Introduction

Cardiac arrest onset can occur suddenly and in every location imaginable. For cardiac arrests that occur outside of a medical setting, limitations on Emergency Medical Service (EMS) response time often delay such treatment and put the patient at greater risk for lasting injury or death. A patient’s chances of survival decrease 7–10% for every minute that passes without treatment and permanent brain damage begins to occur within 4–6 minutes of onset. To help bridge this gap in care, there has been increased investment in Automated External Defibrillators (AEDs). These compact, easy-to-use defibrillators can automatically diagnose the patient’s heart rhythm and determine whether to administer an electric shock, thereby returning the patient’s heart to a normal rhythm. Many businesses and cities have adopted AED placement programs as a way to enable bystanders to rapidly administer defibrillation aid—without previous training—prior to EMS arrival. As AED programs continue to expand, it is important to direct such resources to areas that are most at risk for cardiac arrest, namely, areas with a high prevalence of cardiac arrest health risk factors. Spatially assessing the distribution of these health factors allows for the identification of potential gaps in emergency response within areas of high cardiac arrest vulnerability. Using this methodology, this study focused on the development of an optimization model for ideal AED placement within the city of Philadelphia, PA.

Methodology

An optimization model for ideal AED placement was created using datasets related to population and health demographics, EMS response capabilities, and health outcome statistics of cardiac arrest victims. First, the distribution of cardiac arrest risk factors was assessed for areas throughout the city. Previous studies have shown that individuals aged 45 years or older are most likely to experience a cardiac arrest due to prolonged cardiac arrest without treatment, patients that are at an elevated risk for cardiac arrest and cardiac arrest-related injury, and would thus be in great need of future AED placement. The overlay of the non-residential zoning areas allowed for the specific identification of placement sites within these highlighted areas. In these areas, AEDs could potentially be placed in easily accessible locations, such as convenience stores, information booths, etc. However, some areas that display high need, such as the northeast region of Philadelphia, have very few non-residential areas to place an AED. Such areas might consider implementing public, outdoor AED stations that can be readily accessible to the surrounding residential population. For high risk areas that have not already begun their own AED programs, this analysis provides a target for future cardiac arrest risk awareness and effective AED placement.

Results

The analysis revealed several areas throughout Philadelphia that are at an elevated risk for cardiac arrest and cardiac arrest-related injury, and would thus be in great need of future AED placement. The overlay of the non-residential zoning areas allowed for the specific identification of placement sites within these highlighted areas. In these areas, AEDs could potentially be placed in easily accessible locations, such as convenience stores, information booths, etc. However, some areas that display high need, such as the northeast region of Philadelphia, have very few non-residential areas to place an AED. Such areas might consider implementing public, outdoor AED stations that can be readily accessible to the surrounding residential population. For high risk areas that have not already begun their own AED programs, this analysis provides a target for future cardiac arrest risk awareness and effective AED placement.