

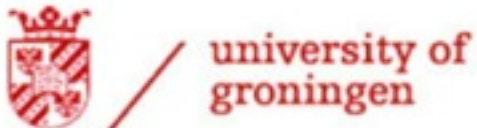
Extending the Emergency Medical Services network for out-of-hospital cardiac arrest victims

An explorative study for the province of Drenthe

Tef Jansma
Master thesis

University of Groningen supervisors:
Dr. ir. Durk-Jouke van der Zee
Dr. ir. Wilfred H.M. Alsem

UMCG Ambulancezorg supervisor:
Ir. Jaap Hatzenboer



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Introduction

- ▶ Extending the emergency medical services network for **out-of-hospital cardiac** (OHCA) arrest victims

- ▶ OHCA
 - “Cessation of cardiac mechanical activity that is confirmed by the absence of signs of circulation, and which occurs outside a hospital setting.”
 - Treatment needs to begin within 4 minutes
 - Incidence: 0.1% of population yearly
 - 4% of blue lights responses

Introduction

- ▶ Case study
 - Drenthe: 490.000 inhabitants
 - EMS provider: UMCG Ambulancezorg
 - OHCA survival rate 10% - 15%
 - Dutch response time requirements
- ▶ Survival rate unacceptable
 - World class: >25% (e.g. King County)
- ▶ Cost-effectiveness of solutions?



Research design

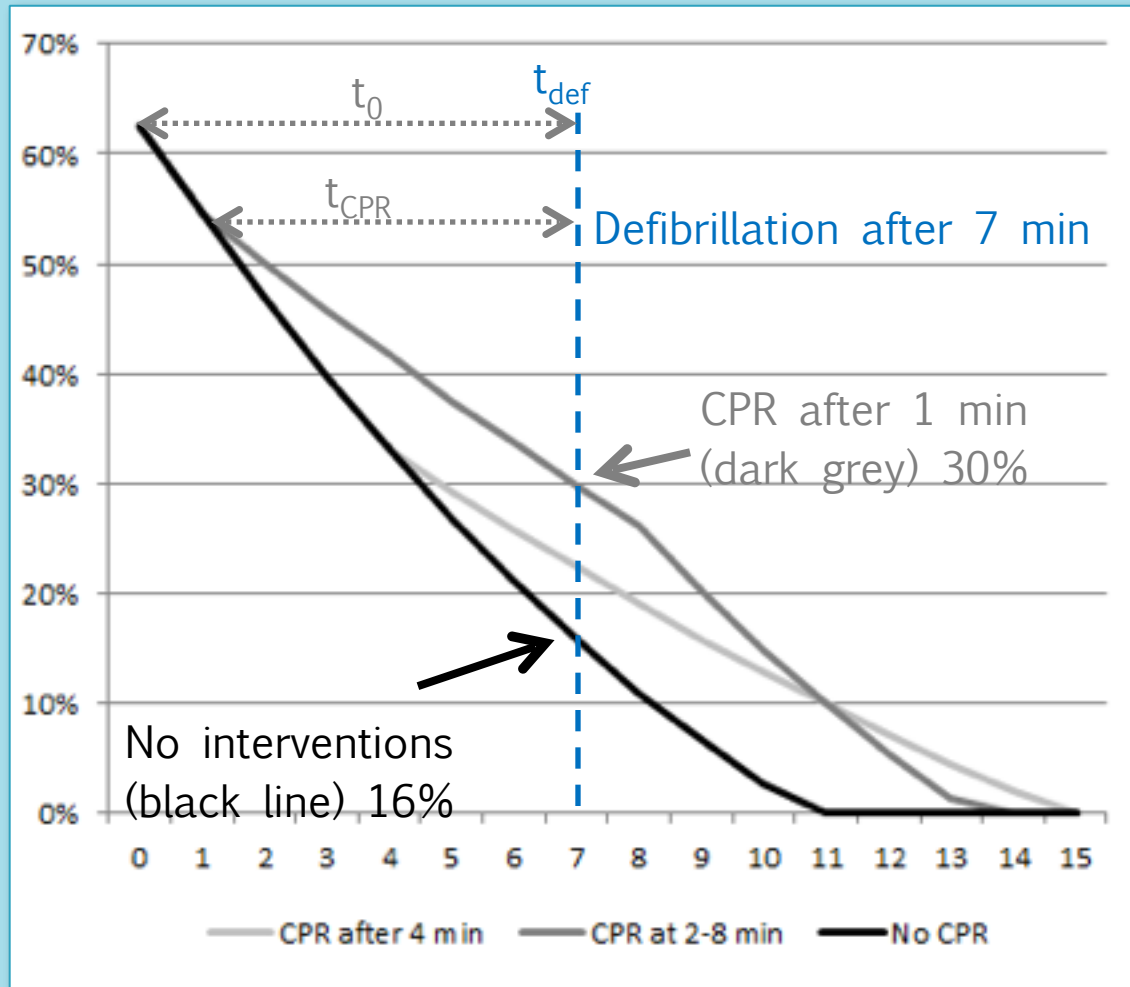
- ▶ Research objective
 - Deliver a cost-efficient system redesign for UMCG Ambulancezorg that improves the estimated survival rate for out-of-hospital cardiac arrests to 25%.
- ▶ Performance indicators
 - Survival rate estimate (%)
 - Investment costs (€) and variable costs (€ / year)
- ▶ Method
 - Simulation

