Printemps de l'urgence 2022
Dr Matthieu HEIDET MD,PhD

Out-of-hospital cardiac arrest:

INSIGHTS FROM A TRANSATLANTIC, FRANCE / CANADA DATABASE

ReACanROC
an international research network

- No conflict of interests

WHY?

OHCA

TRANSAT

EMS SYSTEMS: TWO MAIN TYPES

ANGLO-AMERICAIN

FRANCO-GERMAN

ANGLO-AMÉRICAIN

Historical doctrine

Scoop and run

FRANCO-ALLEMAND

Historical doctrine

Stay and stabilize

ANGLO-AMÉRICAIN

Historical doctrine

Scoop and run

Paramedics
Remote medical supervision

Get at scene
Transport patient to the hospital
In ED +++
AS FAST AS POSSIBLE

FRANCO-ALLEMAND

Historical doctrine

Stay and stabilize

Physician-staffed at scene
Physician-staffed at call center

Get at scene
Transport patient to the hospital
ED bypass +++
IN TARGET TIMES

ANGLO-AMÉRICAIN

Historical doctrine

Scoop and run

Paramedics
Remote medical supervision

Get at scene
Transport patient to the hospital
In ED +++
AS FAST AS POSSIBLE

= Rescue

Firefighters

Paramedics

FRANCO-ALLEMAND

Historical doctrine

Stay and stabilize

Physician-staffed at scene
Physician-staffed at call center

Get at scene
Transport patient to the hospital
ED bypass +++
IN TARGET TIMES

= Public health

Fire / parameds

SMUR

IN EUROPE

ANGLO-AMERICAIN

FRANCO-GERMAN

WHY?

300,000 deaths/year

Public health issue

Glass ceiling?

WHY?

300,000 deaths/year

Public health issue

Glass ceiling?

Multi-tiered

Paramedics

Physicians

ED or not ED?

WHY?

300,000 deaths/year

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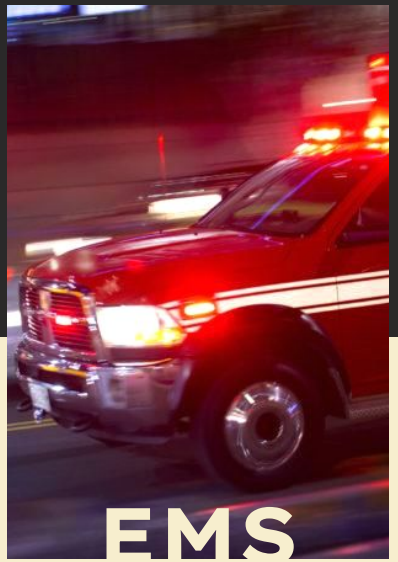
Glass ceiling?



Multi-tiered

Paramedics
Physicians
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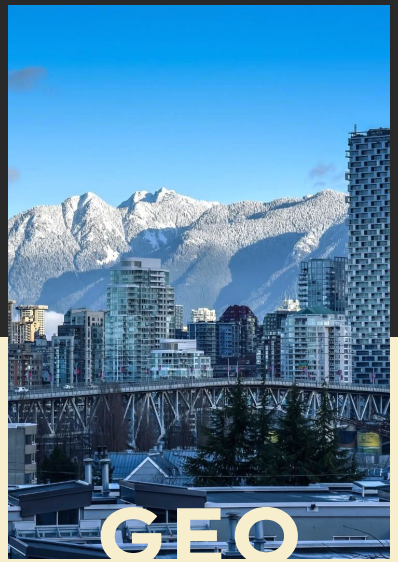

Various territories

Population
Density
Geography

RESUSCITATION 138 (2019) 188–191

Available online at www.sciencedirect.com

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

EUROPEAN RESUSCITATION COUNCIL

Clinical paper

International variation in survival after out-of-hospital cardiac arrest: A validation study of the Utstein template

Table 2b – Characteristics of EMS treatment and patient outcomes for all cases by registry.

	Arrest	German resuscitation registry	Helsinki cardiac arrest registry	Irish OHCAR	Oslo and Akershus Registry	SJA-WA cardiac arrest registry	ROC	CAVAS Project	Swedish Register of CPR	Taipei OHCA registry	VACAR	VICAR
	N = 6782	N = 3776	N = 1367	N = 1976	N = 775	N = 2316	N = 39,637	N = 8522	N = 8711	N = 2,791	N = 8658	N=1448
Call to EMS assessment, mean (SD)	10.1 (5.0)	10.1 (12.5)	10.9 (4.6)	16.6 (48.8)	10.5 (4.7)	–	9.0 (11.0)	–	10.9 (10.5)	22.3 (84.3)	11.3 (7.1)	17.7 (66.2)
EMS chest compressions	0.0%	0.0%	100.0%	99.6%	0.0%	95.6%	99.6%	84.9%	99.3%	98.0%	94.6%	0.0%
Missing or unknown	100.0%	100.0%	0.0%	0.4%	100.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	100.0%
Shocks given, %	52.6%	45.4%	49.0%	38.5%	40.8%	36.4%	34.9%	8.6%	38.4%	11.7%	43.5%	92.6%
Missing or unknown	0.8%	0.0%	0.4%	4.5%	0.4%	0.0%	0.1%	0.0%	4.8%	1.4%	0.0%	0.0%
Assisted ventilation, %	–	–	96.6%	96.7%	78.1%	97.1%	97.9%	68.2%	97.0%	99.7%	92.9%	0.0%
Missing or unknown	100.0%	100.0%	1.8%	3.2%	0.3%	0.0%	0.1%	0.0%	0.2%	0.0%	0.0%	100.0%
Drugs, %												
Epinephrine	–	83.6%	78.7%	52.3%	44.7%	6.0%	77.6%	0.0%	76.9%	19.1%	69.2%	75.7%
Other drugs	–	8.6%	1.0%	0.0%	4.7%	0.0%	2.3%	0.0%	0.6%	0.1%	2.5%	2.1%
No drugs	–	7.8%	20.3%	47.7%	50.6%	94.0%	20.1%	100.0%	22.5%	80.8%	28.2%	22.2%
Missing or unknown	100.0%	0.2%	0.1%	1.3%	1.3%	0.0%	0.4%	0.0%	0.6%	0.0%	0.1%	0.0%
ROSC before ED, %	34.7%	32.4%	49.2%	19.2%	35.1%	15.2%	29.0%	–	–	12.2%	38.4%	30.0%
Missing or unknown	0.3%	1.1%	0.0%	6.3%	0.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	0.0%
ROSC at ED arrival, %	–	26.1%	42.7%	13.8%	29.2%	13.9%	22.6%	1.8%	–	–	32.9%	–
Missing or unknown	100.0%	1.0%	0.0%	7.5%	0.0%	0.0%	8.3%	0.0%	100.0%	100.0%	0.8%	100.0%
Hospital admission, %	39.9%	26.1%	43.0%	–	27.7%	18.0%	23.7%	20.4%	18.3%	26.6%	–	–
Missing or unknown	1.0%	1.0%	0.0%	100.0%	0.0%	0.0%	64.2%	0.0%	0.0%	0.0%	100.0%	100.0%
Survival to hospital discharge, %	20.0%	12.7%	22.1%	6.0%	12.8%	9.0%	7.9%	6.6%	8.5%	6.8%	12.4%	11.4%
Survival to discharge with CPC 1 or 2, %	18.6%	8.4%	19.6%	5.3%	11.6%	–	4.3%	1.8%	94.3%	2.8%	–	8.8%
Missing or unknown	1.5%	1.5%	0.0%	0.8%	0.0%	100.0%	64.0%	0.0%	93.6%	0.9%	100.0%	0.0%

