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OVERVIEW OF CARDIAC ARREST IN THE UNITED STATES: PUBLIC HEALTH BURDEN AND EVOLUTION OF THE FIELD

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IOM Committee on the Treatment of Cardiac Arrest: Current Status and Future Directions

Presenter Disclosure Information

ROBERT W. NEUMAR, MD, PHD

Overview of Cardiac Arrest in the United States: Public Health Burden and Evolution of the Field

DISCLOSURES:

- Employee of the University of Michigan
- Chair, American Heart Association Emergency Cardiovascular Care Committee
- NIH funding for research in postconditioning after cardiac arrest

The Most Important Challenges

- How do we measure and report the burden of disease?
- How can we optimize the system of care?
- What research investment and infrastructure is needed?

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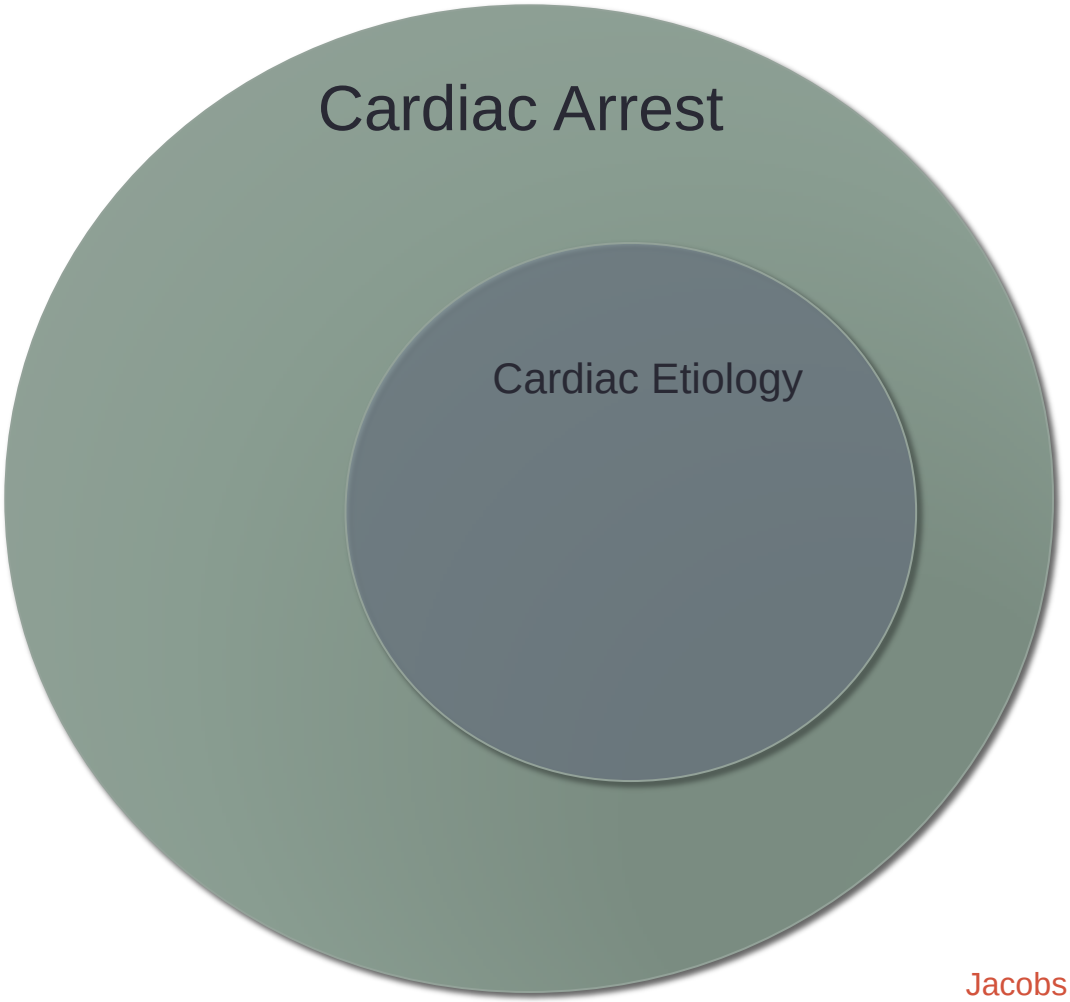
Defining Cardiac Arrest

Utstein Consensus Conference

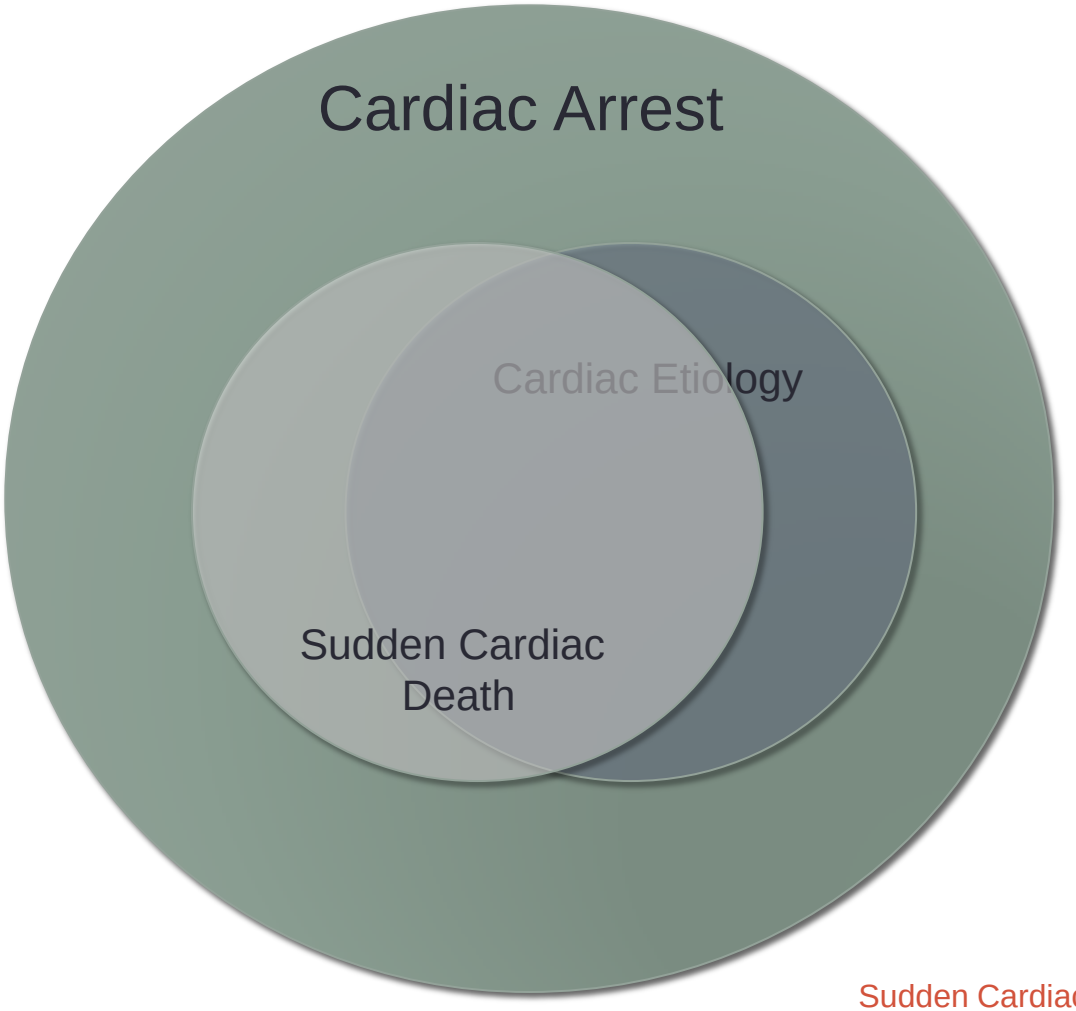


- **Cardiac arrest** is the cessation of cardiac mechanical activity as confirmed by the absence of signs of circulation.
- Presumed to be of **Cardiac Etiology** unless it is known or likely to have been caused by trauma, submersion, drug overdose, asphyxia, exsanguination, or any other noncardiac cause as best determined by rescuers.