Analysis

- ▶ Treatment: CPR, defibrillation, advanced care
- ▶ Executing any step earlier directly improves survival probability
- ▶ CPR < 4 min
- ▶ Defibrillation < 8 min
- ▶ Advanced care < 12 min

Analysis

$$P_{\text{survival}}(t_{\text{def}}) = (0.835 - 0.0775t_0 + 0.0289t_{\text{CPR}}) \times (0.75 - 0.03t_0 + 0.0167t_{\text{CPR}})$$



Analysis – region wide

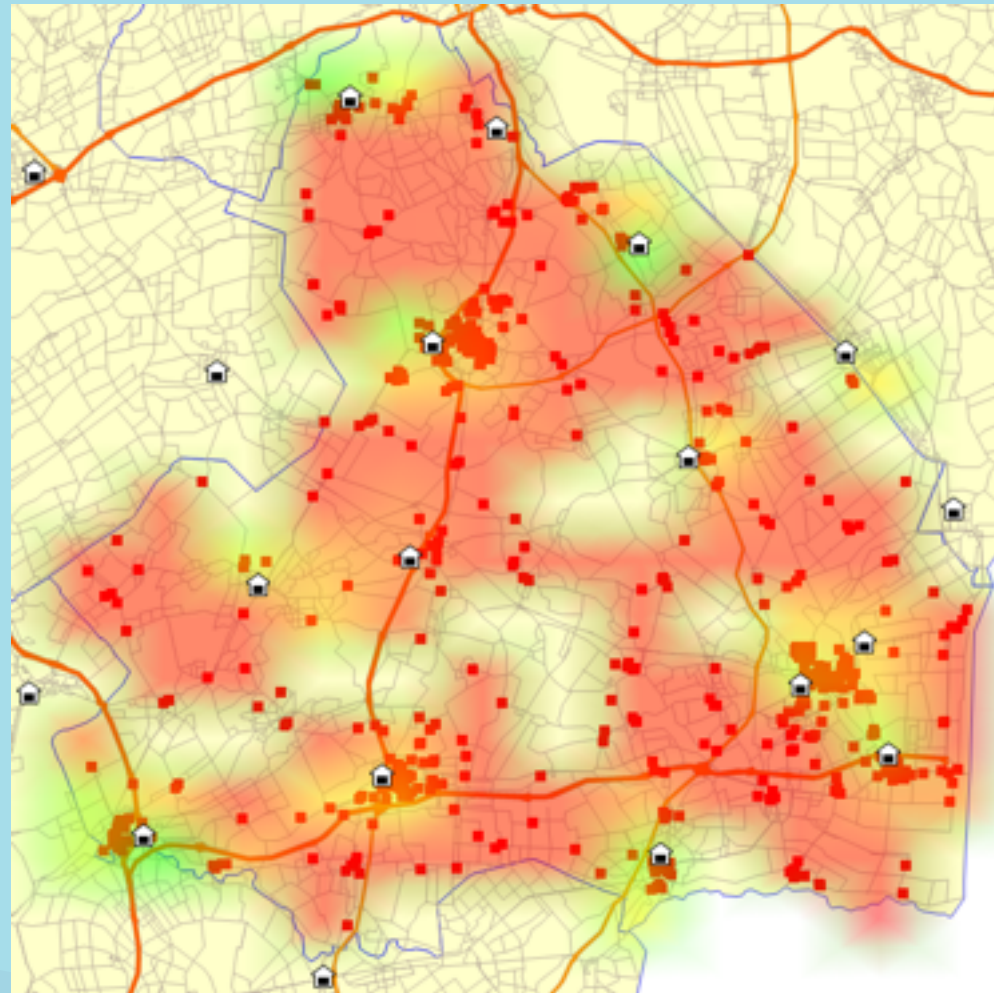