EMS, Emergency Medical Service; SD, Standard deviation; ED, Emergency Department; CPC, Cerebral Performance Category.

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Resuscitation

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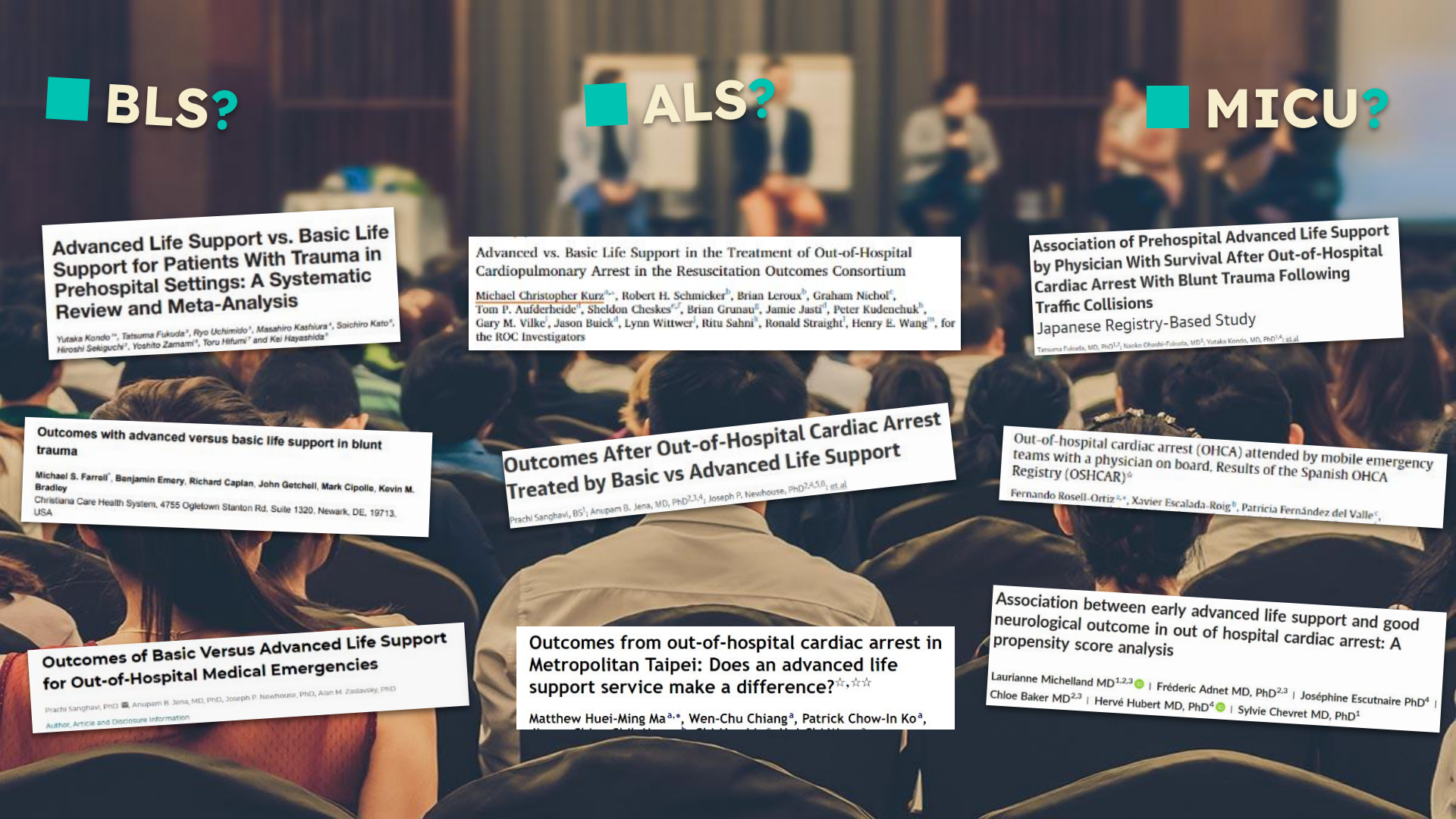
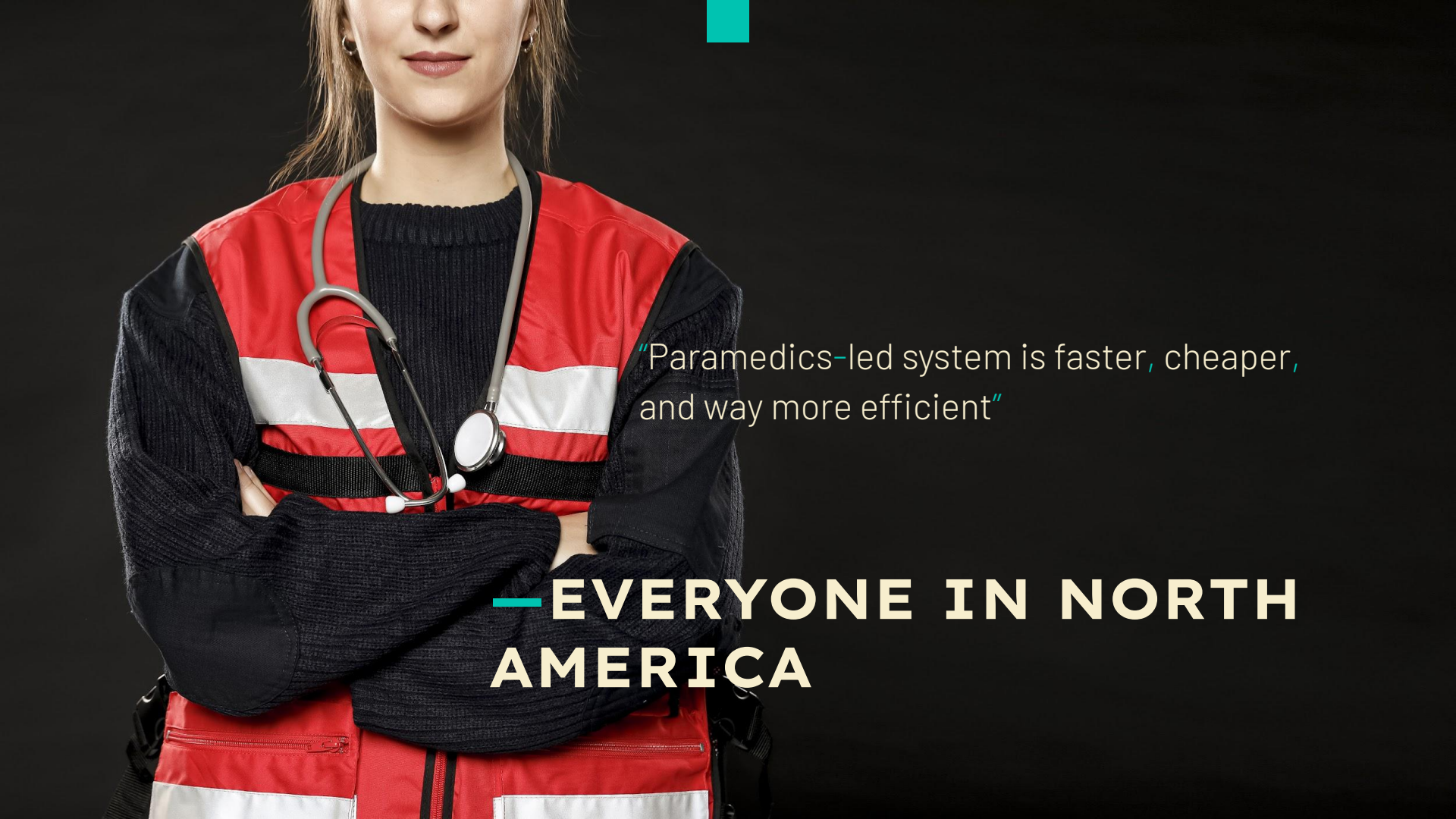
EMS, Emergency Medical Service; SD, Standard deviation; ED, Emergency Department; CPC, Cerebral Performance Category.

