Location-Specific Cost Effectiveness of Public Access Defibrillation

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Ontario Prehospital Advanced Life Support Study

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Public Access Defibrillation (PAD)

- **The effectiveness of rapid defibrillation for cardiac arrest is undisputed**
- **Rationale for PAD: ↑ availability of AEDs → faster defib times → ↑ survival**
- **Little research guiding optimal placement of AEDs**

PAD Considerations

- 3-minute response time interval
- Multiple AEDs may be necessary per site
- Patient, system and clinical factors affect likelihood of an individual cardiac arrest being amenable to defibrillatory shock
- Widespread PAD potentially expensive, divert attention and resources from other programs

What is the cost-effectiveness of PAD when added to existing EMS?

In which specific locations would it be cost-effective to install AEDs?

Objective

To compare the incremental cost-effectiveness of the addition of a PAD program to the standard EMS response for a number of public location categories

OPALS Study

- Prospective before-after clinical trial
- 10 years, 20 Ontario study communities
- Studied impact of early defib/ALS on cardiac arrest survival, neuro outcomes, quality of life
- Phase II: EMS and firefighter rapid AED
- Phase III: Full ALS
- Utstein style

Patients

All adults suffering a prehospital cardiac arrest of presumed cardiac etiology prior to EMS arrival

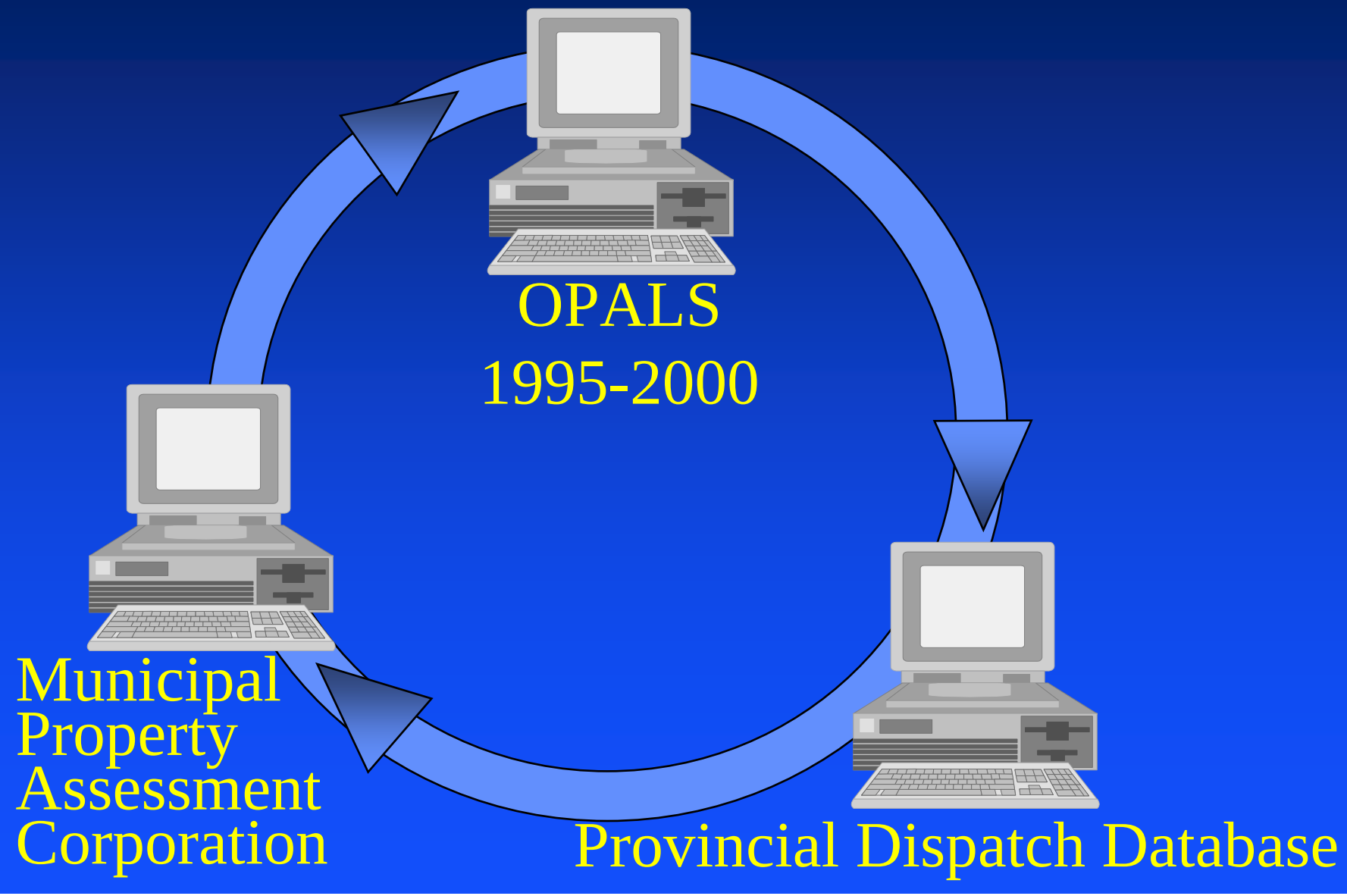
Exclusions:

