in Canada and internationally; in Canada there are over 5,000 opioid toxicity deaths per year. Opioids depress breathing and with no intervention, cardiac arrest results. Every single opioid-related death has progressed through this sequence — with cardiac arrest being the last opportunity to intervene. One of the CanROC sites, British Columbia, started collecting data pertaining to drug toxicity deaths[6,7] in 2016 and found that 10% of cardiac arrest cases occurred in the context of drug toxicity. Other CanROC sites commenced this same data collection in 2022. This data will be critical for monitoring the incidence of cardiac arrest due to drug toxicity and will serve as a foundation for implementation of prospective studies to identify the optimal management strategies for these cases.
- **Innovative defibrillator technique saves lives (DOSE VF study):** Many patients experiencing shockable sudden cardiac arrest require multiple shocks from an AED to survive. CanROC investigators in Ontario published the results[8] of a four-year randomized controlled trial in 2022, which used CanROC infrastructure and data to demonstrate improved outcomes using the novel technique of double sequential external defibrillation (the use of two defibrillators with two sets of pads) compared to standard care. The study has changed practice around the world for patients who present in refractory ventricular fibrillation and is now highlighted in current international guidelines. Moving forward, the researchers will use CanROC data to measure the use of this innovative technique to demonstrate improved survival for this subgroup of patients across the country.

- **Drone delivery of AEDs cuts response time in rural and remote communities:** In rural and remote communities, survival from sudden cardiac arrest is impacted by long EMS response times. CanROC investigators worked with multiple national drone companies and the regulators Transport Canada and NAV Canada to explore the feasibility of using drones to deliver AEDs in rural and remote communities. This work used CanROC data to demonstrate a decrease in response time by employing drones to deliver AEDs. Further work with the regulators and drone manufacturers is ongoing to make this a reality across Canada.
- **Fine-tuning medication dosage could improve treatment (EpiDOSE Trial):** Even though epinephrine has been used for decades to treat sudden cardiac arrest, there is limited proof that the standard dose is effective at improving longer-term outcomes such as survival following hospital discharge. Some research suggests that a lower dose may improve outcomes, but more research is needed. CanROC investigators from the University of Toronto launched EpiDOSE, (epidose.ca) a randomized clinical trial conducted in several centres across Canada that uses the CanROC data platform to answer this question. The objective is to test how effective a lower dose of epinephrine is (up to 2mg total) compared to the current standard dose (up to 6mg total) on survival to hospital discharge in adults who experience an out-of-hospital cardiac arrest.

5. CanROC data: Building the foundation

What data is collected?

CanROC data traces the patient journey from the moment the heart stops beating.

Cardiac arrest occurs	Initial response	Advanced resuscitation	Acute care	Recovery
What is the person's age and sex? Where did the arrest happen? What was the cause of the arrest, if it can be determined? Number of cardiac arrest cases per total population covered	Was the arrest witnessed by a bystander or EMS? Did a bystander use CPR or an AED? Did a 9-1-1 communications officer help the bystander to provide CPR? If a bystander used an AED, what was the patient's heart rhythm?	When did EMS arrive, and who was on the team? Were chest compressions done? For what duration? What was the quality of CPR provided? What was average depth of compressions? Was the heart defibrillated? Were pauses in chest compressions minimized? What medications were administered? Time of all treatments, plus arrival at hospital (or time of death) Did the patient's heart resume spontaneous function?	Did another arrest occur in hospital? Did the patient survive to discharge?	Did they have good neurological function upon release?

How it's collected

CanROC data comes from out-of-hospital and hospital clinical care records that are created by first responders and healthcare providers during the routine course of care for cardiac arrest patients. The process follows these steps.

Authority for collecting data in participating regions is granted through Research Ethics Board (REB) approval and agreements with participating emergency service agencies and hospitals.

Paramedics, firefighters and hospital staff document details of care of cardiac arrest patients as part of routine care.

CanROC researchers identify eligible patients from clinical records (including dispatch records, clinical charting, and defibrillator files). De-identified data is abstracted and entered into a secure database.

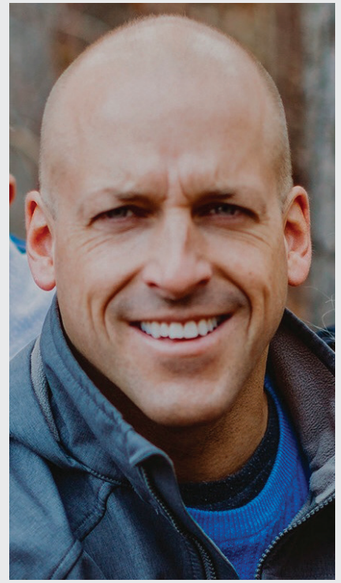
CanROC registry staff review data for errors and inconsistencies and review aggregate statistics.

