Time is Not of the Essence
Re-Evaluating the Traditional Response Interval

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What’s all this stuff about “Response Time?”

Does it make a difference?
EMS Response Intervals

1. Illness / Injury Occurs
2. Ascertain Nature & Transfer
3. Call Prioritization
   Identifying closest unit
4. EMS Dispatching
5. Units Dispatched
6. Response to Scene
7. First Responder (BLS)
   Scene Arrival
8. First Responder (BLS)
   Patient Arrival
9. Paramedic (ALS)
   Scene Arrival
10. Paramedic (ALS)
    Patient Arrival

- 9-1-1 Access
- EMS Call Taking Transfer to FR
Illness / Injury Occurs
Ascertain Nature & Transfer
Call Prioritization Identifying closest unit EMS Dispatching
First Responder (BLS) Scene Arrival
Paramedic (ALS) Scene Arrival

9-1-1 Access
EMS Call Taking Transfer to FR
Units Dispatched Response to Scene
First Responder (BLS) Patient Arrival
Paramedic (ALS) Patient Arrival

1º PSAP Control
Illness / Injury Occurs

Ascertain Nature & Transfer

Call Prioritization Identifying closest unit EMS Dispatching

First Responder (BLS) Scene Arrival

Paramedic (ALS) Scene Arrival

9-1-1 Access

EMS Call Taking Transfer to FR

Units Dispatched Response to Scene

First Responder (BLS) Patient Arrival

Paramedic (ALS) Patient Arrival

Response Time Clock Starts

First Responder Response Time Clock Stops

ALS Response Time Clock Stops
Illness / Injury Occurs

Ascertain Nature & Transfer

Call Prioritization Identifying closest unit EMS Dispatching

First Responder (BLS) Scene Arrival

Paramedic (ALS) Scene Arrival

9-1-1 Access

EMS Call Taking Transfer to FR

Units Dispatched Response to Scene

First Responder (BLS) Patient Arrival

Paramedic (ALS) Patient Arrival

Response Time Clock Starts

First Responder Response Time Clock Stops

ALS Response Time Clock Stops

≤ 4:00 min

≤ ??:?? min
What Do We Know?

What Evidence is Available?

1 study used to set standards of:

- ≤ 4 min - first responders
- ≤ 8 min - advanced care
Cardiac Resuscitation in the Community
Importance of Rapid Provision and Implications for Program Planning

_Eisenberg MS, et al. JAMA 1979;241:1905-1907_

**Conclusion:**
- Victims of non-traumatic cardiac arrest have a better outcome if BLS (CPR) is initiated within 4 min of arrest and ALS (defibrillation) is provided within 8 min

**Problem:**
- Times extrapolated to all patients - medical and trauma
Eight Minutes or Less: Does the Ambulance Response Time Guideline Impact Trauma Patient Outcome?


**Objective:**
Evaluate the effects of exceeding 8 min RT guideline on survival from traumatic injuries

3490 Trauma patients
- Group I: RT ≤ 8 min (n=2450)
- Group II: RT > 8 min (n=1040)

Stratified by age, mechanism of injury, and ISS
- 1-15
- 16-25
- >25
Results:
No difference in survival between ≤ 8 or > 8 min groups

No difference when stratified by age, MOI, ISS… except in > 8 min group:
- Survival increased in ISS > 25 group
  (44% vs 26%, p=0.02)
- No outcome difference for ISS groups 1-15 and 16-25
Eight Minutes or Less: Does the Ambulance Response Time Guideline Impact Trauma Patient Outcome?


Results:
RT stratified in 2-min increments and controlled for ISS group, age, endotracheal intubation, or type of trauma:

No differences in survival for any RT interval

Logistic regression relating survival to independent variables (RT, age, gender, ISS, trauma type, ETI):

No effect on survival based upon RT
Conclusions:

- RT has no effect on survival in trauma
- Exceeding the 8 min RT criterion does not affect survival from traumatic injury
What Do We Know?
What Evidence is Available?

2002
2005
2009
2012
Response Time Effectiveness: Comparison of Response Time and Survival in an Urban Emergency Medical Services System


Purpose:
Determine the effect of RT specifications on survival to hospital discharge (90% fractile = 10:59 and 12:59)
Calculate the probability of mortality as a function of arbitrarily assigned RTs to determine if improved survival would result from reducing times

5424 patients (Priority-1 and 2 transports)
Response Time Effectiveness: Comparison of Response Time and Survival in an Urban Emergency Medical Services System


Results:
Mean RT
Survivors: 6.96 min
Non-survivors: 7.06 min
Difference: 0.10 min (6 sec)
Response Time Effectiveness: Comparison of Response Time and Survival in an Urban Emergency Medical Services System


Results:
Median RT
All patients: 6.5 min (0.2 min to 43.9 min)
90% of responses were within 10.6 min
Survivors: 6.4 min
Non-survivors: 6.8 min
Difference: 0.4 min (24 sec; p=0.10)
Response Time Effectiveness: Comparison of Response Time and Survival in an Urban Emergency Medical Services System


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71 non-survivors
Mortality prevalence of 1.31% (95% CI: 1.02%,1.65%)
Response Time Effectiveness: Comparison of Response Time and Survival in an Urban Emergency Medical Services System


Results:
Probability of mortality as a function of RT...