- ▶ Current EMS system

- ▶ Arrivals

- 6% < 4 min
- 51% < 8 min
- 86% < 12 min

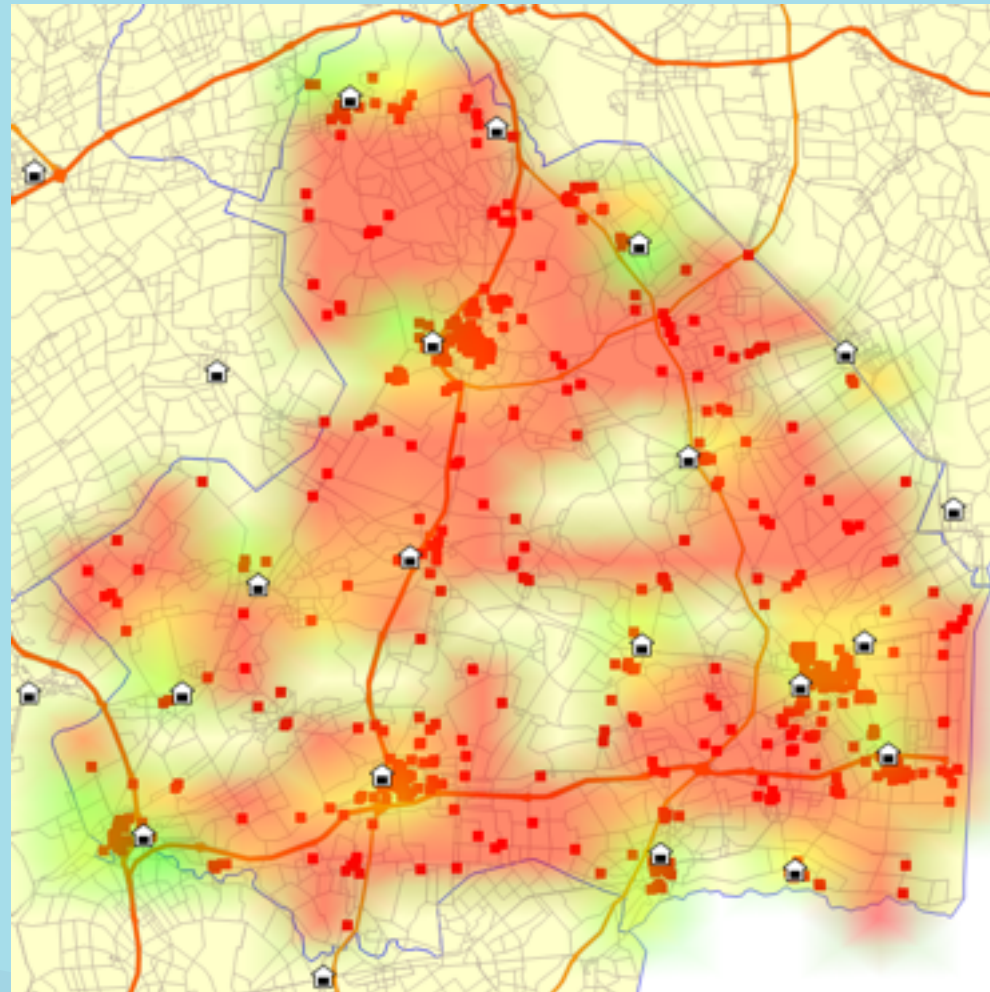
- ▶ Survival

- 11.5% probability



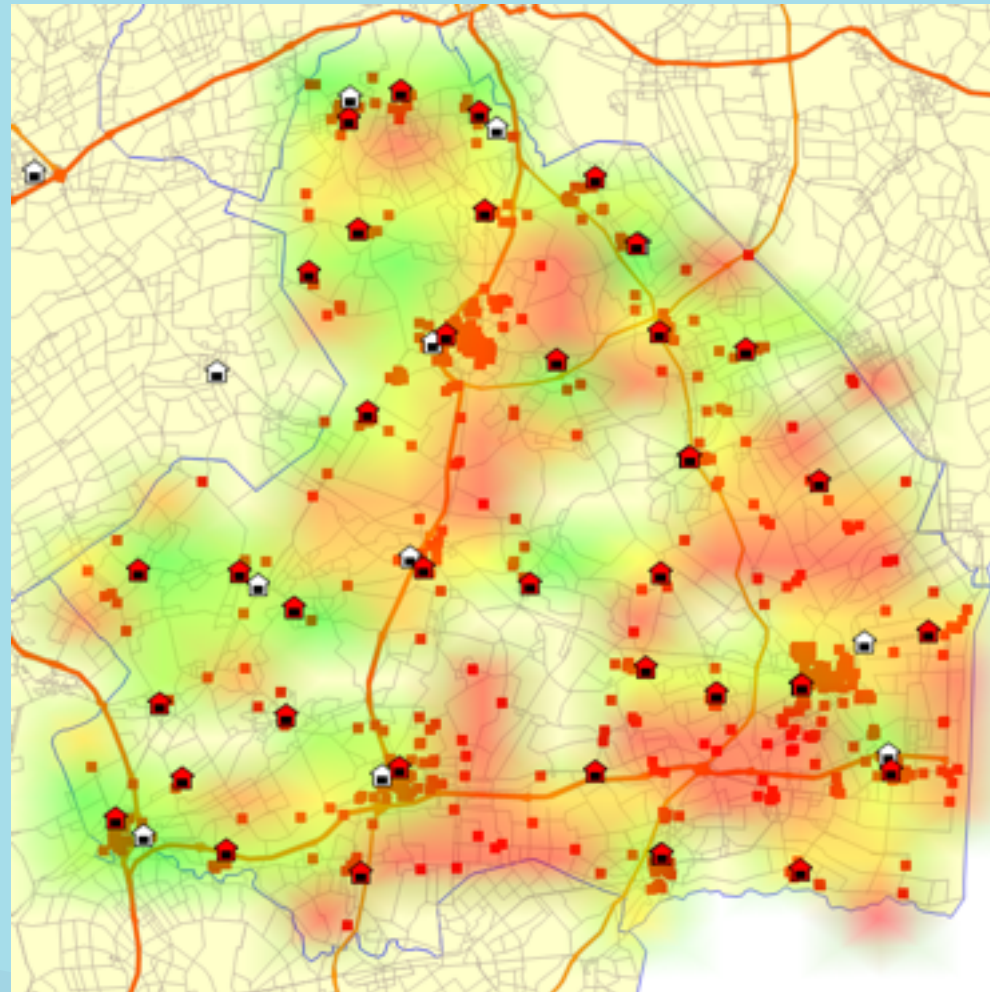
Redesign – region wide

- ▶ Three extra posts (maximizing coverage)
- ▶ Arrivals
 - 9% < 4 min
 - 55% < 8 min
 - 89% < 12 min
- ▶ Survival
 - 12.5% probability
 - (+1.0%, 2M €/year)