- **< 16 years**
- ***Obvious deaths* as per Ambulance Act**
- **Trauma victims**
- **Other non-cardiac etiology**

Design

- Economic Evaluation
- Compare the total costs and life expectancy of treating cardiac arrest patients with and without an on-site automated electronic defibrillator (AED)

Data Collection



Data Collection

- ***A priori*, property type codes grouped into 18 location categories**
- **Roll provided total number of sites, per location type, within the study boundary**

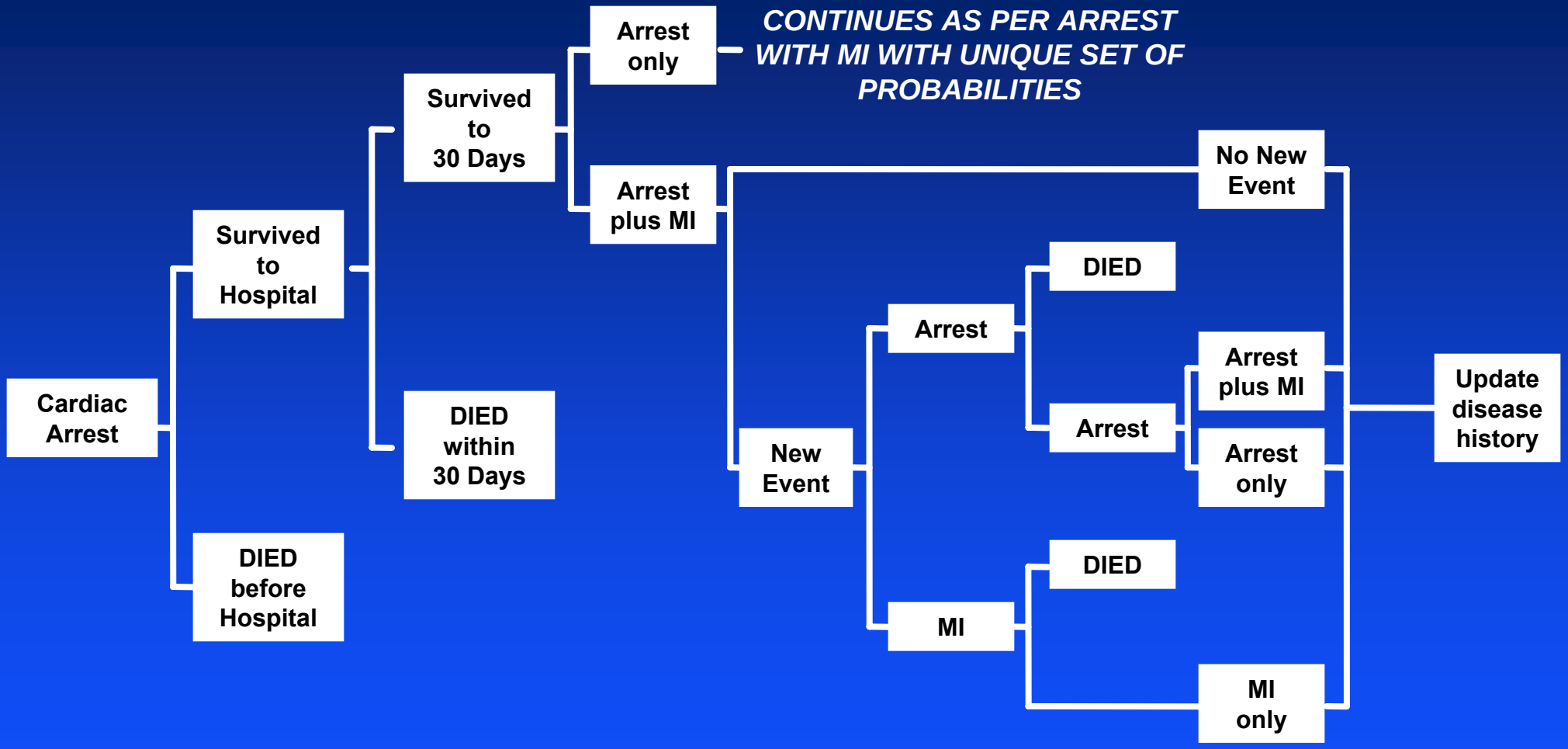
Primary Outcome

- **Incremental Cost Effectiveness Ratio**
- **The relative mean dollar cost of PAD in each location category per additional quality-adjusted life year (QALY).**
- $ICER=(Cost_i - Cost_c) / (QALY_i - QALY_c)$
- **i.e., the additional cost per life year gained**

Decision Analysis Model

- Estimated life expectancy and treatment costs of patients by survival status, gender, age at cardiac arrest.
- Adapted data within **Weinstein model** for survival estimates and disease progression
- Future life expectancy and costs **discounted** at a rate of 5%.
- **Monte Carlo simulation** estimated the uncertainty surrounding the ICERs.

Design of Decision Model



FIRST 30 DAYS AFTER CARDIAC ARREST

FOLLOWING 11 MONTHS AND SUBSEQUENT YEARS

Input Data

- Average *n* of cardiac arrests/yr (OPALS)
- Proportion of patients who die at scene, in hospital and survive to discharge without an on-site AED by gender, age (OPALS)
- Survival benefit from access to on-site AED in ≤ 3 min (OR = 3.0, 95%CI = 2.3-4.0)
- Annual cost of AED materials, training (5-yr amortization = $1319.01/yr)
- Resource utilization costs were based on a representative Canadian sample with incident coronary heart disease

Patient Characteristics (N=7707)

Age	**69**
Male	**67%**
Bystander Witnessed	**49%**
Initial Rhythm:	
VF or VT	**37%**
PEA	**21%**
Asystole	**42%**
Survival	**4.0%**