Jacobs, Circulation. 2004;110:3385-97
*Revision undergoing peer review for publication

Defining Cardiac Arrest

World Health Organization (WHO)



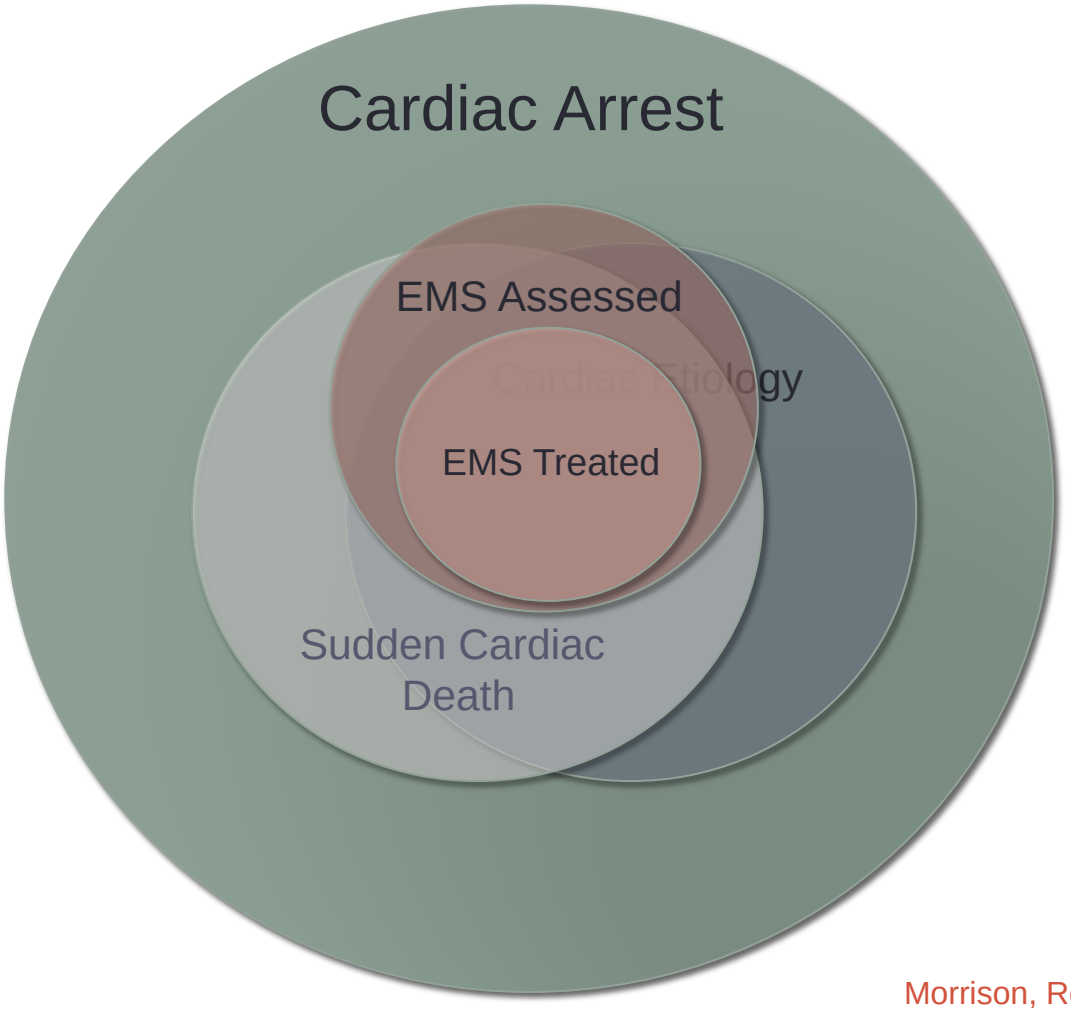
- **Sudden Cardiac Death:** An unexpected, unexplained death within 1 hour of symptom onset for witnessed events, or within 24 hours of last observed alive and symptom-free, for unwitnessed events.

Over 50% of out-of-hospital cardiac arrests are unwitnessed

Sudden Cardiac Death: WHO technical Report Series 726, 1985

Defining Cardiac Arrest

Resuscitation Outcomes Consortium (ROC)



EMS Assessed Cardiac Arrest:

- evaluated by organized EMS personnel, and
- shock delivered or,
- chest compressions by EMS personnel or,
- not treated by EMS personnel.

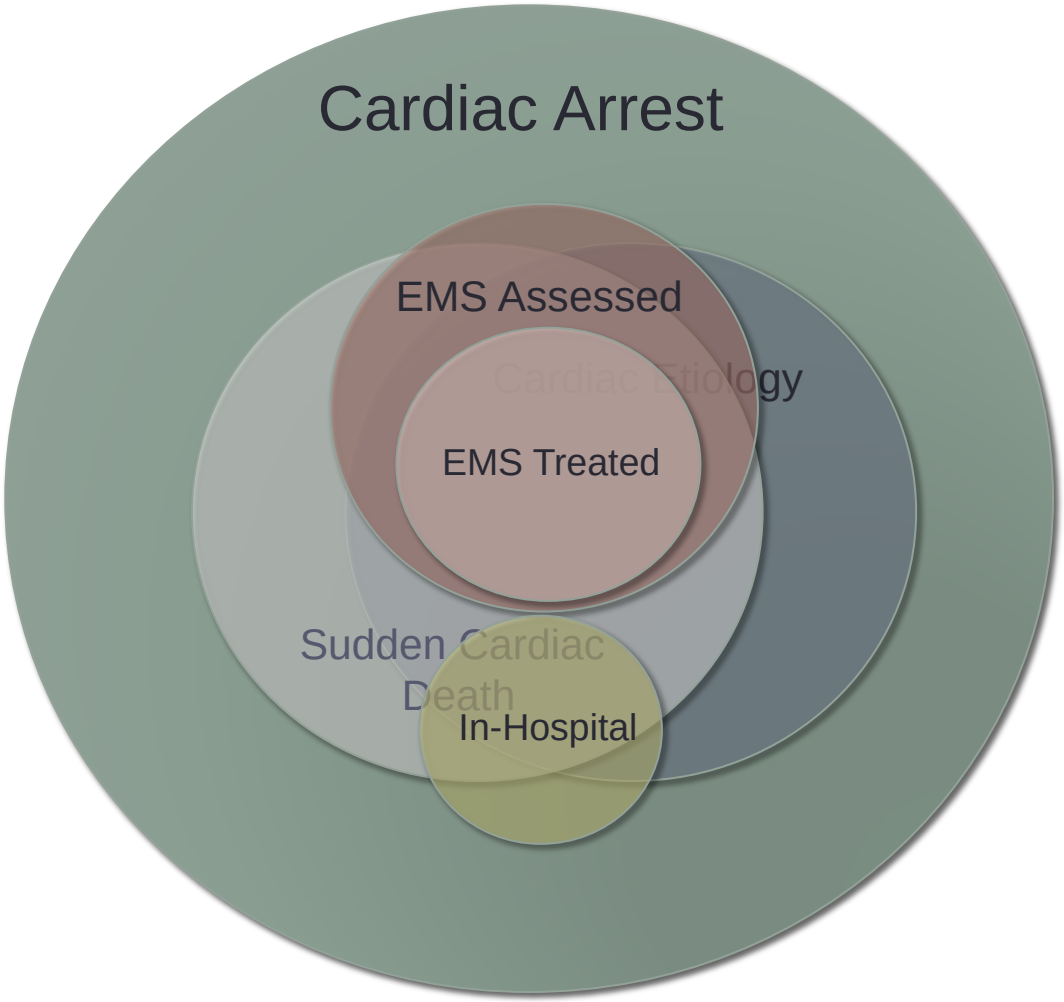
EMS Treated Cardiac Arrest:

- evaluated by organized EMS personnel, and
- shock delivered, or
- chest compressions by EMS personnel

Morrison, Resuscitation. 2008;78:161-9. PMID: 18479802

Defining Cardiac Arrest

Get With the Guidelines - Resuscitation: Formerly National Registry of CPR



In-Hospital Cardiac Arrest

- Patients, visitors, employees, and staff within a facility who experience a resuscitation event

A resuscitation event is defined as:

- Acute respiratory compromise that requires emergency assisted ventilation (either noninvasive or invasive) **or**
- acute respiratory compromise that requires emergency assisted ventilation leading to cardiopulmonary arrest that requires chest compressions and/or defibrillation**, or**
- cardiopulmonary arrest that requires chest compressions and/or defibrillation, ***and***
- elicits an emergency resuscitation response by facility personnel, ***and***
- a resuscitation record is completed for the event.

Peberdy, Resuscitation 2003;58:297-308

Defining Patient Centered Outcomes

Survival with Good Neurologic Function

Cerebral Performance Categories Scale (Safar P. Resuscitation after Brain Ischemia, in Grenvik A and Safar P Eds: Brain Failure and Resuscitation, Churchill Livingstone, New York, 1981; 155-184.):

-CPC Score of 1 or 2 considered “favorable outcome”

Modified Rankin Scale (*van Swieten, J.C., Koudstaal, P.J., Visser, M.C., Schouten, H.J., van Gijn, J. (1988). Interobserver agreement for the assessment of handicap in stroke patients. Stroke, 19, 604-607):

- MRS score of 0,1,2,3 considered “favorable outcome”

Monitoring and Reporting Cardiac Arrest Data

- **There is no national U.S. registry and no mandatory reporting**
- **All currently available surveillance methods have significant limitations**

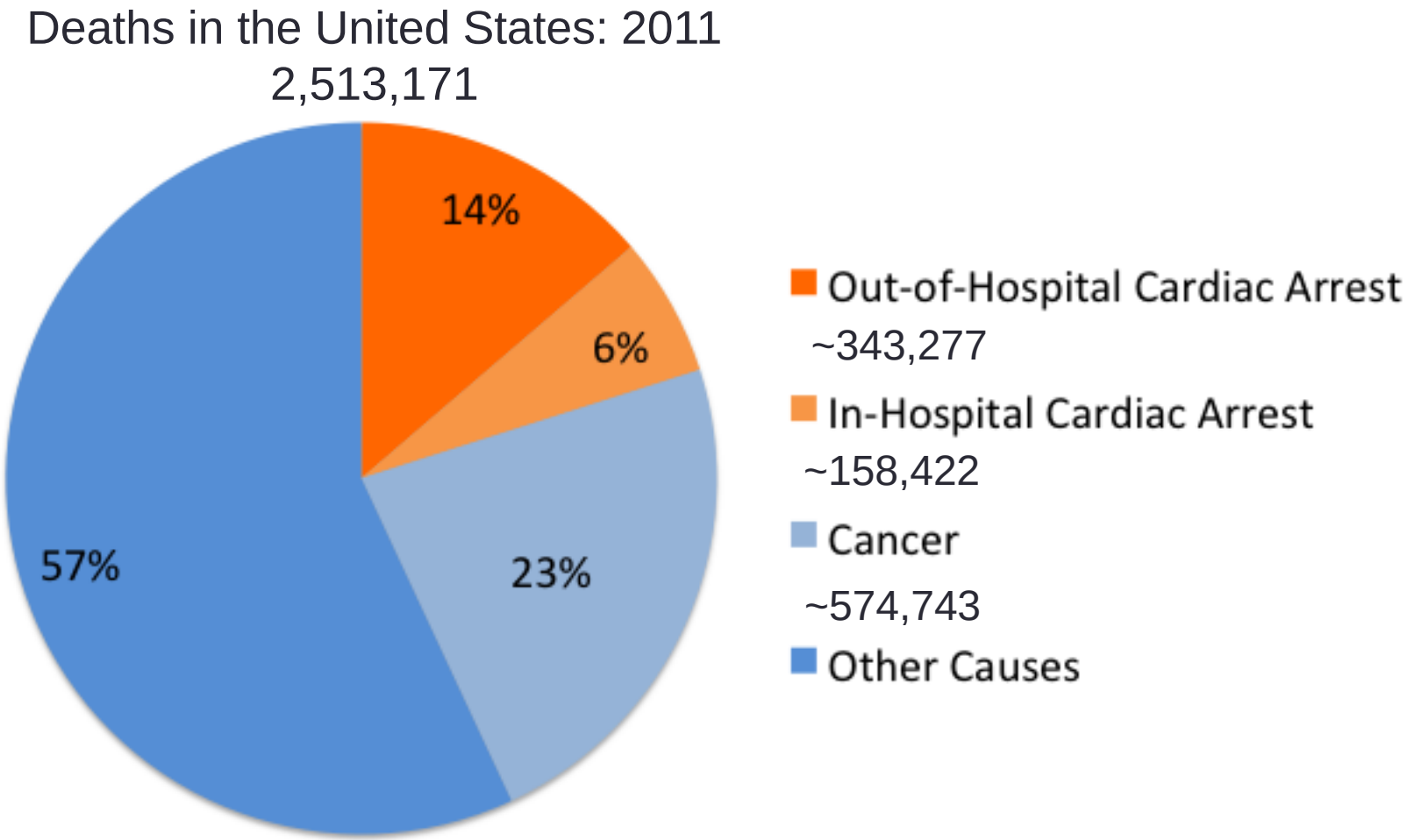
Current State

- Research Network Registries
  - Resuscitation Outcomes Consortium (ROC) Epistry
    - Out-of-Hospital Cardiac Arrest (10,000 cases/year)
- Volunteer Quality Improvement Registries
  - Cardiac Arrest Registry to Enhance Survival (CARES)
    - Out-of-Hospital Cardiac Arrest (~30,000 cases/year)
  - Get with the Guidelines Resuscitation (GWTG-R)
    - In-Hospital Cardiac Arrest (~10,000 cases/year)
- National Databases
  - National EMS Information System (NEMSIS)
  - National Emergency Department Survey (NEDS)
  - National Inpatient Survey (NIS)

Future State

A single National Surveillance Program to monitor and report incidence, processes of care, and patient-centered outcomes at local, state, and national level