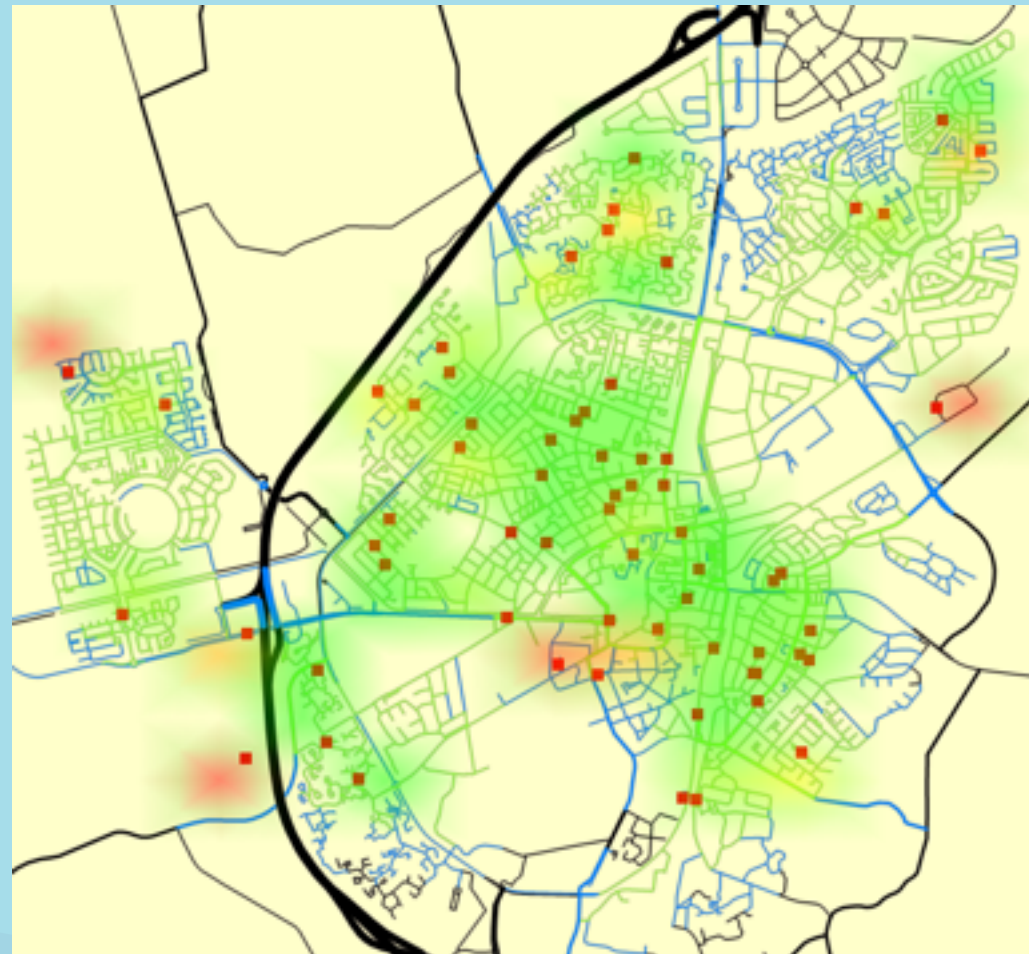
Redesign – region wide

- ▶ Current EMS system
 - 11.5% survival prob.
- ▶ EMS + 3 posts
 - 12.5% survival
 - (+1.0%, 2M €/year)
- ▶ EMS + firefighters
 - 17.6% survival
 - (+6.1%, 50k €/year)