Investigators develop proposals to analyze the registry data to answer specific clinical questions. CanROC committees review and approve proposals, guided by ethical guidelines and CanROC mission.

How it's used

Disaggregated CanROC data is used for approved analyses. Results are presented to knowledge users and policy makers, and submitted for publication. The goal is improving resuscitation science and patient outcomes.

De-identified CanROC data is combined into reports for the public and specific agencies. The goal is to identify opportunities for local quality improvement by understanding the current state and learning from successes in different jurisdictions.



"Medavie Health Services West has been involved with CanROC since 2016 and during that time, has developed important relationships with other EMS agencies from across the country. We have moved away from the siloing of efforts to a more collaborative approach to cardiac arrest care. MHS West regularly uses CanROC data as a benchmark to help identify areas for improvement."
- Jeff Maxim, Medavie Health Services West, Saskatoon

Where CanROC works

CanROC has active data collection agreements in five provinces. These agreements cover 16 separate regions, accounting for more than 32% of Canada's total population.

5,356,000 in CanROC registry	1,500,000 in CanROC registry	350,000 in CanROC registry	5,226,062 in CanROC registry	173,787 in CanROC registry

One in three Canadians are part of a CanROC research site.

Key anonymized aggregate data by region (2022 data)*

	Province A	Province B	Province C	Province D	Province E	National
Total number of cardiac arrests	10281	533	288	8199	2114	21415
Resuscitation attempted by EMS, %	53%	42%	53%	56%	46%	50%
Male, %	65%	71%	69%	69%	69%	68%
Bystander CPR, %	52%	63%	72%	65%	50%	58%
Bystander AED applied, %	3%	5%	5%	5%	3%	4%
Time from 9-1-1 call to EMS arrival (minutes), median	7.1	6.6	11.4	7.4	N/A	7.6
Survival to hospital discharge, %	6%	8%	11%	9%	N/A	9%

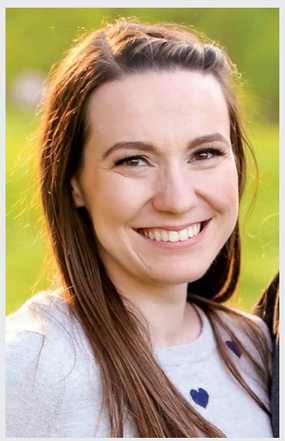
* This data represents a single year, which may be impacted by external factors.
* See additional CanROC data below, pg. 14 - 16
* N/A ('not applicable') indicates that data was not available

6. Listening to voices of experience

Since its inception, CanROC has been committed to engaging those impacted by sudden cardiac arrest, including people who have survived it, family members, and people who have responded to someone experiencing cardiac arrest. They help guide the approach to key actions, including:

- **Research priority setting:** People with lived experience participated in a 2022 exercise that identified 10 priorities for to help guide cardiac arrest research in Canada.
- **Grant and publication reviews:** CanROC's public engagement committee, which includes survivors, family members and lay rescuers, reviews grants and publications and helps determine how outcomes are measured.
- **Knowledge dissemination:** The public engagement committee also led the Cardiac Arrest Conversations webinar series, featuring clinicians, researchers and people with lived experience, to bring trusted information to the public.

1 out-of-hospital cardiac arrest happens in Canada every **9 minutes.**



"I suffered a sudden cardiac arrest while out for a jog at the age of 28. Bystanders immediately stepped in and made the call to 9-1-1 and performed CPR until EMS arrived. I'm alive, well and living a normal life today thanks to the swift action of bystanders. I have been involved with CanROC since shortly after my arrest and am incredibly passionate regarding advocacy and recognizing cardiac arrest and the necessary steps for survival. To improve outcomes, it is imperative that we increase awareness."
– Lauren Ross, cardiac arrest survivor, Ottawa

7. The CanROC team

Structure and governance

CanROC is a nation-wide voluntary consortium of research staff, clinical scientists, and medical responders. The network comprises multiple sites across Canada, with each site contributing to the national research database and organizing patient-care improvement efforts locally.

Nationally, CanROC's governance is guided by several standing committees, each with an individual mandate that contributes to the achievement of CanROC's overall strategic goals.

