The Research Bureau

Dial 911:
Whose Call Is It, Anyway?

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EXECUTIVE SUMMARY

Citizens nationwide expect their local governments to respond to medical emergencies. The protocols for doing so vary among communities and the expense involved can be considerable. The increased demands on public safety officers in part as a result of terrorist threats require every community to think about providing emergency medical response effectively and efficiently. At the request of Worcester's City Manager, The Research Bureau evaluated the City's response to 911-medical emergencies and analyzed the first-response systems of 35 cities nationwide. Based on an analysis of Worcester's first-responder agencies and the protocols they follow, The Research Bureau believes that Worcester's first-response system to medical emergencies should be restructured and that clear standards and protocols should be established. Over-response to medical emergencies—in the form of a fire vehicle, one or sometimes two police cars, and an ambulance, all responding to a non-life-threatening emergency—is both costly and inefficient for the City. The Research Bureau suggests that the City Manager and his administration consider the following changes:

- As the chief public safety officer of the City, the City Manager should chair the City's Emergency Medical Services (EMS) Committee, which oversees first responder and EMS operations. Committee members include the Communications Director, a Worcester Fire Department (WFD) representative, and an UMass Memorial EMS representative.

- The City Manager should work with the Worcester EMS Committee to develop specific criteria and protocols for dispatching first responders that would prevent unnecessary over-response to medical emergencies.

- Emergency medical calls constituted two-thirds of all WFD responses in 2005. If the changes in dispatch criteria reduce the number of the Department's responses to medical emergency calls, the City Manager should consider reducing the size of the WFD staff.

- The City Manager should require a more detailed cost analysis of first-responder services from the WFD and Worcester Police Department (WPD).

- The City Manager should request that all call takers at the UMass Call Center be Emergency Medical Dispatch (EMD)-certified as part of UMass Medical Center's contract renewal with the City, or consider having Worcester's Communications Center provide EMD.

- The City Manager should consider equipping all police vehicles with automatic external defibrillators (AEDs) and request that the UMass Call Center be notified of the location of all AEDs in the community.

- In order to improve performance measurement and record-keeping in the City's 911 Communications Call Center, the City Manager and the City Council should consider funding improvements to its computer-aided dispatch (CAD) system.

- The City Manager should consider contracting with a local hospital to provide one medical director who supervises both fire and police first-responder medical operations, rather than having two, one for each department, which is currently the case.

- The City Manager should consider implementing response-time performance standards for Worcester's first responders.

- The City Manager should propose the purchase of automatic vehicle locators (AVLs) for all first responder vehicles, and consider installing additional emergency vehicle pre-emption equipment on traffic signals.

Introduction

Responding to medical emergencies of citizens has become an important public safety function of local government. Across the nation, citizens are told that in case of an emergency, call 911 and someone, commonly police officers or firefighters, will respond with assistance. In Worcester, both the police and the fire departments share responsibility for being first responders to 911 calls. [1] Police and fire are supposed to be dispatched according to the type of medical emergency that has been reported to the 911 Communications Center operated by the City. While police and fire serve as first responders, UMass Memorial Medical Center provides transport, pre-hospital care, and medical dispatching. Because the Police Department, the Fire Department, the 911 Communications Center, and one private agency are all involved in the medical emergency first response system, the protocols and the procedures regarding which agency responds to what kind of emergency and which agency has authority at the scene of the emergency need to be clear. In fact, there are on-going meetings among the agencies to redefine the protocols and make them more clear. The City Manager supports this effort. He wants to ensure the operation of a safe, successful, and cost-effective first-response system. At his request, The Research Bureau examined the first-response system in Worcester and compared it to systems in other cities. This report explains Worcester's first-response system, identifies first-responder best practices in other cities, and offers suggestions for increasing the effectiveness and reducing the cost of first-responder service to the City.

The need to develop more specific 911 protocols is not unique to Worcester. In its recent study of emergency medical systems nationwide, the *Institute of Medicine of the National Academies* found that "accountability has failed to take hold in emergency care to date because responsibility is dispersed across many different components of the system, so it is difficult even for policymakers to determine where system breakdowns occur and how they can subsequently be addressed."[2]

[1] There has been anecdotal evidence of disagreements between the two departments regarding who should respond to what calls. For example, see Chris Kanaracus, "Backfire," *Worcester Magazine*, Sept. 9-15, 2004, Vol. 29, No. 51, http://www.worcestermag.com/archives/2004/09-09-04/current/cover.shtml.