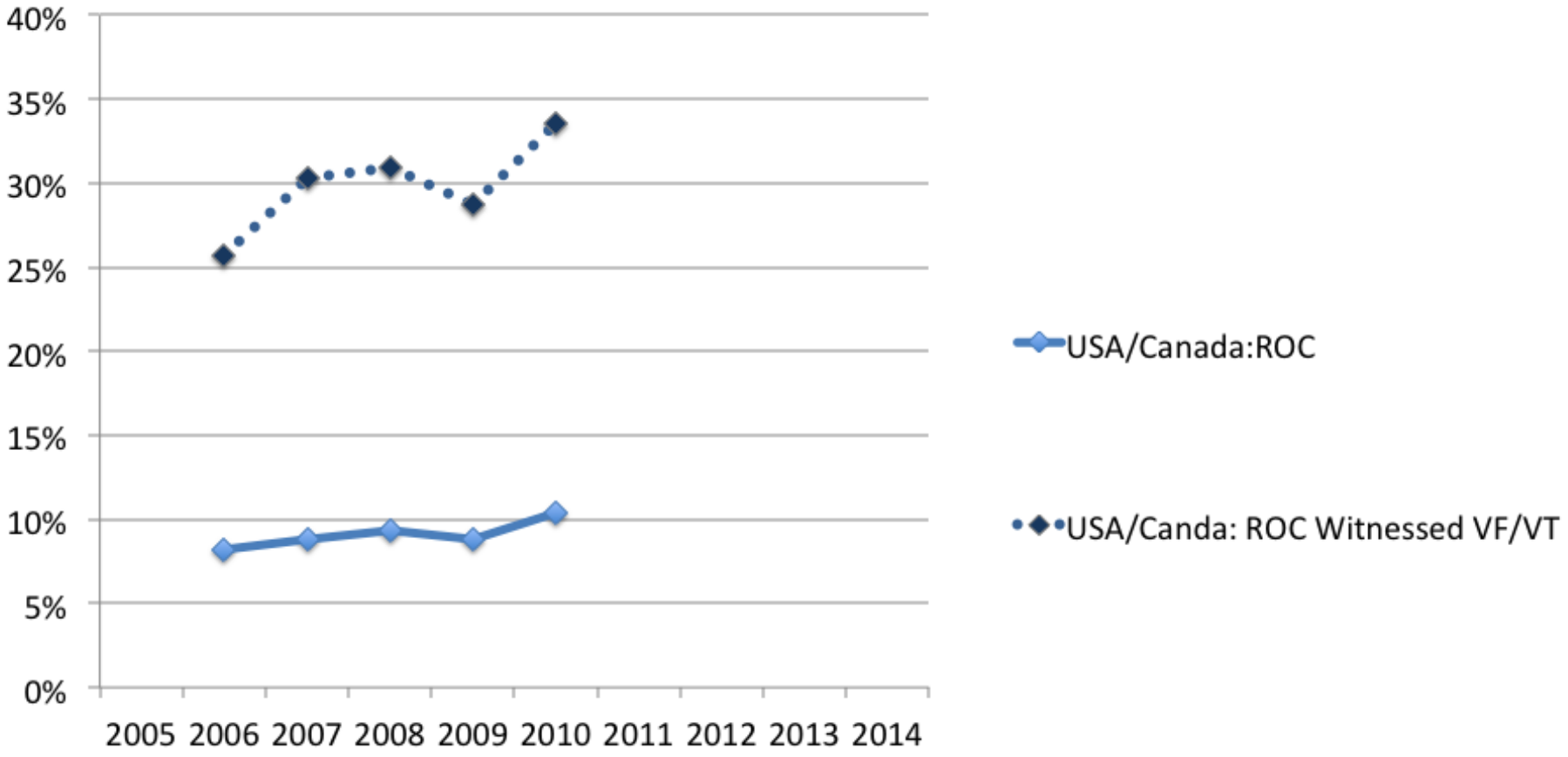
Cardiac Arrest is Responsible for **One of Every Five Deaths** in the United States.



CDC Death Statistics 2011 http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_06.pdf
AHA Statistical Update, Go et al, Circulation 2013;129:e28-e292

Survival Trends: EMS Treated Out-of-Hospital Cardiac Arrest

Statistically significant increase in survival rate in ROC Consortium between 2006 and 2010.



Daya, Circulation Suppl, 2013;128:A5

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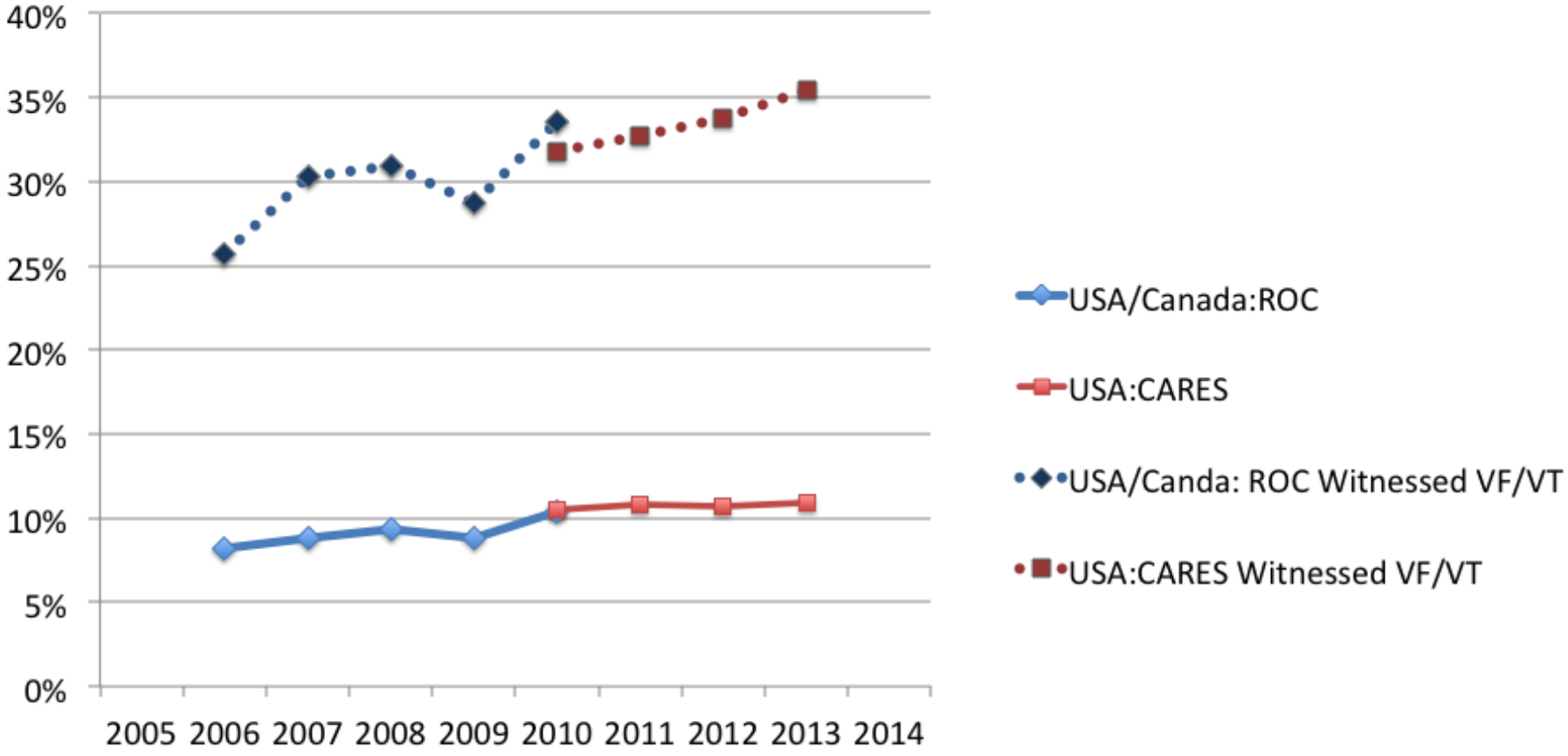


Daya, Circulation Suppl, 2013;128:A5

CARES AHA/ECC Report 2013

Survival Trends: In-of-Hospital Cardiac Arrest

GWTG-R Hospitals

Risk adjusted rates of survival to discharge increased from **13.7% to 22.3%** between 2000 and 2009.