Executive Committee

Sheldon Cheskes MD CCFP (EM) FCFP DRCPSC, Medical Director, Sunnybrook Centre for Prehospital Medicine, Professor, Emergency Medicine, Family and Community Medicine, Faculty of Medicine, University of Toronto

Jim Christenson MD FRCPC, Professor, University of British Columbia Department of Emergency Medicine, Providence Research

Katie N. Dainty, PhD, Research Chair, Patient-Centred Outcomes, North York General Hospital, Associate Professor, Institute of Health Policy, Management & Evaluation, University of Toronto

Brian Grunau MD MHSc, Assistant Professor, Department of Emergency Medicine, University of British Columbia , and doctor, emergency medicine

Christian Vaillancourt MD, MSc, FRCPC, CSPQ, Professor and Vice-Chair, Research, Department of Emergency Medicine, Senior Scientist, Ottawa Hospital Research Institute, Associate Medical Director, Regional Paramedic Program for Eastern Ontario

Additional CanROC committees:

- **Steering Committee**
- **Cardiac Arrest Committee**
- **Public Engagement Committee**
- **Publication Committee**
- **EMS Committee**
- **Data Management Committee**
- **Pediatric Committee**
- **Data Access Committee**
- **Trainee and Early Career Researcher Support Committee**

Partners

CanROC is a highly collaborative network with representation across the country. This work is made possible by the contributions of a number of organizations, including: funding partners that sponsor the work, health systems partners who share data and provide care, research institutions that coordinate all study activities, paramedic and fire services that treat patients and collect primary data, medical oversight groups that assist in education, training and study development and hospitals that receive and treat those whose hearts are restarted. These partners include:

EMS Partners

- Abbotsford Fire
- Agassiz Fire Department
- Alberta Health Services
- British Columbia Emergency Health Services
- Burnaby Fire
- Central Saanich Fire
- Centre for Paramedic Education and Research
- City of North Vancouver Fire
- Coquitlam Fire
- County of Simcoe Paramedic Service
- Delta Fire
- Esquimalt Fire
- Essex-Windsor EMS
- Frontenac Paramedic Service
- Greater Sudbury EMS
- Halton Region Paramedic Services
- Health PEI
- Health Sciences North Centre for Prehospital Care
- Island EMS
- Kamloops Fire
- Kelowna Fire
- Kingston Fire and Rescue
- Langford Fire
- London Fire
- Maple Ridge Fire
- Medavie Health Services West
- Middlesex-London EMS
- Mission Fire
- Nanaimo Fire
- New Westminster Fire
- Niagara EMS
- Niagara Falls Fire
- North Vancouver District Fire
- Northumberland Paramedics
- Northwest Regional Prehospital Care Program
- Oak Bay Fire Department
- Ottawa Fire Services
- Ottawa Paramedic Service
- Peel Regional Paramedics
- Port Coquitlam Fire and Emergency Services
- Port Moody Fire Rescue
- Richmond Fire
- Regional Paramedic Program for Eastern Ontario
- Saskatoon Fire Department
- Sooke Fire Rescue
- Southwest Ontario Regional Base Hospital Program
- St. Catharines Fire Services
- Sudbury Fire
- Sunnybrook Centre for Prehospital Medicine
- Superior North EMS
- Surrey Fire Service
- Thorold Fire Department
- Thunder Bay Fire Rescue
- Toronto Paramedic Services
- Vancouver Fire Rescue
- Victoria Fire Department
- Welland Fire and Emergency Services
- West Kelowna Fire Rescue
- West Vancouver Fire
- White Rock Fire Rescue
- Windsor Fire Rescue
- Winnipeg Fire Paramedic Service
- Winnipeg Regional Health Authority
- York Region Paramedic Services

Research Institution Partners

- Holland College
- Ottawa Hospital Research Institute
- Providence Health Care Research Institute
- St. Michael's Hospital
- University of British Columbia
- University of Calgary
- University of Manitoba
- University of Prince Edward Island
- University of Saskatchewan
- University of Toronto