[2] "Emergency Medical Services: At the Crossroads," *Institute of Medicine of the National Academies,* http://darwin.nap.edu/books/0309101743/html (2006), p. 8.

PART I: EMERGENCY MEDICAL SERVICES (EMS) AND FIRST RESPONDER: How it works in Worcester

In the case of a medical emergency, citizens call 911 for medical assistance. A call taker asks their address and the type of emergency. The call taker then dispatches medical assistance, in the form of an ambulance (EMS transport) and a first responder. First responders are expected to arrive at the scene of the emergency and stabilize the situation before the ambulance arrives. This includes the initial provision of CPR, early defibrillation, first aid, and/or epinephrine injections and administration of aspirin. When the ambulance arrives, EMS paramedics and emergency medical technicians (EMTs) transport the victim by ambulance to a hospital while providing pre-hospital care en route. First responder and EMS are thus two different components of the emergency medical system: the first responder provides care to the victim at the scene of the emergency before the EMS vehicle (ambulance) arrives, and EMS provides pre-hospital care at the scene and on the way to the hospital. EMS providers are the higher-ranking medical personnel at the scene of an emergency, and may relieve first responders from responsibility or request their assistance.

According to the 105 Code of Massachusetts Regulation 170.020, a first responder agency is a police department, fire department, state police participating in highway patrol, an emergency reserve unit of a volunteer fire department, or a group of appointed temporary lifeguards.[3] Under current law, municipalities are not required to designate first responder agencies to respond to medical emergencies. [4]

The organization of EMS and first response varies from city to city. In Worcester, the Fire Department and the Police Department have been designated as first responders for medical emergencies. In the early 1980s, the WPD was generally the first responder to medical emergencies, while WFD duties were limited to responding to fires, car accidents, and other life-threatening incidents. As the number of structure fires decreased, freeing up firefighters from their traditional duties, the WFD increasingly focused its efforts on responding to more 911 medical emergencies. In the mid-90s the Fire Department increased its training for first responders and acquired automatic external defibrillators (AEDs) for all of its engines.[5]

Table 1: 2005 Worcester Fire Department Responses

Incident Type	#	% of Total Incidents
Emergency Medical Rescue Responses	14,558	66.0%
False Alarms	3,102	14.1%
Good-Intent Incidents[1]	1,322	6.0%
Structure Fire Responses	749	3.4%
Hazardous Conditions	726	3.3%
Vehicle Fire Responses	184	0.8%
Arson Fire Responses	29	0.1%
Total Incidents	**22,070**	

[1]Includes seeing smoke coming from behind a hill, smelling smoke, WFD going to investigate.

Source: Worcester Fire Department

[3] 105 CMR 170.020: Definitions.

[4] New regulations governing first responder and EMS have been promulgated but not implemented. See Section: New Regulations, p. 8, for more information.

[5] Automatic external defibrillators (AEDs) are vital for reviving cardiac arrest patients. See Section: Defibrillators in Part II, p. 20, of this report for a more thorough description.

The increased role of the WFD as first responder is not unique to Worcester; as structure fires have declined nationwide, many fire departments increased their first response to medical emergencies; some have assumed responsibility for ambulance transport and EMS. Fire and police departments are generally first responders to medical emergencies nationwide because of their station locations and patrols throughout the community. As shown in Table 1, in 2005, WFD responded to 14,558 medical emergencies, which comprised 66% of Fire Department activity. This is similar to responses nationwide. As shown in Table 2, in 2004, the last year for which figures are available, 62.3% of fire department responses nationwide were to medically-related incidents, in contrast to 6.9% of responses to fire incidents.

Table 2: 2004 Fire Dept Responses Nationwide

Incident Type	#	% of Total Incidents
Medical Aid	14,100,000	62.3%
Hazardous	3,876,000	17.1%
False Alarms	2,106,000	9.3%
Fires[1]	1,550,500	6.9%
Mutual Aid/Assistance[2]	984,000	4.4%
TOTAL	**22,616,500**	**100.0%**

[1]Includes structure, vehicle, and arson fires.

[2]Providing assistance to neighboring communities in emergency situations.