1.8 % to 94.3 % ?


BLS?
ALS?
MICU?
Advanced Life Support vs. Basic Life Support for Patients With Trauma in Prehospital Settings: A Systematic Review and Meta-Analysis
Yutaka Kondo, Tatsuma Fukuda, Ryo Uchimido, Masahiro Kashiura, Soichiro Kato, Hiroshi Sekiguchi, Yoshito Zamami, Toru Hifumi and Kei Hayashida
Advanced vs. Basic Life Support in the Treatment of Out-of-Hospital Cardiopulmonary Arrest in the Resuscitation Outcomes Consortium
Michael Christopher Kurz, Robert H. Schmicker, Brian Leroux, Graham Nichol, Tom P. Aufderheide, Sheldon Cheskes, Brian Grunau, Jamie Jasti, Peter Kudenchuk, Gary M. Vilke, Jason Buick, Lynn Wittwer, Ritu Sahni, Ronald Straight, Henry E. Wang, for the ROC Investigators
Association of Prehospital Advanced Life Support by Physician With Survival After Out-of-Hospital Cardiac Arrest With Blunt Trauma Following Traffic Collisions
Japanese Registry-Based Study
Outcomes with advanced versus basic life support in blunt trauma
Michael S. Farrell, Benjamin Emery, Richard Caplan, John Getchell, Mark Cipolle, Kevin M. Bradley
Christiana Care Health System, 4755 Ogletown Stanton Rd, Suite 1320, Newark, DE, 19713, USA
Outcomes After Out-of-Hospital Cardiac Arrest Treated by Basic vs Advanced Life Support
Prachi Sanghavi, BS; Anupam B. Jena, MD, PhD; Joseph P. Newhouse, PhD; et al
Out-of-hospital cardiac arrest (OHCA) attended by mobile emergency teams with a physician on board. Results of the Spanish OHCA Registry (OSHCAR)
Fernando Rosell-Ortiz, Xavier Escalada-Roig, Patricia Fernández del Valle,
Outcomes of Basic Versus Advanced Life Support for Out-of-Hospital Medical Emergencies
Prachi Sanghavi, PhD; Anupam B. Jena, MD, PhD; Joseph P. Newhouse, PhD; Alan M. Zaslavsky, PhD
Author, Article and Disclosure Information
Outcomes from out-of-hospital cardiac arrest in Metropolitan Taipei: Does an advanced life support service make a difference?
Matthew Huei-Ming Ma, Wen-Chu Chiang, Patrick Chow-In Ko,
Association between early advanced life support and good neurological outcome in out of hospital cardiac arrest: A propensity score analysis
Laurianne Michelland MD, Fréderic Adnet MD, PhD, Joséphine Escutnaire PhD, Chloe Baker MD, Hervé Hubert MD, PhD, Sylvie Chevret MD, PhD