8. Additional CanROC data*

	Province A	Province B	Province C	Province D	Province E	National
Total number of cardiac arrests	10281	533	288	8199	2114	21415
Resuscitation attempted by EMS, %	53%	42%	53%	56%	46%	50%
Age (years), median	69	64	68	65	63	67
Male, %	65%	71%	69%	69%	69%	68%
Obvious cause of cardiac arrest						
None (presumed cardiac), %	85%	76%	71%	88%	75%	79%
Drug poisoning, %	6%	7%	3%	6%	12%	7%
Location of cardiac arrest						
Home location, %	80%	72%	84%	71%	70%	75%
Private location, %	87%	78%	88%	81%	81%	73%
Public location, %	13%	22%	12%	19%	19%	15%
Witnessed status						
Bystander witnessed, %	37%	46%	61%	42%	34%	39%
EMS witnessed, %	11%	10%	14%	9%	8%	10%
Bystander CPR, %	52%	63%	72%	65%	50%	58%
Bystander AED applied, %	3%	5%	5%	5%	3%	4%
Time from 9-1-1 call to EMS arrival (minutes), median	7.1	6.6	11.4	7.4	N/A	7.6
EMS CPR quality						
Proportion of time with chest compressions, median	0.80	0.92	0.85	0.85	N/A	0.83
Compression depth (cm), median	5.38	N/A	4.97	N/A	N/A	5.38
Compressions per minute, median	106	114	119	104	N/A	106
Pre-shock pause (seconds), median	2.1	5.4	13.0	0.23	N/A	2.1
Initial shockable rhythm, %	12%	21%	20%	13%	21%	17%
Bystander witnessed and initial shockable rhythm, %	8%	18%	17%	9%	7%	12%
ROSC, %**	21%	26%	25%	27%	28%	25%
Survival to hospital discharge, %	6%	8%	11%	9%	N/A	9%

* N/A ('not applicable') indicates that data was not available

** Return of spontaneous circulation: the patient regained a pulse.

Subgroups of cases with resuscitation attempted by EMS

	Province A	Province B	Province C	Province D	Province E	National
Private location cases						
Survival to hospital discharge, %	5%	6%	8%	7%	N/A	6%
Public location cases						
Survival to hospital discharge, %	14%	14%	32%	18%	N/A	17%
EMS witnessed cases						
Initial shockable rhythm, %	11%	14%	18%	22%	25%	18%
ROSC, %	45%	55%	55%	58%	49%	52%
Survival to hospital discharge, %	15%	18%	23%	25%	N/A	20%
Bystander witnessed cases						
Survival to hospital discharge, %	10%	13%	13%	13%	N/A	12%
Bystander unwitnessed cases						
Survival to hospital discharge, %	3%	2%	2%	4%	N/A	3%
Bystander witnessed cases and initial shockable rhythm						
ROSC, %	50%	55%	58%	53%	55%	54%
Survival to hospital discharge, %	25%	28%	31%	28%	N/A	28%

"Nova Scotia's participation in CanROC has improved our capacity to collect and learn from cardiac arrest data in Nova Scotia. It has been amazing to see how the CanROC network has expanded opportunities for collaboration, research, and innovation in Nova Scotia."
– Judah Goldstein, Dalhousie Department of Emergency Medicine, Division of EMS, Halifax

Pediatric dataset*:

	<1 year Total: 76	1-12 years Total: 58	>12 years Total: 208
Total number of cardiac arrest	76	58	208
Resuscitation attempted by EMS, %	93%	90%	68%
Age (years), median	2 months	3 years	16 years
Male, %	65%	65%	56%
Obvious cause of cardiac arrest			
None (presumed cardiac), %	49%	21%	68%
Drug poisoning, %	0%	0%	0%
Cardiac arrest was at home, %	92%	85%	80%
Witnessed status			
Bystander witnessed, %	21%	27%	28%
EMS witnessed, %	0%	0%	6%
Bystander CPR, %	61%	65%	70%
Bystander AED applied, %	3%	0%	16%
EMS CPR quality			
Proportion of time with chest compressions, median	0.75	0.78	0.83
Chest compression depth (cm), median	N/A	4.47	5.1
Chest compressions per minute, median	117	117	113
Pre-shock pause (seconds), median	N/A	N/A	3.75
Initial shockable rhythm, %	0%	4%	8%
ROSC, %	20%	23%	32%
Survival to hospital discharge, %	6%	12%	6%
Subgroups of cases with resuscitation attempted by EMS			
EMS witnessed cases			
ROSC, %	0%	0%	6%
Survival to hospital discharge, %	0%	0%	0%
Bystander witnessed cases with initial shockable rhythms	0%	2%	2%
ROSC, %	0%	100%	0%
Survival to hospital discharge, %	0%	100%	0%

* N/A ('not applicable') indicates that data was not available

"Resuscitation is a core skill for paramedics—if they resuscitate well, they also handle other critical calls well, such as stroke and heart attacks. CanROC data are essential to better understand how we are doing as a system, and most importantly identify areas where we can improve."
– Dr. Mark MacKenzie, Alberta Health Services EMS

Endnotes

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