Source: US Fire Administration, http://www.usfa.dhs.gov/statistics/national/

The WPD was dispatched to fewer medical emergencies than the WFD. As Table 3 indicates, the WPD response to medical emergencies was 20.5% of their total non-criminal responses, and only 5% of all responses numbering 97,645.

Massachusetts law requires first responders to complete training in first aid, including cardiopulmonary resuscitation (CPR).[6] CPR training includes training in automatic and semi-automatic defibrillator use. Refresher courses in first aid must be completed every three years after initial training, and refresher courses in CPR must be completed every year after initial training. Massachusetts law also allows first responders to be trained to inject epinephrine, which is used for victims suffering from severe allergic reactions. The WFD and the WPD are trained in first aid, CPR, and defibrillator use. The WFD and the WPD have different medical directors who oversee the training for each. WPD training is overseen by the UMass Memorial Medical Center's medical director, and the WFD's training is supervised by a St. Vincent Hospital doctor.[7]

Table 3: 2005 Worcester Police Dept Responses

Non-Criminal Incidents	#	% of Total Incidents
False Alarms	8,069	31.7%
911 Medical Emergencies	*5,224*	*20.5%*
General Assistance-Other	4,190	16.4%
General Assistance-Health	3,314	13.0%
Suspicious Person, Vehicle	3,039	11.9%
General Assistance-Property	1,304	5.1%
Persons Reported Missing	337	1.3%
Total Non-Criminal Incidents	**25,477**	
Total Non-Criminal Incidents & Criminal Incidents	**97,645**	

Source: Worcester Police Department

[6] 105 CMR 171.000: Massachusetts First Responder Training.

As first responders in Worcester, the WFD and the WPD are often both dispatched to the same medical emergency. At times the arrival of three different vehicles to the scene of a medical emergency—a fire vehicle, a police cruiser, and an ambulance—can result in confusion for the patient involved and in the minds of the general public. Who is in charge? This situation increases the risk of traffic accidents, adds to the use of fuel which is increasingly expensive, and diverts personnel who may be needed for more serious emergencies. Without clear protocols, there is often tension between police officers and firefighters over whose authority takes precedence. The current arrangement may result in an over-response at an emergency that needed only one first responder or none at all since an ambulance arrives either at the same time or within a few minutes.

UMass Memorial Medical Center has been providing ambulance transport free of charge to Worcester since 1991 following the closing of Worcester City Hospital which had provided ambulance transport until that time.[8] Under this arrangement, the City does not have to purchase or maintain ambulances, or provide advanced life support training to other City personnel. As EMS provider, UMass EMS transports patients to the hospital of their choice. In other instances, patients are transported to a specific hospital based on their emergency. If the patient is in sudden cardiac arrest, the patient is transported to the closest hospital. Major trauma cases go to UMass and pediatrics go to St. Vincent's Hospital or UMass.[9] Sometimes UMass EMS requests back-up assistance for medical emergencies from private EMS services (AMR and EasCare) or neighboring towns. In 2005, the private ambulance services responded to just under 900 calls, or 3% of total call volume, and neighboring towns were requested 14 times, or less than 1% of total call volume.

Among 200 cities surveyed by the *Journal of Emergency Medical Services*, approximately 7.4% of cities nationwide utilize hospital-based ambulance services like Worcester's.[10] As a hospital-based EMS service, UMass Memorial EMS benefits from the clinical oversight and training provided by UMass Medical Center. The current contract between the City and UMass Memorial Medical Center must be renewed on or before May 1, 2007.[11]

[7] The WFD's medical doctor was assigned by a previous state Office of Emergency Medical Services director to the WFD when the WFD acquired defibrillators.

[8] "Worcester City Hospital: Part I," *The Research Bureau*, No. 90-3. "Worcester City Hospital: Part II," *The Research Bureau*, No. 90-4.

[9] Interview with UMass Medical Center staff.

[10] David M. Williams, "2005 JEMS 200 City Survey," *Journal of Emergency Medical Services*, February 2006, p. 47.