"Paramedics-led system is faster, cheaper, and way more efficient"

— EVERYONE IN NORTH AMERICA

STEP 1

Crude comparaisons

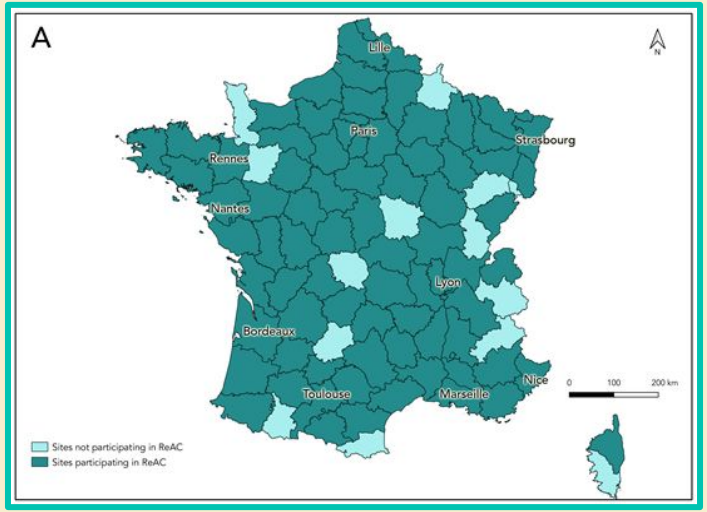
CanROC

2 provinces

and nationally expanding

(20 million people)

RéAC



90%

of all physician-led ALS units

(60 million people)

2011 to 2016

CanROC
n=33,688

RéAC
n=55,358

- **MALES 60s**
- **PRESUMED CARDIAC**
- **AT HOME**
- **NON-SHOCKABLE**

Heidet M, Fraticelli L, Grunau B et al. Resus 2020

2011 to 2016

CanROC
n=33,688

RéAC
n=55,358

- **SHORTER EMS-RT**

  6.5 min [5-8.5] vs. 10 min [7-15]

- **HIGHER RATES OF BYST. DEFIB.**

  4% vs. 2%

- **HIGHER RATES OF SHOCKABLE RH.**

  22% vs. 14%

Heidet M, Fraticelli L, Grunau B et al. Resus 2020

2011 to 2016

CanROC
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- **HIGHER RATES OF BYST. DEFIB.**
  4% vs. 2%
- **HIGHER RATES OF SHOCKABLE RH.**
  22% vs. 14%

RéAC
n=55,358

- **HIGHER RESUS. ATTEMPTS**
  82% vs. 60%
- **PRE-TRANSPORT DISCONTINUATION**
  79% vs. 45%
- **LONGER TIME TO 1ST DOSE OF ADRE.**
  25 min [18-34] vs. 20 min [16-25]