Plotted proportion of those who did not survive at each integer response time (0-12 min) with the number of non-survivors that would have been expected if observed death proportion (1.31%) was uniform across all times.

No inequality between observed and expected death rates for all RTs (p=0.14)
Response Time Effectiveness: Comparison of Response Time and Survival in an Urban Emergency Medical Services System


**Results:**

But…

Number of actual deaths consistently fell below the expected number for RTs less than 5 min, but exceeded the number at response times ranging from 5 to 12 min.

So…

Post hoc test for effect on survival of RT dichotomized at < 5 min and ≥ 5 min.
Response Time Effectiveness: Comparison of Response Time and Survival in an Urban Emergency Medical Services System


Results:

<table>
<thead>
<tr>
<th>Mortality Risk</th>
<th>&lt; 5 min</th>
<th>≥ 5 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patients</td>
<td>1381</td>
<td>4043</td>
</tr>
<tr>
<td>Deaths</td>
<td>7 (0.51%)</td>
<td>64 (1.58%)</td>
</tr>
</tbody>
</table>

Mortality risk curve was generally flat over RT intervals exceeding 5 min
Conclusion:
Mortality risk appeared sensitive to RTs < 5 min
There were no statistically significant differences for RTs between 5 and 10 min
There was evidence to suggest that very low RTs (< 5 min) are associated with a low risk of mortality and may theoretically save as many as 6-10 lives per year
Purpose:
Evaluate the effect of paramedic RT on unselected patient survival to discharge, controlling for confounders:
- Age, gender, ST, TT, 3 categories of illness severity

<table>
<thead>
<tr>
<th>Risk of Mortality</th>
<th>% Survival to Hospital Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>All (9559)</td>
<td>92%</td>
</tr>
<tr>
<td>Low (6696)</td>
<td>99%</td>
</tr>
<tr>
<td>Intermediate (2619)</td>
<td>83%</td>
</tr>
<tr>
<td>High (244)</td>
<td>3%</td>
</tr>
</tbody>
</table>

\( p=0.0001 \)
Paramedic Response Time: 
Does it Affect Patient Survival


**Results:**
RT modeled as continuous variable controlling ST, TT, age, gender, ISS:
No effect on survival

RT categorized as ≤ 4 and > 4 min:
Survival benefit identified ≤ 4 min
(Intermediate and high risk groups)

RT categorized as ≤ 8 and > 8 min:
No survival benefit identified at 8 min cutoff
Paramedic Response Time: Does it Affect Patient Survival


Conclusion:

• Survival benefit was identified for RT < 4 min (immediate or high risk of mortality)

• Paramedic RT > 4 min did not influence mortality, even after controlling for illness severity
Lack of Association Between Prehospital Response Times and Patient Outcomes


Purpose:
Examine EMS RTs, clinical care provided, and patient outcome for high acuity 9-1-1 calls to determine if the current response time specifications and clinical care provision set for the community are appropriate

746 medical and trauma patients (priority transports)
- RT > 10:59 (cases: n=373)
- RT ≤ 10:59 (controls: n=373)
Lack of Association Between Prehospital Response Times and Patient Outcomes


Results:
Survival to hospital discharge:
- Cases: 80% (95% CI: 76% to 84%)
- Controls: 82% (95% CI: 77% to 85%)
Yield:
- 95% CI for 2% difference in proportions of -6% to +4%

ALS procedures performed:
- Cases: 47% (95% CI: 43% to 53%)
- Controls: 45% (95% CI: 40% to 51%)
Yielded:
- 95% CI for 2% difference in proportions of -10% to +5%
Conclusion:
• The 95% confidence interval analysis suggests: Priority patients who wait longer than 10:59 min could experience between a 6% increase to a 4% decrease in mortality.

No evidence of increased mortality nor increased requirement for critical procedures for priority patients where RT exceeded 10:59 min.
Purpose:
To determine whether an ALS RT of ≥ 8 min (compared with < 8 min) was associated with increased mortality in an urban system

Adults with potentially life-threatening conditions (delta and echo MPDS calls)
Emergency Medical Services Response Time and Mortality in an Urban Setting


Results:
7760 calls
   1865 (24%) ≥ 8 min
   5895 (76%) < 8 min
Risk of mortality:  
   ≥ 8 min: 7.1%
   < 8 min: 6.4%
Adjusted OR of mortality ≥ 8 min: 1.19% (CI: 0.97, 1.47)
Emergency Medical Services Response Time and Mortality in an Urban Setting


Conclusion:
No statistically significant difference in all-cause mortality for patients receiving a response of ≥ 8 min versus < 8 min
Many studies (mostly non-trauma patients) include RTs as part of dataset, but most focus on scene time and total prehospital time - only few looked at actual RT, but...