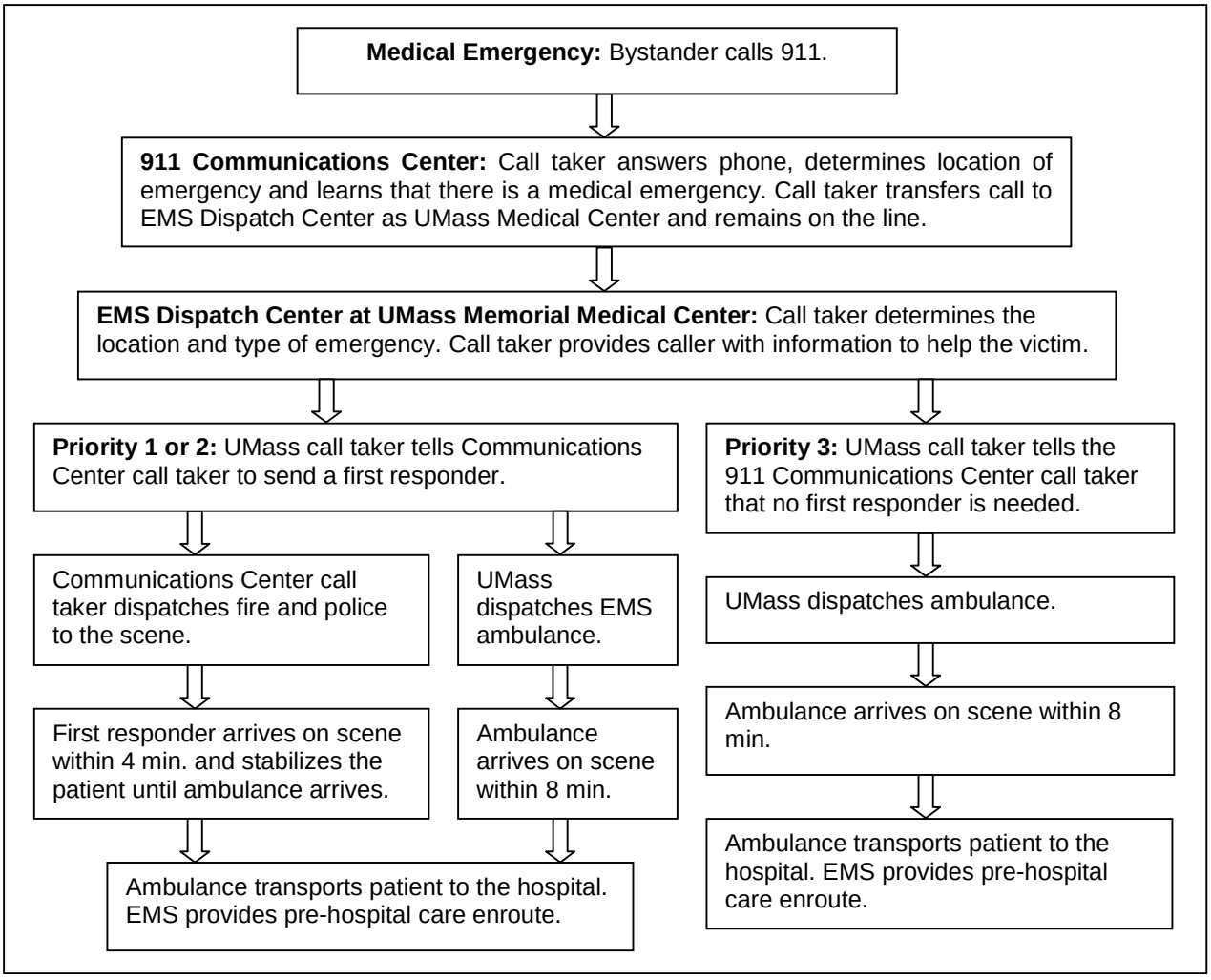
[11] Agreement between the City of Worcester and UMass Memorial Medical Center for Ambulance Service and Dispatch for the City of Worcester, Massachusetts, November 25, 2002.

911 Dispatch Center

The City of Worcester's 911 Communications Center is located in the Worcester Police Department. Total operations personnel include one director, one assistant director, six dispatch supervisors, 45 dispatchers, and a clerk. Call takers/dispatchers operate on four days-on, two days-off shifts. Current shifts run from 7am-3pm, 3pm-11pm, and 11pm-7am. The minimum number of call takers per shift is 7-8 people. All call takers in Massachusetts must attend 16-hour training on basic call taking and 911 equipment operations. In addition, Worcester call takers undergo three months of on-the-job training.

As the primary Public Safety Answering Point (PSAP), the Communications Center answers all 911 calls. First the call taker ascertains the location of the caller and the type of emergency. In the case of a fire, a fire truck or engine and a police unit are dispatched—the firemen put out the fire and the police direct traffic around the fire truck or engine. If it is a crime-related emergency, police are dispatched.