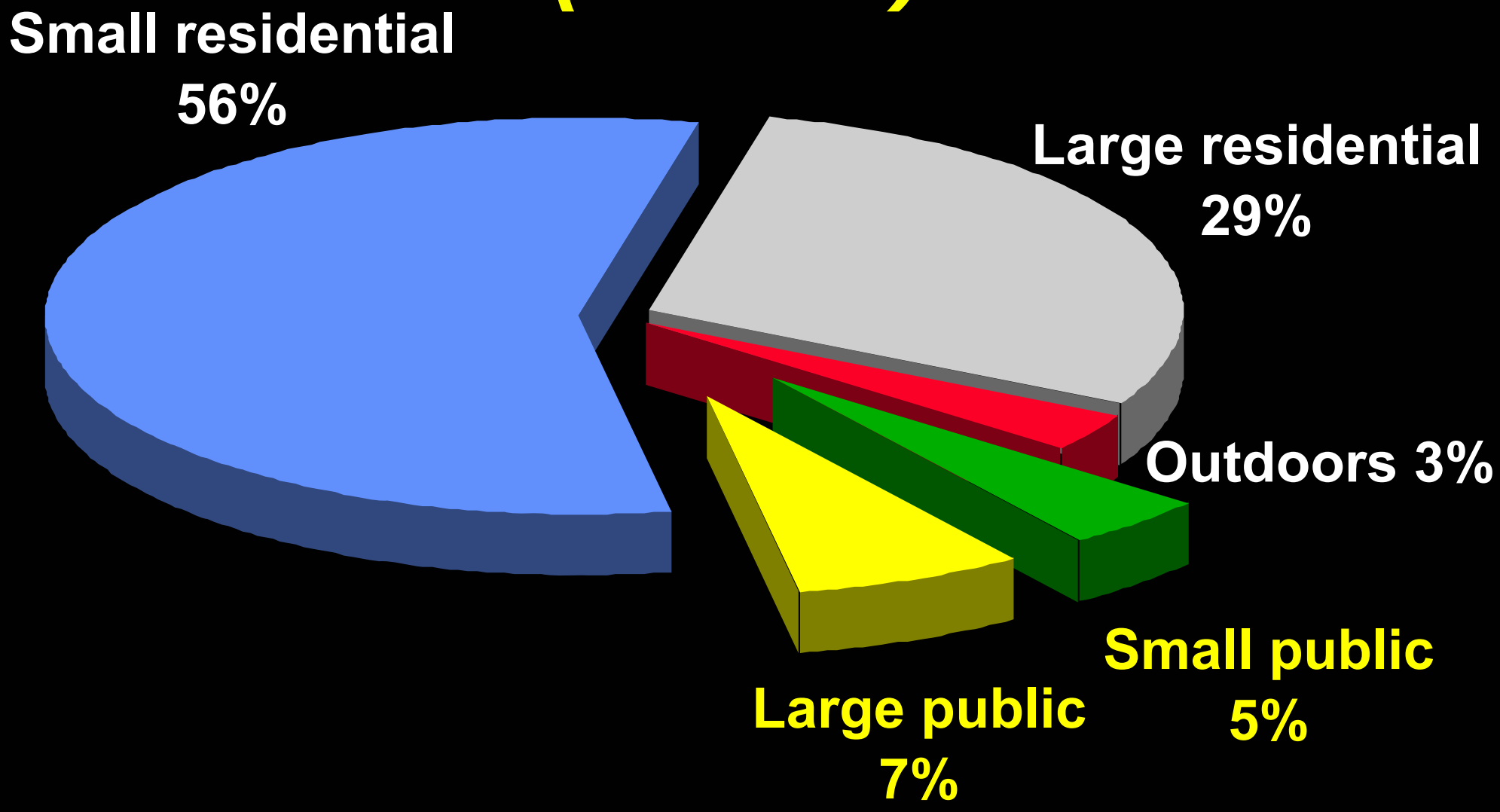
EMS Characteristics (N=7707)

Bystander CPR	**16%**
Fire/police CPR	**39%**
PAD response	**0.2%**
