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A Systems Engineering Approach to Improving Emergency Medical Services Provision

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Abstract: Many Emergency Medical Services (EMS) systems in the United States rely on a “two-tier” response network. The initial tier consists of fire department volunteer rescue squads who are responsible for primary first response during medical emergencies. The second tier includes ambulance companies and other advanced lifesaving resources. As the number of volunteers and their response capability decline, ambulance companies become increasingly stressed to meet first response demands. In rural regions without dedicated or proximate ambulance units, EMS service provision suffers, often resulting in unsatisfactory response times. This research analyzed the EMS system in Tompkins County, NY, and used an iterative systems engineering approach to make recommendations towards optimizing first response resource allocation and increasing long term volunteerism to decrease emergency response times across the county. The research began with a focus on system understanding and modeling including analysis of response times and response rates by location and call type. Using empirical parameters, deterministic models were developed to predict the required number of first response resources needed to achieve acceptable response times. The proposed solution outlined an incremental approach to achieving the appropriate number of paid first response providers. Starting with mild, less expensive solutions and ending with extreme, costly solutions, a simulation analysis of each alternative sought to predict response times across the county with the prescribed resource modifications. An additional output of the research was a Volunteer Social Factor model. This is a qualitative model derived from stakeholder engagement which enables volunteer agencies to increase long term volunteerism and reliability through an understanding of their external and organizational environments. An incremental approach to additional resources and the qualitative volunteer model ensured goals and requirements of all stakeholders were met in this complex and evolving system.

Keywords: Emergency Medical Services, simulation, qualitative models