Heidet M, Fraticelli L, Grunau B et al. Resus 2020

2011 to 2016

CanROC
n=33,688

RéAC
n=55,358

HIGHER RATES OF SURVIVAL AT DISCHARGE

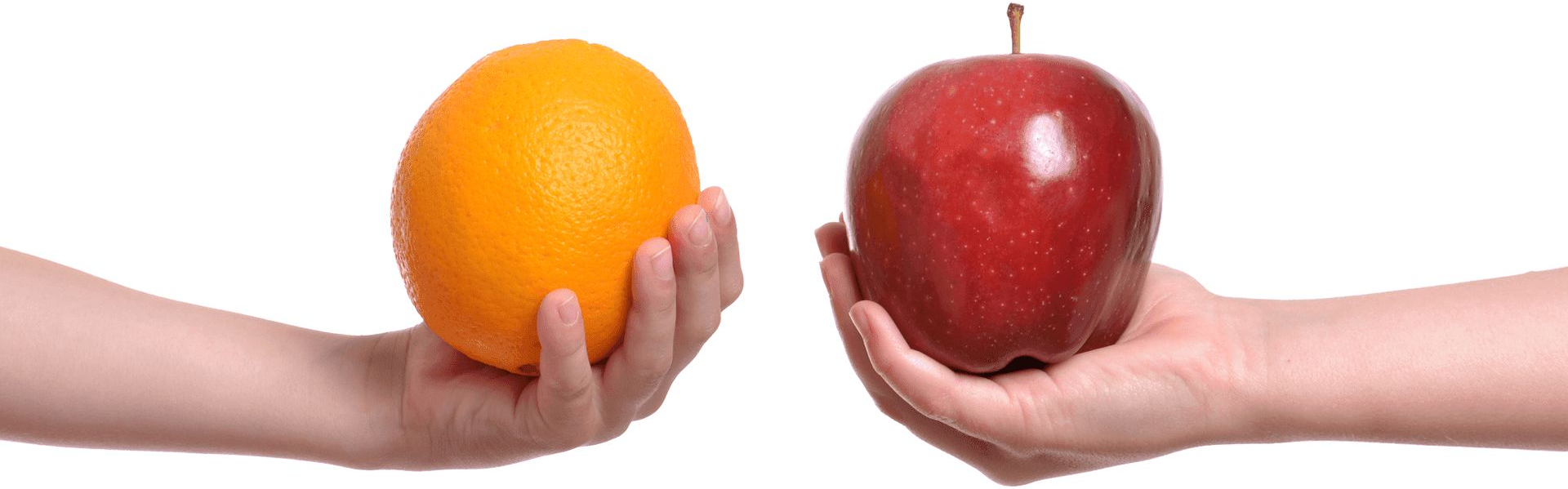
11% vs. 5%

POORER NEURO. OUTCOMES

84% vs. 92%

Heidet M, Fraticelli L, Grunau B et al. Resus 2020

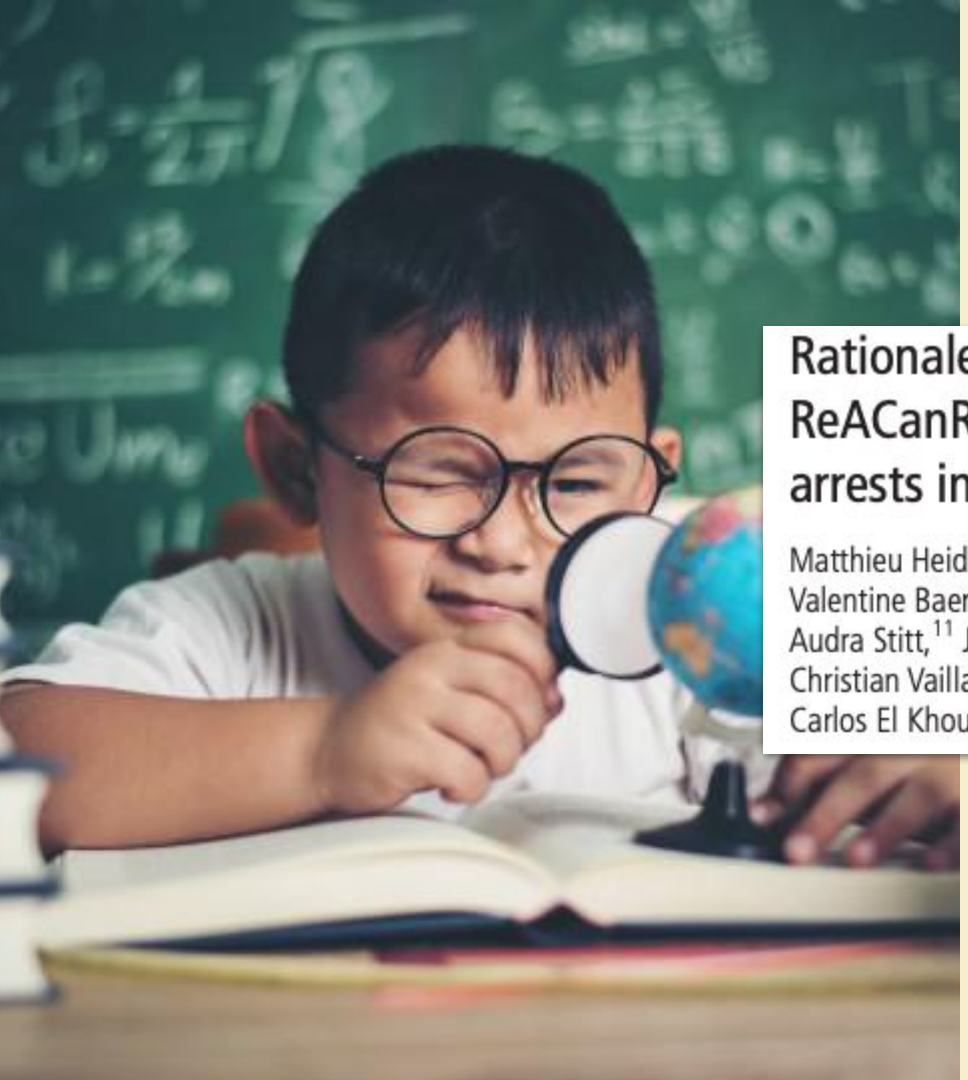
WHAT IF?



STEP 2

Adjusted comparaisons

Research network (+steering committee)
International, nationwide registry for
OUT-OF-HOSPITAL CARDIAC ARREST



Rationale, development and implementation of the ReACanROC registry for out-of-hospital cardiac arrests in France and Canada

Matthieu Heidet [1,2,3] Hervé Hubert,[4,5] Brian E Grunau,[6,7,8,9] Sheldon Cheskes,[10,11] Valentine Baert,[4,5] Laurie Fraticelli,[12,13] Julie Freyssenge,[12,14] Eric Lecarpentier,[1] Audra Stitt,[11] John M Tallon,[6,9] Karim Tazarourte,[14,15] Courtney Truong,[11] Christian Vaillancourt,[16,17] Christian Vilhelm,[5] Kosma Wysocki,[11] Jim Christenson,[6,7,8] Carlos El Khoury,[12,14,18] Gr-ReAC and CanROC investigators

THE PROCESS

PHASE ONE

Align & merge full datasets

Sept.2019 -Jun.2021

THE PROCESS

PHASE ONE

Align & merge full datasets

Sept.2019 -Jun.2021

PHASE TWO

In-depth comparisons

Jan.2022-Dec.2022

THE PROCESS

PHASE ONE

Align & merge full datasets

Sept.2019 -Jun.2021

PHASE TWO

In-depth comparisons

Jan.2022-Dec.2022

PHASE THREE

Matched analyses pt.1 & 2

Jun.2021-Dec.2021

Subsets

Association between location of out-of-hospital cardiac arrest, on-scene socioeconomic status, and accessibility to public automated defibrillators in two large metropolitan areas in Canada and France

Matthieu Heidet[1,2], Julie Freyssenge[3,4], Clément Claustre[4], John Deakin[5], Jennie Helmer[5], Bruno Thomas-Lamotte[6], Mathys Wohl[4], Li Danny Liang[7], Hervé Hubert[8,9], Valentine Baert[8,9], Christian Vilhelm[8], Laurie Fraticelli[10], Éric Mermet[11,12], Axel Benhamed[13], François Revaux[1], Éric Lecarpentier[1], Guillaume Debaty[14,15], Karim Tazarourte[3,13], Sheldon Cheskes[16,17], Jim Christenson[18,19,21], Carlos El Khoury[4,20], Brian Grunau[18,19,21], on behalf of the Gr-RéAC, CanROC and RéACanROC investigators