Graph 1: Medical Emergency Flow Chart

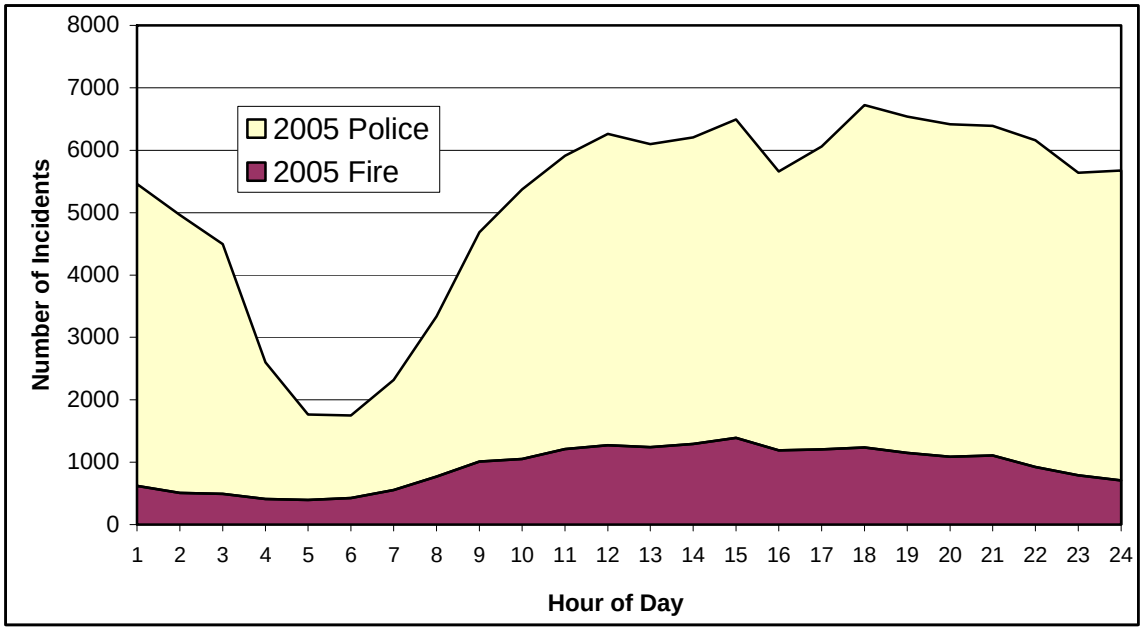


Prepared by: The Research Bureau

In the case of a medical emergency, the call is immediately forwarded from the 911 Communications Center to the EMS dispatch center at UMass Memorial Medical Center. (See Graph 1: Medical Emergency Flow Chart.) These call takers are trained EMTs who have been certified as Emergency Medical Dispatchers (EMDs). They use a Medical Priority Dispatch System originally developed by Dr. Jeff Clawson, co-founder of the National Academy of Emergency Dispatch and medical director of Salt Lake City's EMS system. (See Part II, Section: Emergency Medical Dispatch for further information on medical dispatch systems.) Dr. Clawson observed that medical dispatchers are the true first responders because they can provide assistance to the caller over the phone: the medical dispatcher "provides first responder care [to the victim] through the caller. Such skills have been shown to help preserve lives, prevent further injuries, and even assist with the delivery of babies."[12] There are 2-3 call takers on duty at UMass Memorial Medical Center at all times.

The Communications Center budget in FY06 was $2 million and is projected to be about $2.5 million, a 25% increase, in FY07. The increase results from hiring three new dispatchers to work the "impact shifts." These shifts overlap the already existing shifts and run from 11am-7pm and 7pm-3am, allowing for a smoother transition between call taker shifts. The Center's records show that incidents per hour in 2005 are basically steady between 11am in the morning and 2am the following day, with the Center experiencing a dip in calls from 4am to 7am. As shown in Graph 2, the police were dispatched to 100,910 incidents in 2005, while firefighters were dispatched to 22,053. (Graph 2 shows all incidents, not just medical emergencies.)