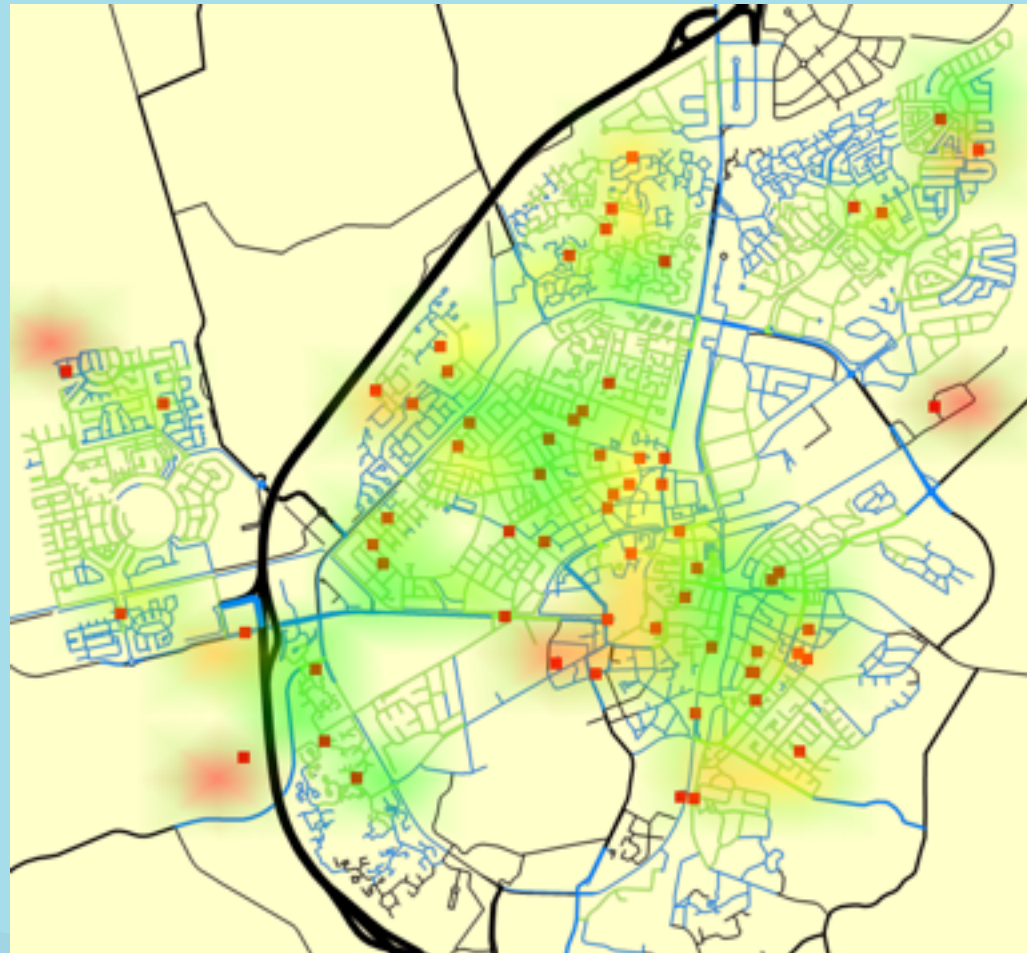
Redesign – local, volunteers

- ▶ Current volunteer network (100% responding)
- ▶ Arrivals
 - 36% < 4 min
 - 93% < 8 min
 - 100% < 12 min
- ▶ Assen
 - Call hotspot
 - 70.000 inhabitants



Redesign – local, volunteers

- ▶ 50% volunteer density / responding
- ▶ Arrivals
 - 21% < 4 min
 - 86% < 8 min
 - 99% < 12 min