Submitted

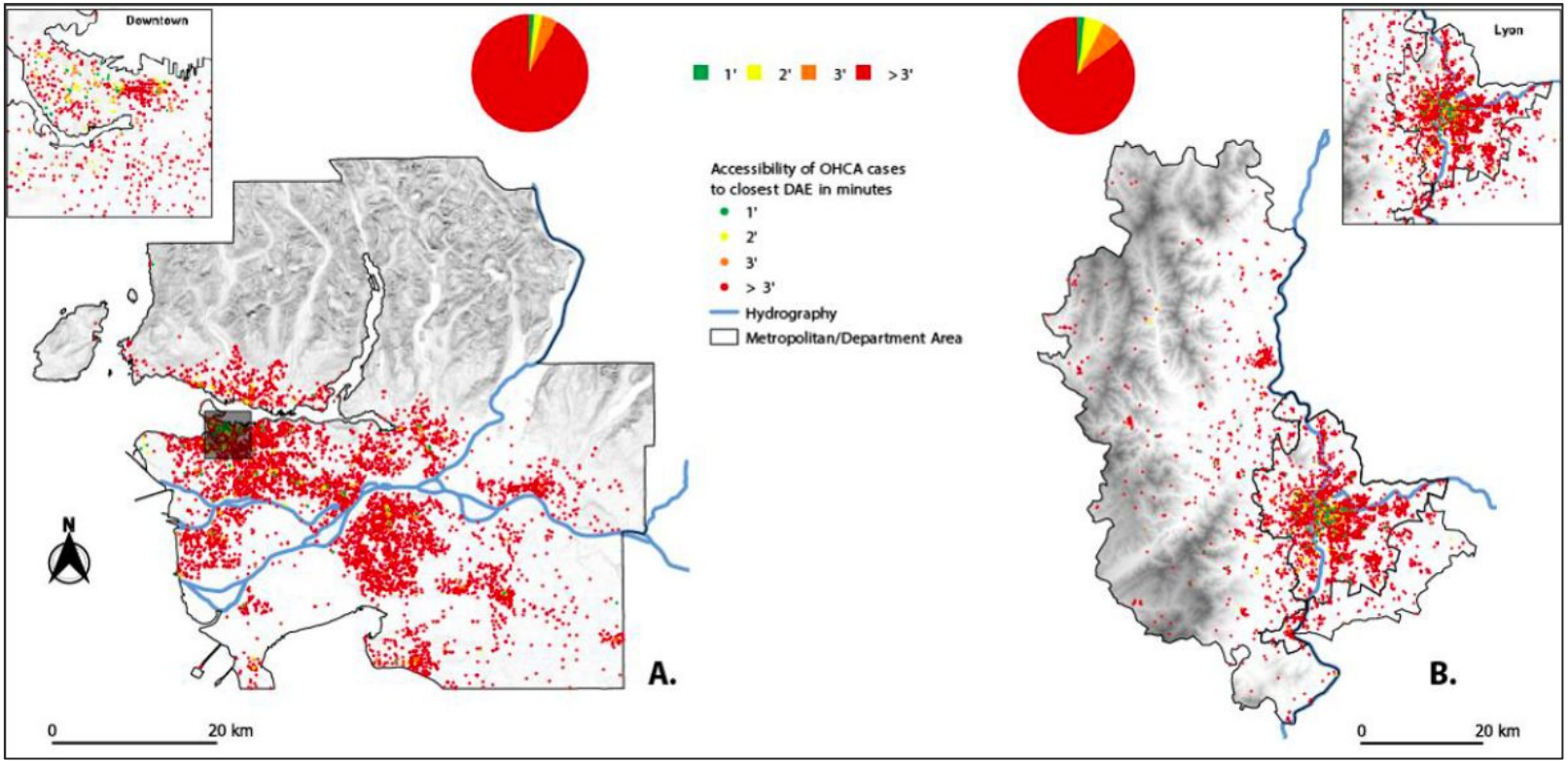
- **Method**
  - Metro Vancouver vs. Rhône
  - OHCA 2014-2018 (CanROC or RéAC)
  - Socioeconomic status (SES) at census tract level (INSPQ or French-EDI)
    - Q1 (less deprived) to Q5 (most deprived)
  - Public AED registries
  - **Judgement criteria**
    - Distance OHCA - closest AED
    - Simulated walking time to closest AED
    - Prognosis

- **Results**
  - Metro Vancouver : N = 6,187 vs. Rhône : N = 3,239

  - **Metro Vancouver Q5**
    - AED farther (79% > 400m vs. 67%, p<0.01)
    - AED less accessible (97% > 3 min vs. 91%, p<0.01)
    - Lower survival (9% vs. 13%, p<0.01)
    - Poorer neurologic status (6% vs. 9%, p=0.01)

  - **Rhône Q5**
    - AED closer (50% vs. 57%, p<0.01)
    - AED not less accessible (85% vs. 86%,p=0.79)
    - No prognostic association

Fig.1 Spatial distribution of OHCA represented by walking access time



Submitted

Table 3. Predictors of mortality before hospital discharge, uni- and multivariate models