Unadjusted Survival To Discharge

Girota N Engl J Med 2012;367:1912-20.

National Cancer Institute Model

The Surveillance, Epidemiology and End Results Program

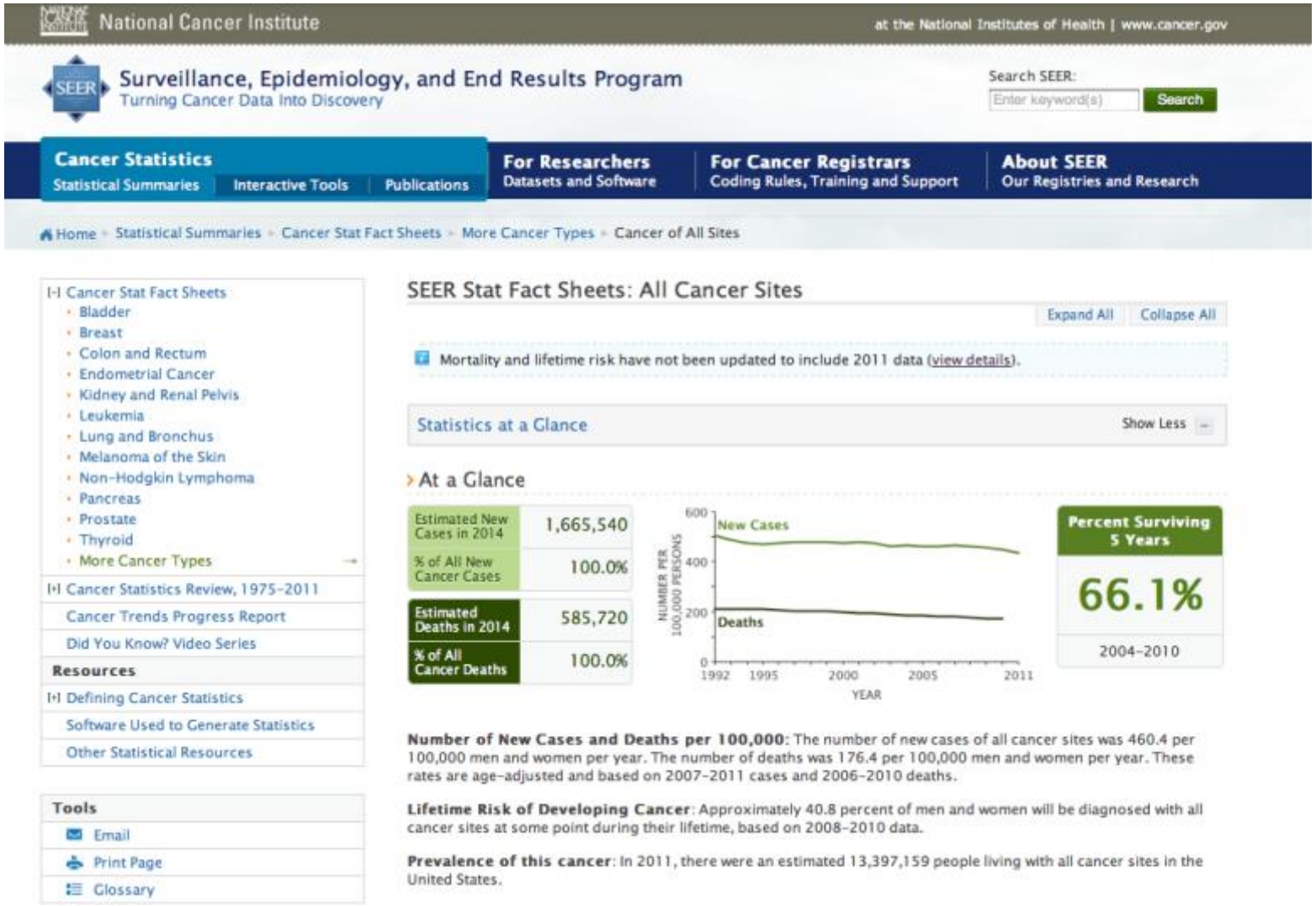
The National Cancer Institute's (NCI) Surveillance, Epidemiology and End Results (SEER) program is a large population-based registry. It collects information from certain geographic areas which represent 28% of the US population, including:

- Cancer incidence (new cases)
- Survival
- Prevalence (number of people living with cancer during a given time period)

The NCI contracts with non-profit organizations to collect data on new cancer diagnoses in the designated geographic locations. Cases are followed up each year to determine survival. The data, along with data on cancer-related deaths from the entire US from the National Center for Health Statistics (NCHS), are analyzed and are published annually in the SEER Cancer Statistics Review.

http://www.cancer.org/cancer/cancerbasics/cancer-surveillance-programs-and-registries-in-the-united-states. Accessed 6/14/2014

National Cancer Institute Model



http://seer.cancer.gov/statfacts/html/all.html

The Most Important Challenges

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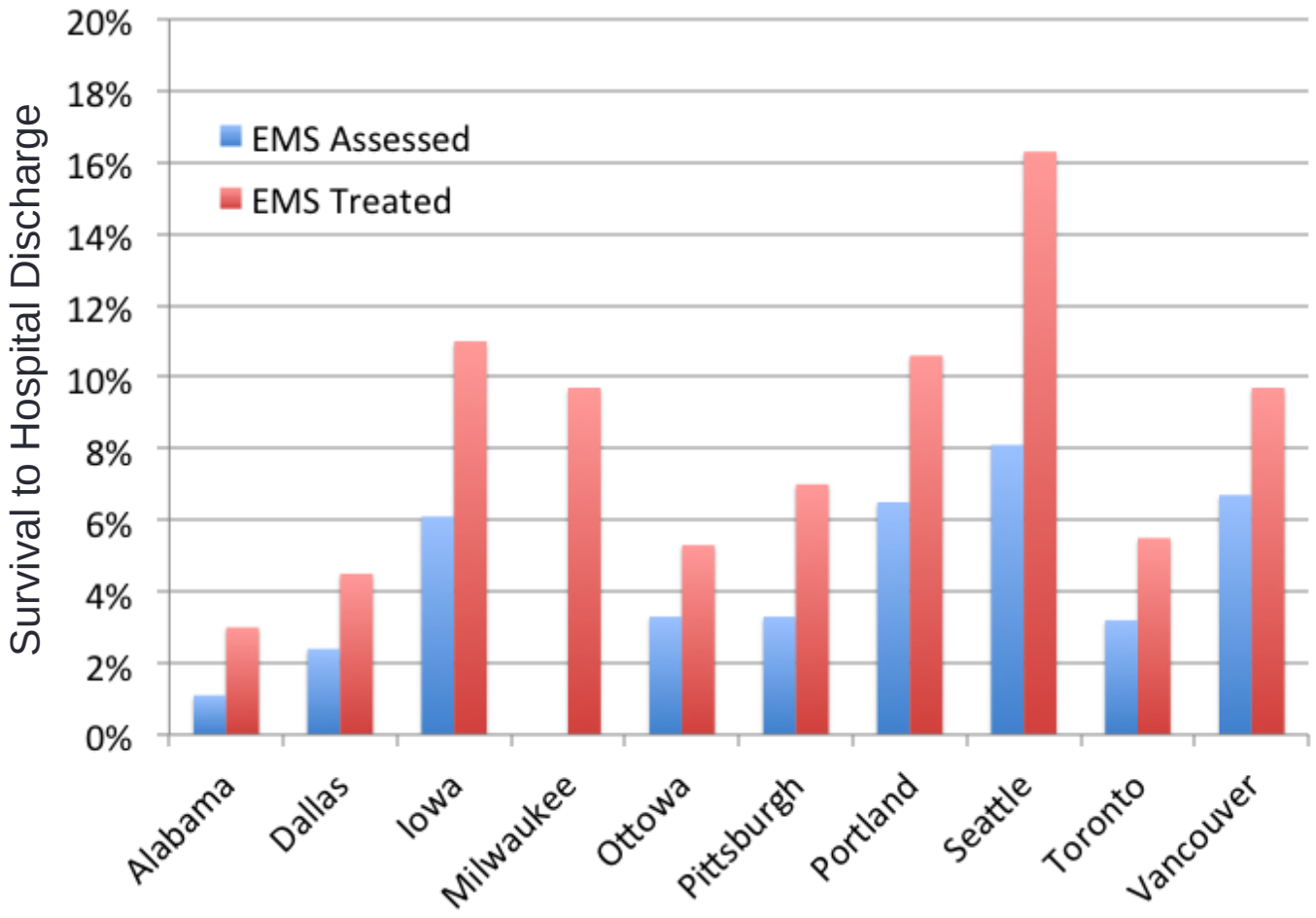
Variability in Out-of-Hospital Cardiac Arrest Survival within Resuscitation Outcomes Consortium (ROC)