Fire first	**49%**
Defibrillation	**43%**

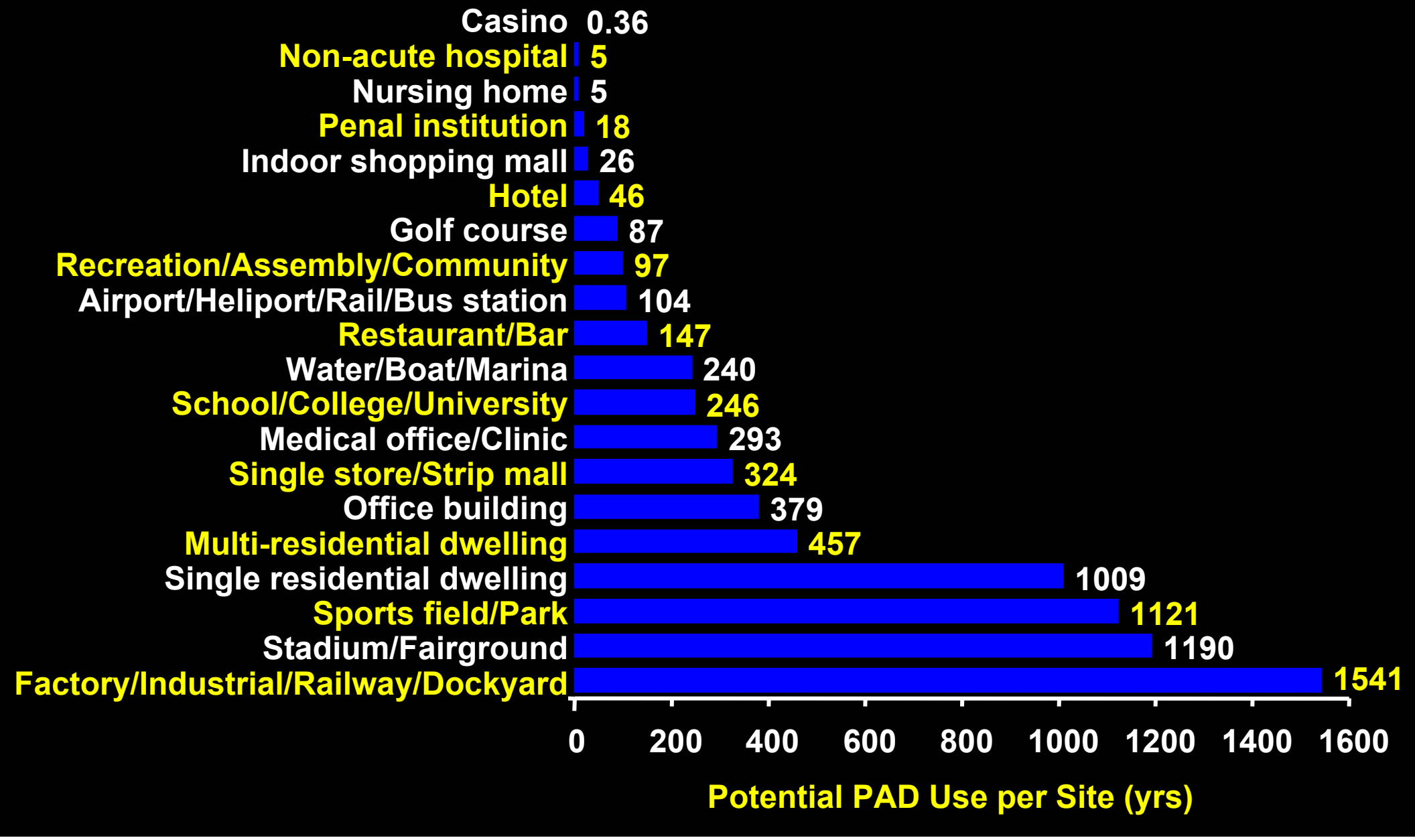
Defibrillation response interval:

Mean (min)	**5.4**
Response ≤ 8 min	**91%**

OPALS Cardiac Arrest Locations (N=7707)



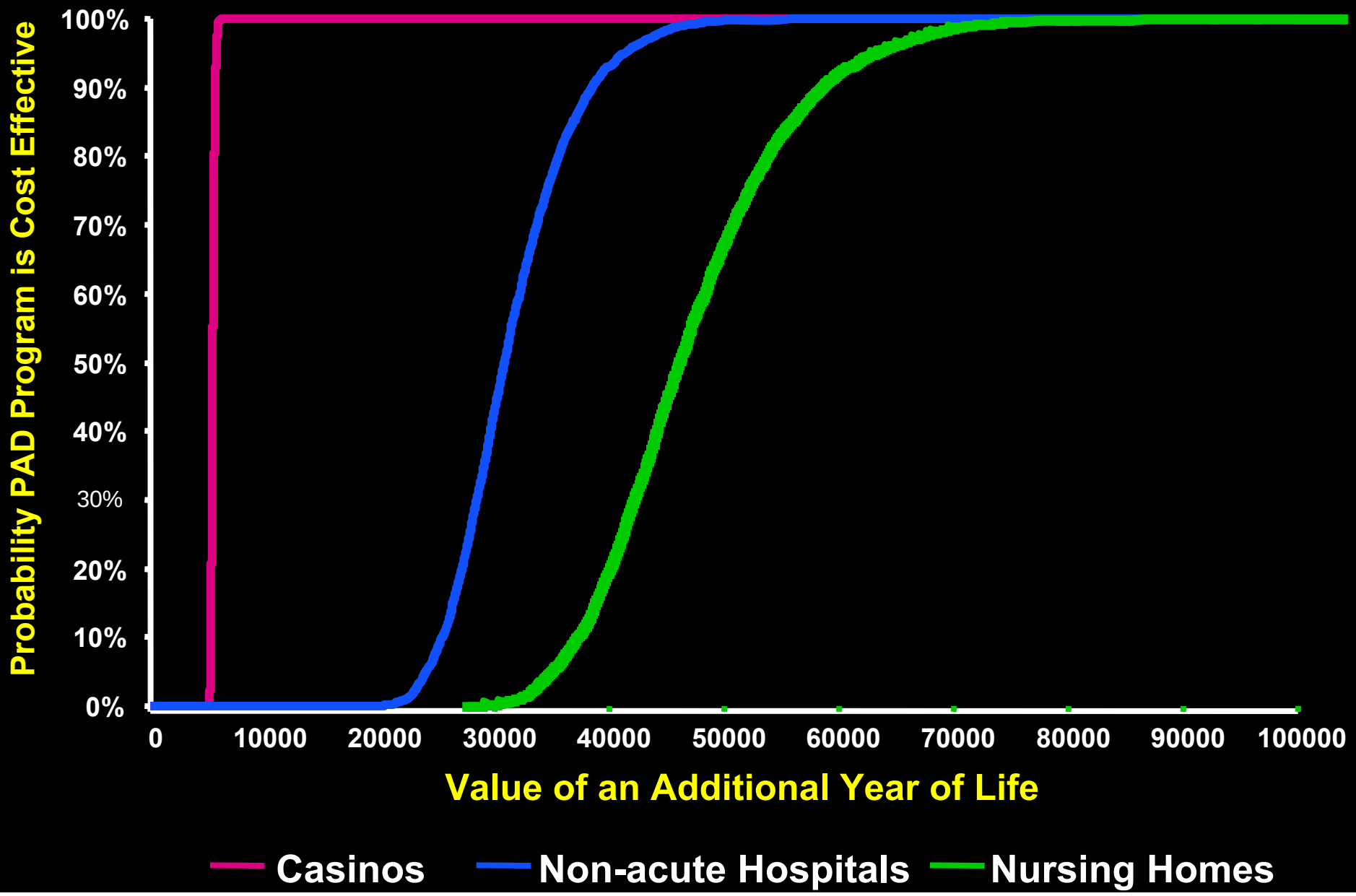
Average Years Between PAD Use (per Site)