It is the RT that has become a measure of effective ambulance service
Evidence Conclusion…..

Many studies (mostly non-trauma patients) include RTs as part of dataset, but most focus on scene time and total prehospital time - only few looked at actual RT, but…

It is the RT that has become a measure of effective ambulance service

RT standard developed based on one intervention and where data exists documenting the need for specific RT
Evidence Conclusion…..

4 studies demonstrated no improvement in outcome based on short RT

RT < 4 or 5 min may improve survival
Evidence Conclusion.....

4 studies demonstrated no improvement in outcome based on short RT

RT < 4 or 5 min may improve survival

Maybe we need RTs for interventions within a time frame rather than the delivery of the equipment!
Decreasing Response Time
Decreasing Response Time

Warning Lights and Sirens
Decreasing Response Time

Warning Lights and Sirens

1. Is ambulance transport time with lights and siren faster than without?  

2. The effectiveness of lights and siren use during ambulance transport by paramedics  

3. Time saved with use of emergency warning lights and sirens during response to requests for emergency medical aid in an urban environment  

4. Time saved with the use of emergency warning lights and siren while responding to requests for emergency medical aid in a rural environment  
   *Ho J, Lindquist M. Prehosp Emerg Care 2001;5:159-162*

5. Do warning lights and sirens reduce ambulance response times?  
Decreasing Response Time

More resources
Decreasing Response Time

American Ambulance Association…
Significant financial cost associated with lowering response times.

Cost of 1 ambulance + labor 24 hrs / day / year:

$500,000 - $600,000
Survey of emergency medical services in the nation’s 50 largest cities

<table>
<thead>
<tr>
<th>City</th>
<th>Paramedic Ratio</th>
<th>Survival Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston</td>
<td>9.5 per 100,000</td>
<td>40%</td>
</tr>
<tr>
<td>Seattle</td>
<td>13.5</td>
<td>45%</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>17.9</td>
<td>27%</td>
</tr>
<tr>
<td>San Antonio</td>
<td>33.2</td>
<td>9%</td>
</tr>
<tr>
<td>Nashville</td>
<td>33.3</td>
<td>5%</td>
</tr>
<tr>
<td>Omaha</td>
<td>44.6</td>
<td>3%</td>
</tr>
</tbody>
</table>
Decreasing Response Time

System Status Management
High Performance System

Demand Analysis
1330-1430
Tuesdays
2006-2009
Increasing Response Time
Increasing Response Time

Luxury Defined
Entitlement to EMS
Increasing Response Time

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Entitlement to EMS
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Luxury Defined
Entitlement to EMS
Increasing Response Time

Jurisdiction Infrastructure
Impediment to response
Response Time Standards

Governance of Response Times

Federal or State laws: None
  Many municipal, e.g. 3rd service, fire-based services have no response performance standards

Contractual agreements (EMS & political) stipulating response times: Some
  Many non-municipal, e.g. public utility, hospital-based, private services have adopted some response standard
Response Time Standards

Governance of Response Times
National Fire Protection Association's (NFPA) 1710

- Standard for the organization and deployment of fire suppression operations, emergency medical operations, and special operations to the public by career fire departments

- Provides key EMS benchmarks for municipal and career fire departments
Response Time Standards

NFPA 1710 standard:
- Establishes
  - Turnout time: 1 minute
  - First responder arrival: 4 minutes
  - Objective met: 90%

- Fire-based ALS service
  - Arrival: 8 minutes
  - Objective met: 90%
  - Personnel: 2 Paramedics, 2 EMTs
Response Time Standards

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  - Personnel: 2 EMTs
Response Time Standards

NAEMSP Position Paper
Considerations in Establishing Emergency Medical Services Response Time Goals

Response Time - Dependent Clinical Conditions

Possible
1. Pulmonary
   a. COPD exacerbation
   b. Asthma exacerbation
   c. Toxic inhalation

2. Cardiovascular
   a. Acute MI
   b. Malignant dysrhythmias
   c. Decompensated heart failure
Response Time - Dependent Clinical Conditions

Possible
3. Neurological
   a. Thrombotic stroke
   b. Status seizure

4. Other
   a. Choking
   b. Diabetic
   c. Overdose
   d. Childbirth
   e. Significant Trauma?
Response Time - Dependent Clinical Conditions

No Question
1. VT / VF arrest  (defibrillation)
2. Severe anaphylactic reaction  (epinephrine)
3. Uncontrolled hemorrhagic shock  (transport)
Response Time - Dependent Clinical Conditions

No Question
1. VT / VF arrest (defibrillation)
2. Severe anaphylactic reaction (epinephrine)
3. Uncontrolled hemorrhagic shock (transport)
4. Aortic disease (transport)
   - Dissection
   - Leaking aneurysm
What’s all this stuff about “Response Time?”

Does it make a difference?
What’s all this stuff about “Response Time?”

For most, it probably doesn’t matter…