Survival to hospital discharge ranged from **3.0% to 16.3%** for EMS Treated OOHCA[10]



Nichol, JAMA, 2008;300:1423-1431

Variability in Bystander CPR Rates within CARES Registry

Reported bystander CPR rates ranged from **9% to 64%** for EMS Treated OOHCA (FIGURE 6)

McNally, CDC MMWR Vol 60 No 8 2011

Cardiac Arrest Systems of Care

Out-Of Hospital Cardiac Arrest

- Citizen Response
- 911 Dispatch
- EMS
- Hospital
- Rehabilitation

In-Hospital Cardiac Arrest

- Rapid Response Team
- Code Team
- ICU
- Rehabilitation

Optimizing Systems of Care

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association

Implementation Strategies for Improving Survival After Out-of-Hospital Cardiac Arrest in the United States: Consensus Recommendations From the 2009 American Heart Association Cardiac Arrest Survival Summit

Robert W. Neumar, Janice M. Barnhart, Robert A. Berg, Paul S. Chan, Romergryko G. Geocadin, Russell V. Luepker, L. Kristin Newby, Michael R. Sayre and Graham Nichol

Neumar, Circulation 2011;123:2898-2910

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association

Strategies for Improving Survival After In-Hospital Cardiac Arrest in the United States: 2013 Consensus Recommendations: A Consensus Statement From the American Heart Association

Laurie J. Morrison, Robert W. Neumar, Janice L. Zimmerman, Mark S. Link, L. Kristin Newby, Paul W. McMullan, Jr, Terry Vanden Hoek, Colleen C. Halverson, Lynn Doering, Mary Ann Peberdy and Dana P. Edelson

on behalf of the American Heart Association Emergency Cardiovascular Care Committee, Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation, Council on Cardiovascular and Stroke Nursing, Council on Clinical Cardiology, and Council on Peripheral Vascular Disease

Morrison, Circulation 2013;127:1538-1563

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Leading Causes of Death: 2011

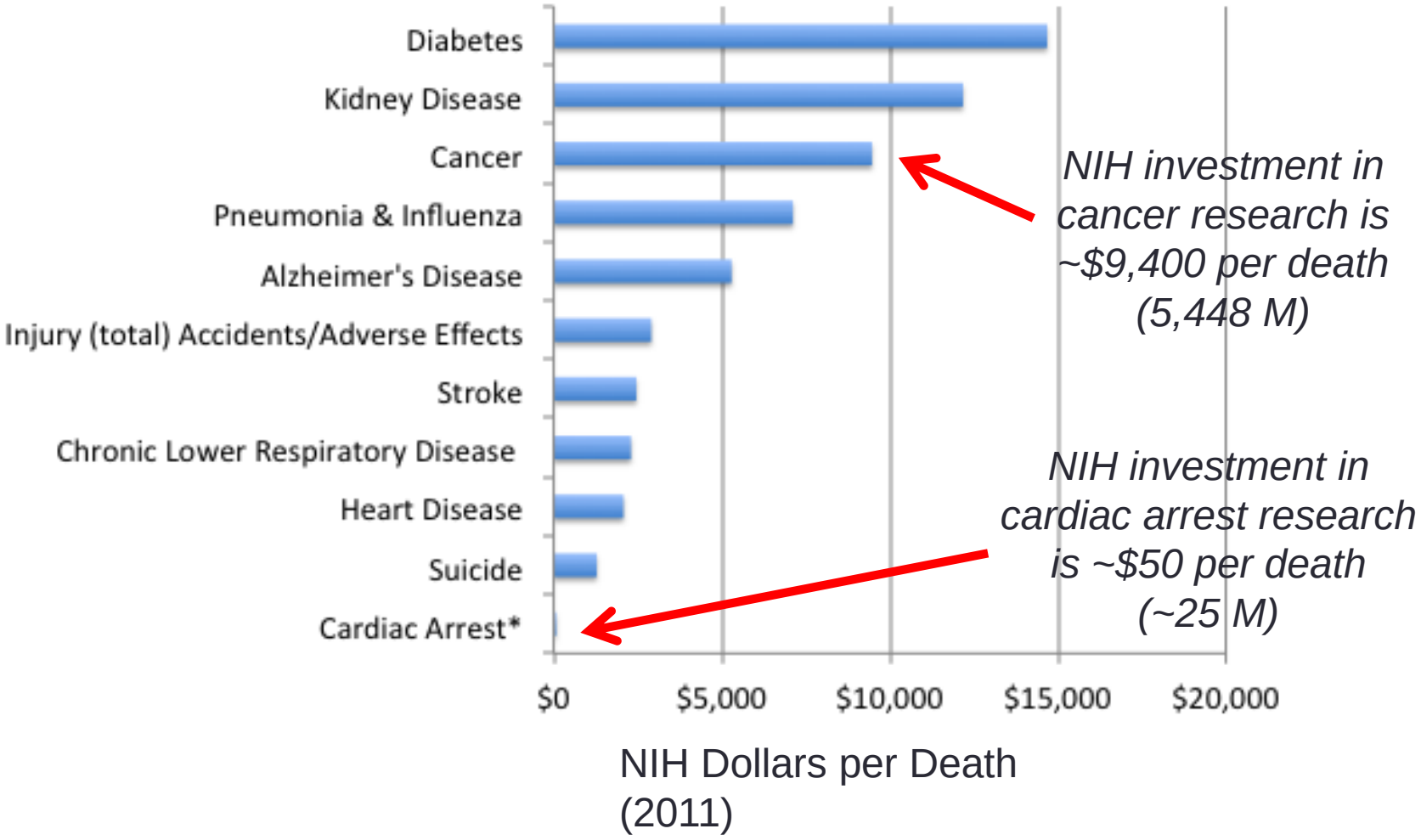
Number of deaths for leading causes of death