	Mortality							
	Vancouver metro				Rhône county			
	Univariate		Multivariate		Univariate		Multivariate	
	OR [95%CI]	p-value	OR [95%CI]	p-value	OR [95%CI]	p-value	OR [95%CI]	p-value
Age, years (ref: 65; step: 5)	1.09 [1.07 ; 1.11]	< 0.01	1.14 [1.11 ; 1.17]	< 0.01	1.15 [1.11 ; 1.19]	< 0.01	1.15 [1.11 ; 1.20]	< 0.01
Sex: male	0.62 [0.51 ; 0.76]	< 0.01	1.28 [0.84 ; 1.96]	0,25	0.65 [0.45 ; 0.95]	0,02	1.07 [0.46 ; 2.50]	0,88
Scene location: home	5.10 [4.28 ; 6.07]	< 0.01	3.27 [2.69 ; 3.97]	< 0.01	2.58 [1.85 ; 3.60]	< 0.01	1.82 [1.28 ; 2.58]	< 0.01
Quintile of deprivation (ref: Q1)								
Q2	1.08 [0.84 ; 1.39]	0,55	1.30 [0.74 ; 2.27]	0,36	0.75 [0.41 ; 1.37]	0,34	1.04 [0.33 ; 3.30]	0,95
Q3	1.26 [0.98 ; 1.63]	0,07	1.79 [0.97 ; 3.30]	0,06	0.77 [0.43 ; 1.38]	0,39	1.07 [0.36 ; 3.18]	0,90
Q4	1.16 [0.91 ; 1.49]	0,23	1.35 [0.77 ; 2.36]	0,29	0.95 [0.53 ; 1.71]	0,86	1.34 [0.44 ; 4.07]	0,60
Q5	1.64 [1.25 ; 2.15]	< 0.01	1.56 [0.86 ; 2.82]	0,14	0.68 [0.43 ; 1.09]	0,11	1.13 [0.46 ; 2.78]	0,79
Type of territory: urban	0.73 [0.59 ; 0.91]	< 0.01	0.75 [0.59 ; 0.94]	0,01	0.97 [0.66 ; 1.41]	0,85	1.06 [0.67 ; 1.69]	0,80
Presence of a bystander	0.19 [0.16 ; 0.23]	< 0.01	0.18 [0.15 ; 0.23]	< 0.01	0.18 [0.11 ; 0.30]	< 0.01	0.23 [0.13 ; 0.38]	< 0.01
Bystander-attempted CPR	0.45 [0.38 ; 0.54]	< 0.01	0.71 [0.58 ; 0.86]	< 0.01	0.26 [0.18 ; 0.37]	< 0.01	0.38 [0.25 ; 0.56]	< 0.01
PAD access time,min (ref: < 1)								
[1-2[	2.50 [1.24 ; 5.03]	0,01	2.15 [0.97 ; 4.73]	0,06	1.02 [0.37 ; 2.80]	0,97	0.93 [0.32 ; 2.70]	0,89
[2-3[	2.88 [1.59 ; 5.22]	< 0.01	2.02 [1.03 ; 3.98]	0,04	2.22 [0.74 ; 6.62]	0,15	2.10 [0.67 ; 6.61]	0,20
≥ 3	5.33 [3.22 ; 8.83]	< 0.01	2.47 [1.38 ; 4.43]	< 0.01	1.88 [0.80 ; 4.41]	0,15	1.92 [0.77 ; 4.79]	0,16
Interaction men x quintile of deprivation (ref: Q1)								
Q2	X	X	0.56 [0.30 ; 1.07]	0,08	X	X	0.98 [0.25 ; 3.91]	0,98
Q3	X	X	0.43 [0.21 ; 0.85]	0,02	X	X	0.68 [0.18 ; 2.50]	0,56
Q4	X	X	0.49 [0.26 ; 0.92]	0,03	X	X	0.74 [0.20 ; 2.76]	0,66
Q5	X	X	0.61 [0.31 ; 1.21]	0,16	X	X	0.57 [0.20 ; 1.64]	0,30

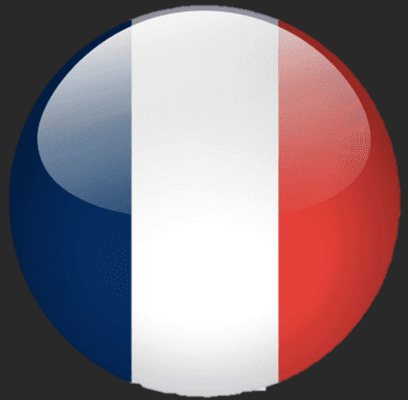
CPR: cardio-pulmonary resuscitation; PAD: public automated defibrillator; ROSC: return of spontaneous circulation

An "X" is displayed for the interaction term in the univariate column as an interaction cannot be univariate

Submitted

TERRITORY(IES) SES

PROGNOSTIC

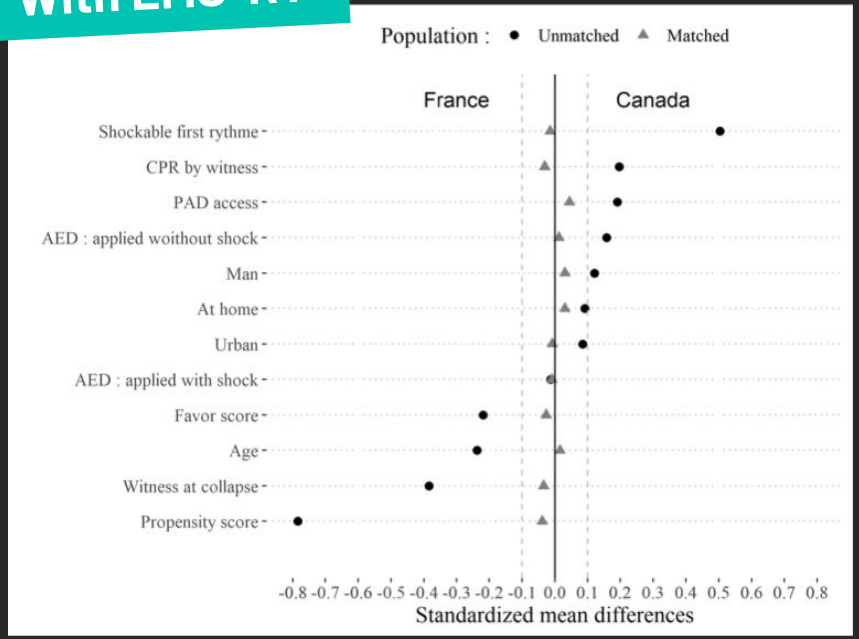


NOT PROGNOSTIC

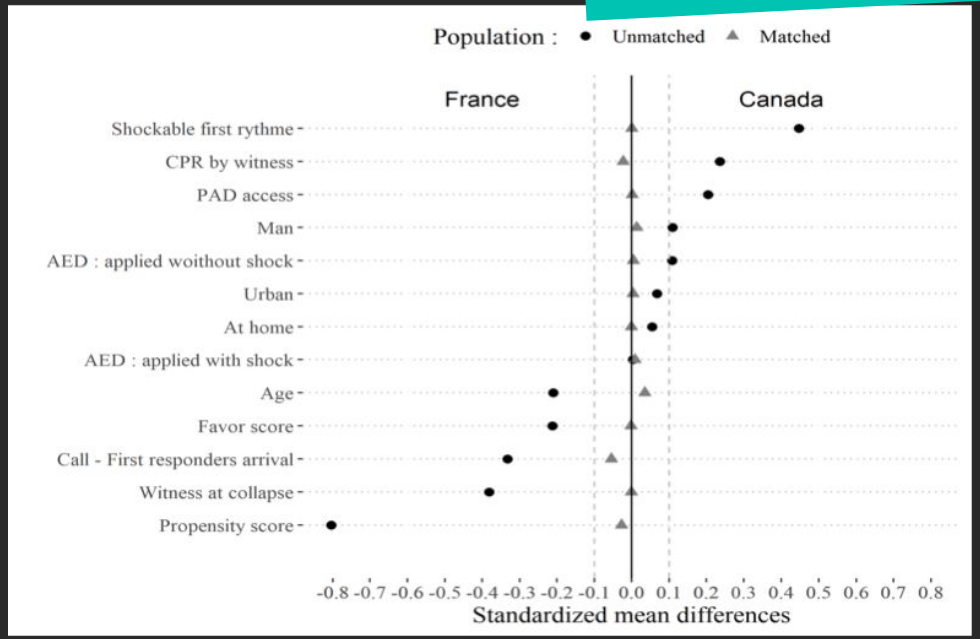
... MATCHED ANALYSES

N= 5,240 (2,620 X 2)