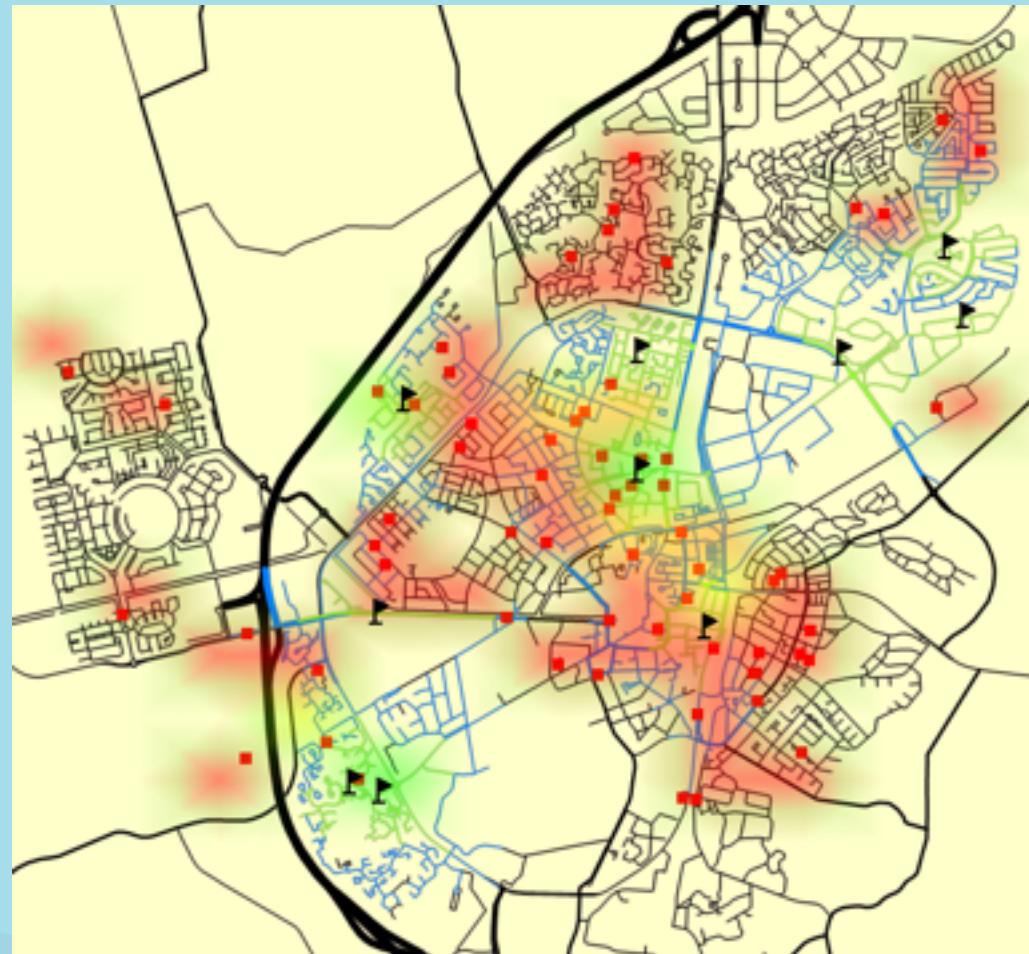


Redesign – local, AEDs

- ▶ Current AED network

- ▶ Arrivals

- 6% < 4 min