- Heart disease: 597,689
- Cancer: 574,743
- Chronic lower respiratory diseases: 138,080
- Stroke (cerebrovascular diseases): 129,476
- Accidents (unintentional injuries): 120,859
- Alzheimer's disease: 83,494
- Diabetes: 69,071
- Nephritis, nephrotic syndrome, and nephrosis: 50,476
- Influenza and Pneumonia: 50,097
- Intentional self-harm (suicide): 38,364

Cardiac Arrest: ~500,000

5. CDC Death Statisics 2011 http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_06.pdf

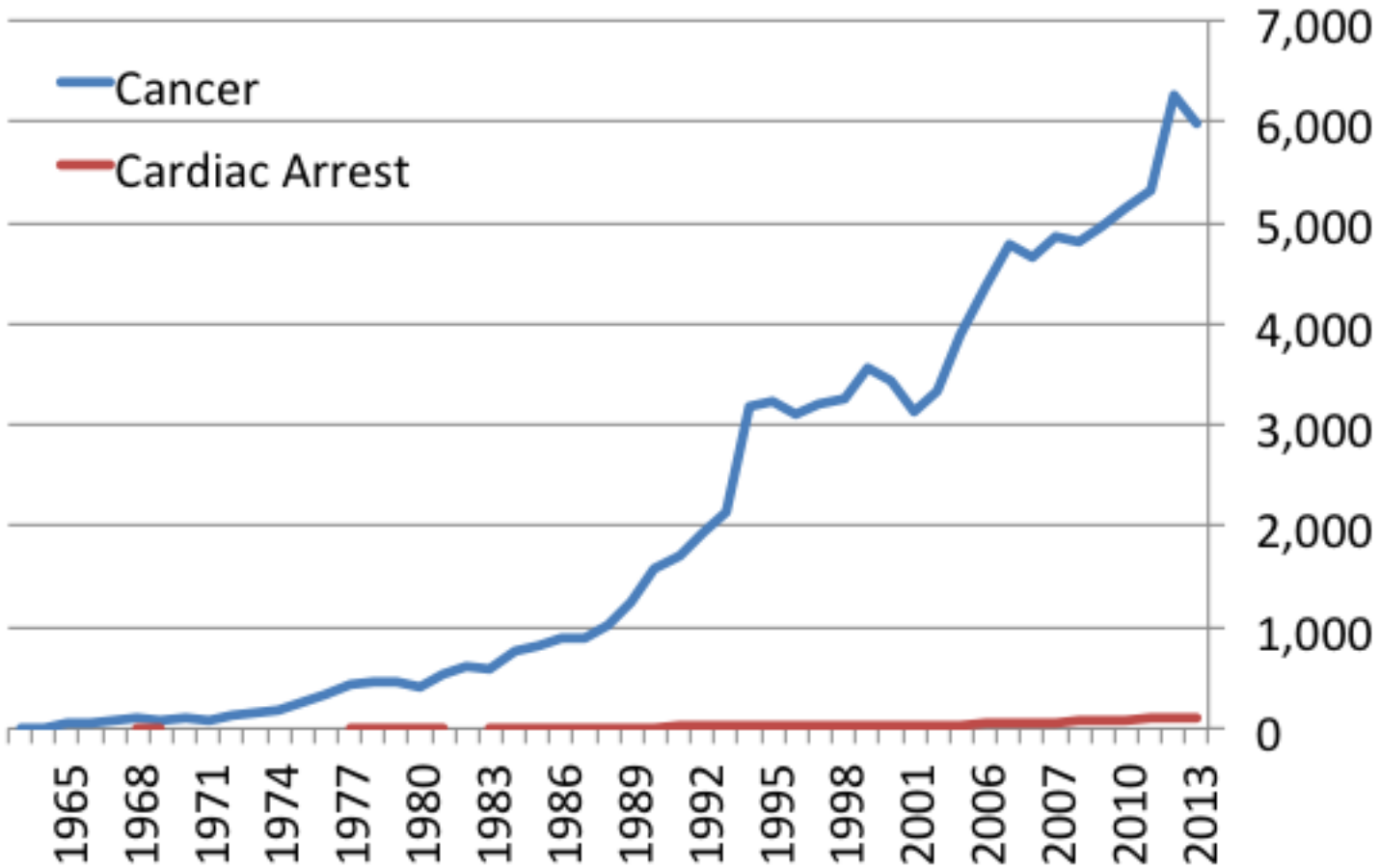
NIH Investment for Leading Causes of Death: 2011



CDC Death Statisics 2011 http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_06.pdf
NIH Reporter website: http://report.nih.gov/categorical_spending.aspx
*NIH Reporter: Search Terms Cardiac Arrest or Resuscitation, results limited to 2011

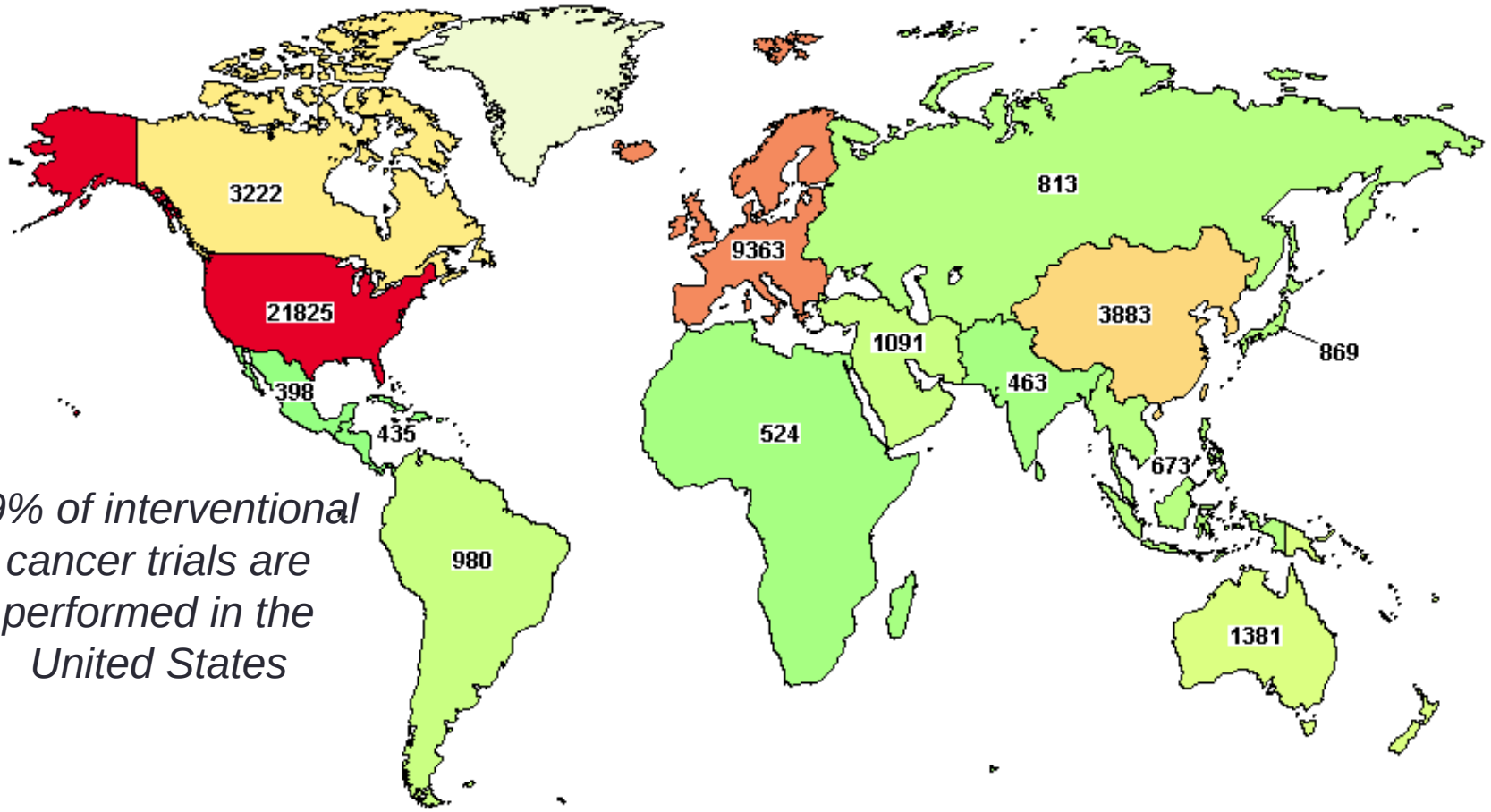
Published Clinical Trials

(PubMed Major Mesh Heading "Heart Arrest" and "Cancer" limited to clinical trials)



