How Time to Prehospital Intervention Affects OHCA Survival for Different Subpopulations

Mechanical & Industrial Engineering
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Background

- Common (mis)interpretation of Valenzuela et al. (1997) is that OHCA survival decreases by 10% for every minute longer it takes EMS to administer CPR, based on 1,872 OHCAs
- It is unknown how this statistic varies by subpopulations in a much larger and more recent data set

Objectives

1. Confirm Valenzuela et. al's results on a data set 10x as large
2. Extend Valenzuela et. al's results for different subpopulations

Data

- Included all non-traumatic, non-EMS witnessed, treated, public and private, witnessed and unwitnessed OHCAs
- January 1 2007 to December 31 2016
- Exclusions: younger than 18, dead on arrival, DNR, non-cardiac etiologies
- Data from Toronto and surrounding regions from Rescu Epistry-Cardiac Arrest database

34,660 OHCAs

Models

- Developed logistic regression models
- Performance was measured using area under the ROC curve (AUC)
- Used percent change in the odds of survival to interpret effect of variables

Basic Model

- Recreated Valenzuela et al.'s simplified model

Advanced Model:

- We developed a base model and 8 subpopulation models
- These models were generated by filtering on the following non-modifiable variables from the overall dataset:
  - Public arrests
  - Private arrests
  - Bystander witnessed arrests
  - Unwitnessed arrests
  - Patients who are 65 and older
  - Patients who are under 65
  - Arrests with bystander resuscitation
  - Arrests with no bystander resuscitation

Disclosures| None

Model Variables

Basic Model (1)

Independent Variables

- Time from 911 Call to CPR
- Time from 911 Call to defibrillation

Dependent Variable

- Survival to discharge (Y/N)

Advanced Model (2)

Independent Variables

- Age
- Sex
- Public (Y/N)
- Shockable (Y/N)
- Bystander Witnessed (Y/N)
- Bystander Resuscitation (Y/N)
- Time between 911 call and patient contact

Dependent Variable

- Survival to discharge (Y/N)

Results: Valenzuela Comparison (1)

Basic Model — AUC: 0.64

Variable	Coefficient	% Change	Significant
(Intercept)	-1.1	-67.62	Y
Time between Dispatch Call and EMS CPR	-0.11	-10.16	Y
Time between Dispatch Call and EMS AED	-0.08	-7.31	Y

Table 1a: Coefficient value and percent change in the odds of survival for a unit increase in each variable for the Valenzuela model applied to our data

Valenzuela (1997) — AUC: 0.65

Variable	Coefficient	% Change	Significant
(Intercept)	0.26	29.69	Y
Time between Dispatch Call and EMS CPR	-0.106	-10.06	Y
Time between Dispatch Call and EMS AED	-0.139	-12.98	Y

Table 1b: Coefficient value and percent change in the odds of survival for a unit increase in each variable for the original Valenzuela model

Results: Effect of Time For Different Subpopulations (2)

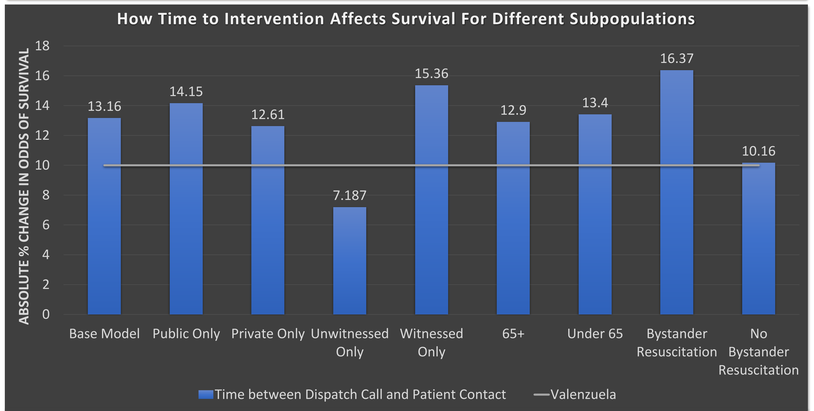

Figure 1: The effect of a one minute delay in response time on the odds of survival for different subpopulations. This effect can be as low as a 7.2% reduction and as high as a 16.4% reduction, a contrast to Valenzuela's commonly accepted 10% rule

Discussion

Basic Model

- Similar results to the Valenzuela comparison, even on a larger data set
- For both studies all variables were statistically significant and had a similar effect (about 10%) on odds of survival
- An AUC of 0.65 is not very strong

Advanced Model

- Had a much higher AUC (average 0.85), demonstrating a stronger model
- Demonstrates that the relationship between patient contact time and survival differs depending on the non-modifiable characteristics of the arrest
- Largest change in odds of survival (16.4%) was for OHCAs with bystander resuscitation, suggests that OHCA are even more time sensitive than originally thought and a minute improvement can have a 70% greater improvement on odds then originally thought

Conclusion

Basic Model

Validated that a minute increase in time to intervention results in a 10% decrease in the odds of survival on a larger data set

Advanced Model

Demonstrated that the effect time to intervention has on survival changes for different subpopulations

Effect of time to intervention for **general cases:**	**-13.16%**
Effect of time to intervention for **unwitnessed:**	**-7.19%**
Effect of time to intervention for **bystander resuscitation:**	**-16.37%**

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