- 28% < 8 min
- 68% < 12 min

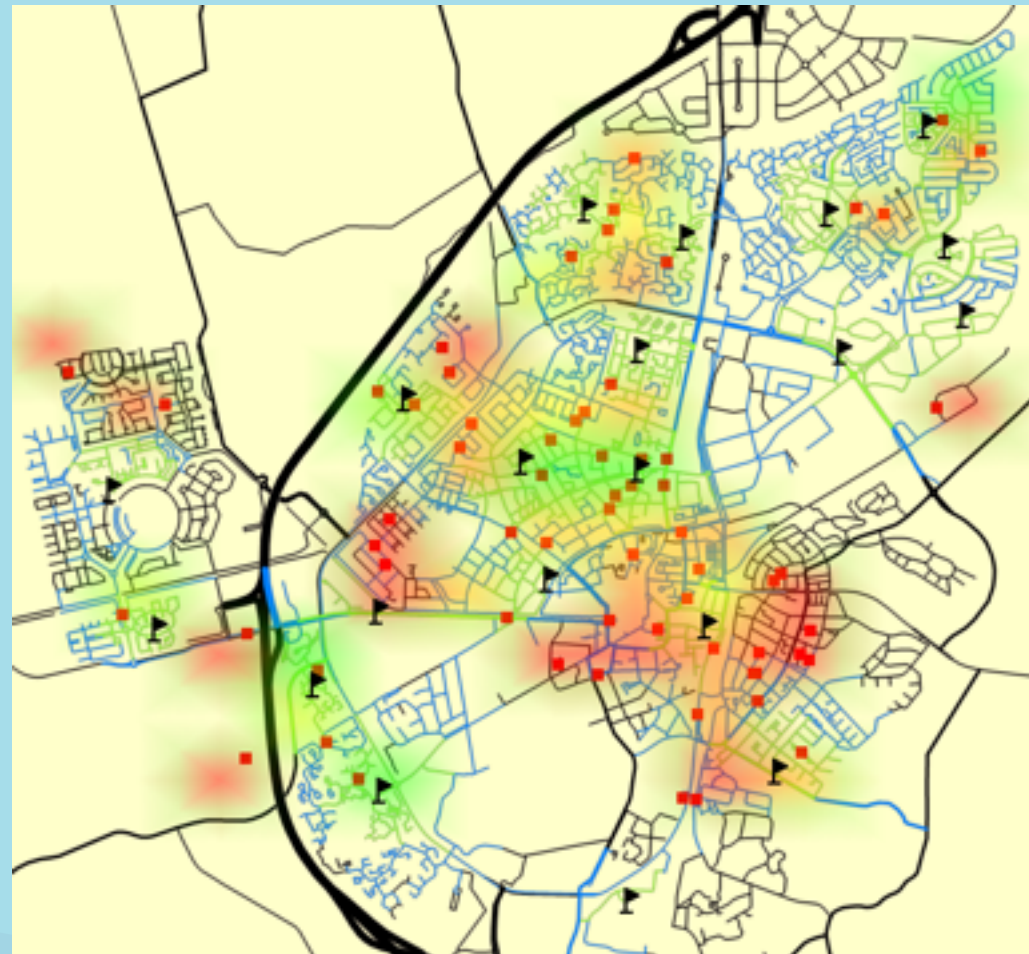


Redesign – local, AEDs

- ▶ Double AED density:

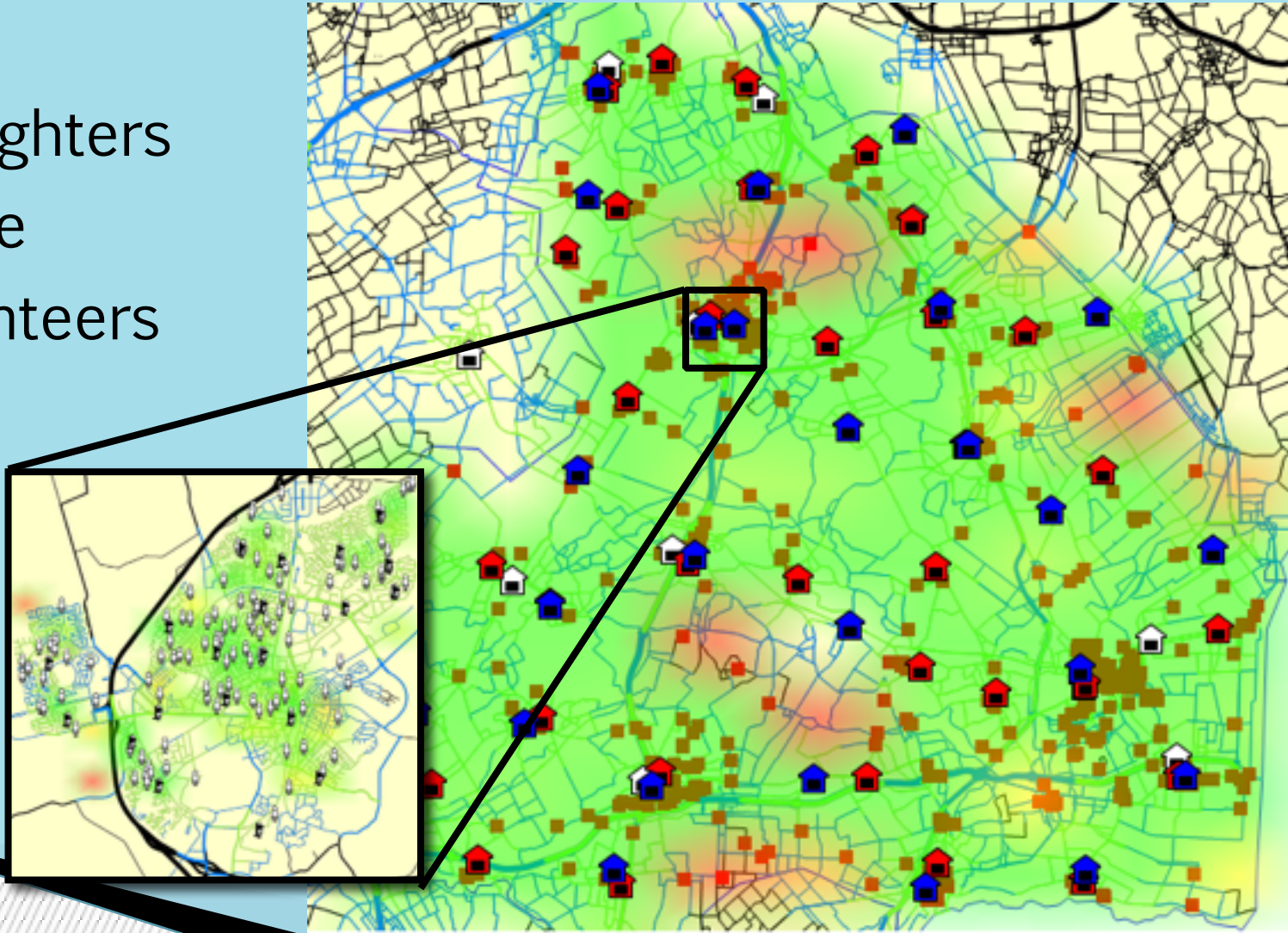
- ▶ Arrivals

- 10% < 4 min
- 54% < 8 min
- 96% < 12 min



Redesign – combining networks

- ▶ EMS
- ▶ Firefighters
- ▶ Police
- ▶ Volunteers
- ▶ AEDs



Conclusions & Further research

- ▶ Conclusion: 25% survival rate is attainable
 - Call center needs to alert all networks
 - Other networks must actively cooperate
 - Systematically collect (performance) data
 - At least double public AEDs (230 pcs, 345.000 €)
 - AEDs in rescue services cars (150 pcs, 225.000 €)
 - Increase public awareness and volunteer base
- ▶ Further research
 - Include general practitioner network
 - Effective volunteer dispatching strategies

Thank you for your attention!

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