Location	Arrests	Sites	Arrest/Site/Yr	ICER
Casino	28	2	2.800	$542
Non-acute hospital	42	42	0.200	$30750
Nursing home	457	460	0.199	$45926
Indoor shopping mall	77	394	0.039	$67690
Penal institution	6	21	0.057	$128783
Hotel	65	604	0.022	$143530
Golf course	9	156	0.012	$205990
Recreation/Assembly/Community	165	3206	0.010	$205407
Restaurant/Bar	48	1410	0.007	$347954
Airport/Heliport/Rail/Bus station	4	83	0.010	$368608
Water/Boat/Marina	5	240	0.004	$478647
School/College/University	36	1770	0.004	$598210
Single store/Strip mall	231	14956	0.003	$925784
Medical office/Clinic	41	2399	0.003	$955614
Office building	96	7276	0.003	$990511
Stadium/Fairground	1	238	0.001	$1910193
Sports field/Park	14	3139	0.001	$4104539
Factory/Industrial/Railway/Docks	56	17261	0.001	$4323180

Location	Probability Cost Effective	# AEDs Cost Effective
Casino	100%	54.8
Non-acute hospital	99%	1.7
Nursing home	67%	1.1
Indoor shopping mall	2%	<1
Penal institution	0%	<1
Hotel	0%	<1
Golf course	0%	<1
Recreation/Assembly/Community	0%	<1
Restaurant/Bar	0%	<1
Airport/Heliport/Rail/Bus station	0%	<1
Water/Boat/Marina	0%	<1
School/College/University	0%	<1
Single store/Strip mall	0%	<1
Medical office/Clinic	0%	<1
Office building	0%	<1
Stadium/Fairground	0%	<1
Sports field/Park	0%	<1
Factory/Industrial/Railway/Docks	0%	<1

Cost Effectiveness Acceptability Curves



Limitations

- No large metropolitan centers (>1 million) in our population
- Few large sporting venues in this Canadian study region
- Canadian costs
- Assumptions of economic analysis
- Some would argue for willingness to pay threshold greater than $50,000/life year gained

Conclusions

- Only 3 locations where PAD considered cost-effective based on willingness to pay $50K/life year gained
- Does not appear cost-effective to install AEDs in any of the other 16 locations
- No convincing evidence to support widespread implementation of PAD

Conclusions cont'd…

- **EMS and public health directors should consider methods for improving survival for *ALL* cardiac arrest patients**

  (e.g., improving citizen CPR, optimizing the traditional EMS response, targeted responder programs)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