Clinical Science: Cancer
Global Distribution of Interventional Trials

36758 studies found for “Cancer” limited to interventional studies

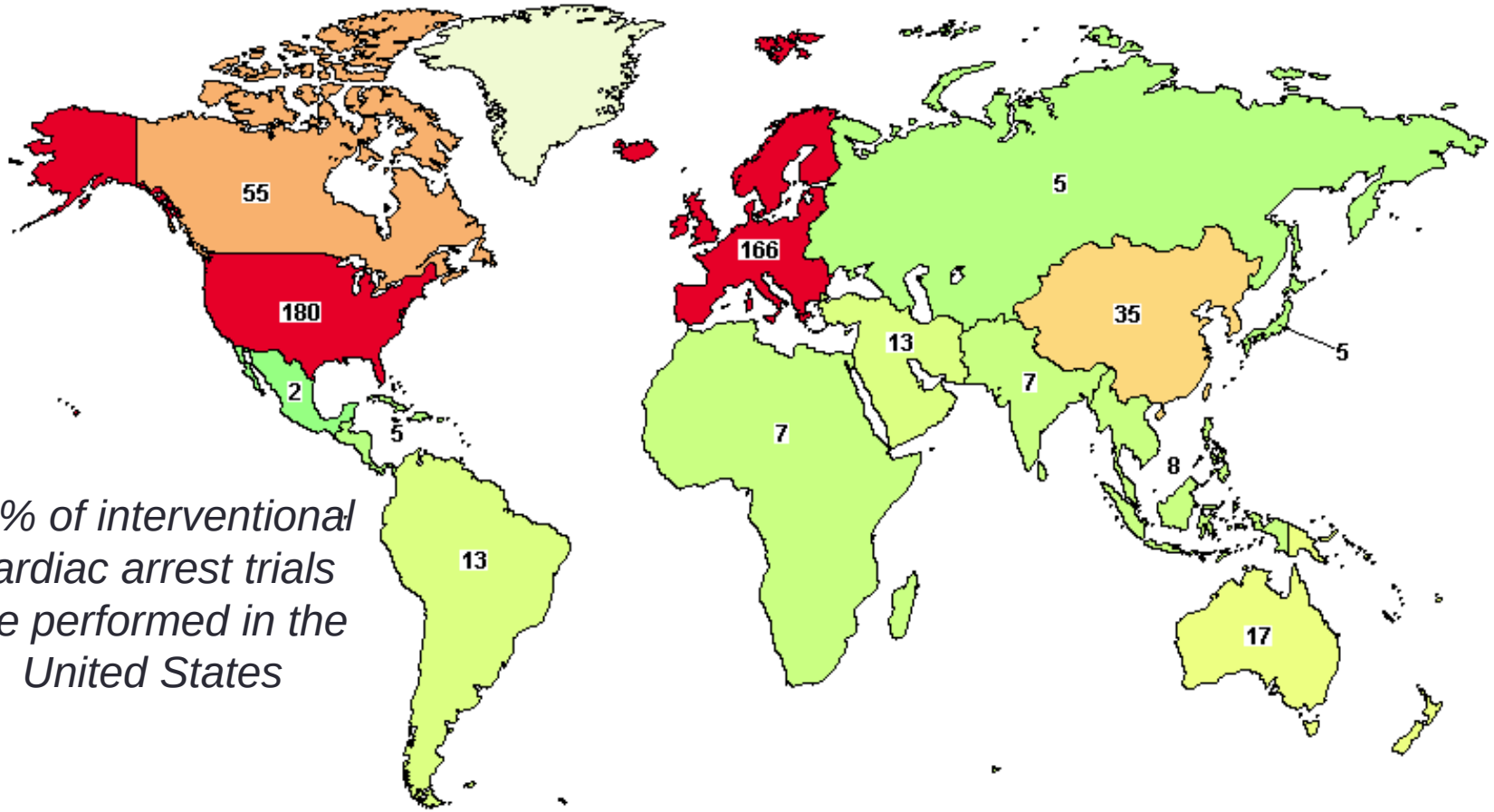


59% of interventional cancer trials are performed in the United States

Clinicaltrials.gov accessed 6/14/2014

Clinical Science: Cardiac Arrest
Global Distribution of Interventional Trials

469 studies found for “Cardiac Arrest or Heart Arrest” limited to interventional studies



38% of interventional cardiac arrest trials are performed in the United States

Clinicaltrials.gov accessed 6/14/2014

Cardiac Arrest Research Infrastructure

- **Laboratory Science**
  - Multicenter pre-clinical cardiac arrest research network to provide robust development and evaluation of promising therapies and treatment strategies prior to clinical trials.

- **Clinical Science**
  - Multicenter cardiac arrest clinical trial network(s) to support all phases of clinical trials.

- **Health Services/Population Science**
  - National surveillance program to monitor and report incidence, processes of care, and outcomes at local, state, and national level.

Cardiac Arrest Research Priorities

- **Laboratory Science**
  - Pathophysiology of total body ischemia/reperfusion
  - Mechanisms of post-cardiac arrest brain injury and repair
  - Mechanisms and optimization of targeted temperature management
  - Physiologic monitoring during CPR
  - Goal-directed CPR based on physiologic monitoring
  - Goal-directed post-cardiac arrest care
  - Extracorporeal CPR (ECPR)

Cardiac Arrest Research Priorities

- **Clinical Science**
  - Physiologic monitoring during CPR
  - Goal-directed CPR based on physiologic monitoring
  - Extracorporeal CPR (ECPR)
  - Optimization of targeted temperature management
  - Goal-directed post-cardiac arrest care
  - Post-cardiac arrest PCI
  - Post-cardiac arrest neuroprotection
  - Reliable post-cardiac arrest prognostication
  - Organ donation

Cardiac Arrest Research Priorities

- **Health Services/Population Science**
  - Cardiac arrest prevention
  - Early detection of unwitnessed cardiac arrest
  - Optimizing citizen response
  - Optimizing systems of care for out-of-hospital cardiac arrest
  - Optimizing systems of care for in-hospital cardiac arrest
  - Disparities

The Most Important Challenges

- How do we measure and report the burden of disease?
  - National Surveillance Program to monitor and report incidence, processes of care, and patient-centered outcomes at local, state, and national level
- How can we optimize the system of care?
  - Full implementation of effective therapies, practice guidelines, and best practices across the entire chain of survival for both out-of-hospital and in-hospital cardiac arrest
- What research investment and infrastructure is needed?
  - Research infrastructure and funding for laboratory, clinical, and health service/population research that is proportionate to the burden of disease

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