With EMS-RT



Without EMS-RT



- Results

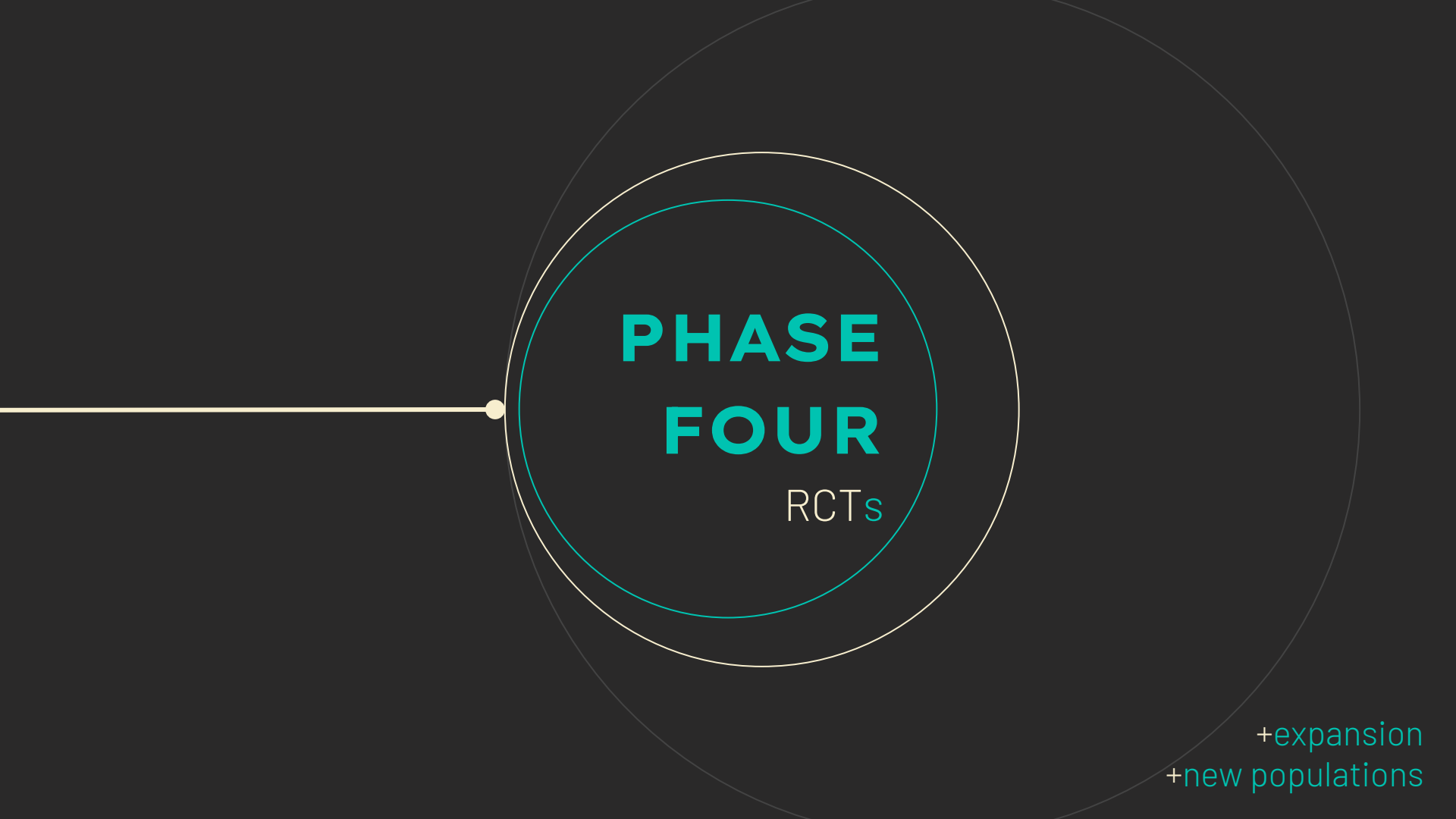
- **Results**
  - Death at scene
    - **Rhône 76% vs. Vancouver 57 %** p<0.01
  - CPR ongoing at ED arrival
    - **Vancouver 11% vs. Rhône 2%** p<0.01
  - Sustained ROSC
    - **Vancouver 43% vs. Rhône 25%** p<0.01
  - Discharged alive
    - **Vancouver 8% vs. Rhône 5%** p<0.01
  - Favorable neurologic status
    - **Vancouver 6% vs. Rhône 3%** p<0.01

CONFIRMED !

WHICH IMPLICATIONS?

- **Further exploration of hidden determinants**
  - Definitions ?
  - Géographic ?
  - Socioeconomic ?
  - Practices ?
  - Organizations ?

- **ON ALIGNED, MERGED, NATIONAL DATASETS !**


PHASE
FOUR
RCTs
+expansion
+new populations

THANK YOU

And all CanROC / RéAC collaborators who made this project come true

Special thanks to

Jim Christenson, Brian Grunau, Sheldon Cheskes, Christian Vaillancourt, Courtney Truong & Kosma Wyzocki
Carlos El Khoury, Hervé Hubert, Valentine Canon, Karim Tazarourte, Julie Freyssenge, Clément Claustre & Eric Lecarpentier

- SEE YOU DOWN THE ROAD!