Graph 2: 2005 Fire & Police Incidents by Hour



Note: Because both police and fire may be dispatched for the same incident, some incidents may be counted twice.
Source: City of Worcester Communications Department

[12] Jeff J. Clawson, MD, "Emergency Medical Dispatching," *National Association of EMS Physicians*, http://www.naemsp.org/Position#20Papers/EmerMedDispatch.html (May 2006).

Currently the Communications Center must wait for UMass approval to dispatch police or fire for a medical emergency. However, the Communications Center, UMass, and the WFD and WPD are in the midst of changing this process. In the future, Communications Center personnel will be trained to dispatch police or fire immediately based on specific criteria, without waiting for UMass approval. (See Appendix C for a list of criteria used to determine to which medical emergencies the first responder should be sent.)

New Regulations

The new 105 Code of Massachusetts Regulations (CMR) 170.000 requires the City to designate its emergency medical service zone—the designated area of the city that is covered by EMS and first responder—and identify the entities that perform patient transport and first responder within that zone. This legislation does not require that municipalities designate a first responder agency; however, if a city has designated a first responder agency to respond to medical emergencies, it is required to identify this first responder agency in the service zone plan. Service Zone Applications must be completed, approved by the Regional EMS Council, and submitted to the Office of Emergency Medical Services by December 31, 2006.[13] Following the submission of the service zone plan, municipalities may change their EMS or first-response systems at any time, but must submit a new, updated service zone plan to the Regional EMS Council and state.

CMR 170.000 also authorizes a new voluntary category of medical emergency first responders. Cities can apply under their service zone plans to designate their first responder agencies as 'EMS First Responders' (EFRs). EFRs are subject to more extensive state regulation and are obliged to carry certain equipment according to their level of designation. The three EFR levels from lowest to highest are EMS first response, basic life support (BLS), and advanced life support (ALS).[14] The OEMS is responsible for inspecting EFR vehicles and checking the maintenance of equipment. Service licenses for EFRs at the EMS first response level cost $100 biennially.[15] The fee for inspection of EFR service vehicles at the BLS or ALS level is $200 per vehicle, per inspection. EFR designation enables first responders to provide greater medical assistance than currently. Worcester will have to weigh the costs and benefits of adopting one of these new designations. Designating the fire or police departments in Worcester as EFRs would subject them to higher levels of accountability to the City and state, such as inspections by the state of their first-responder vehicles and supplies.

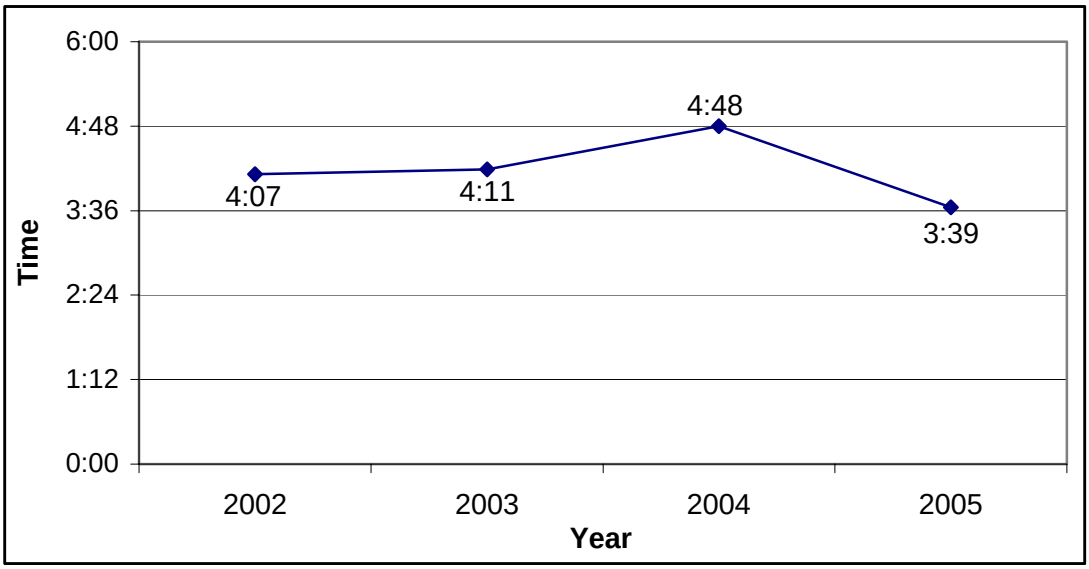
[13] "Memorandum: Service Zone Planning Template," *Massachusetts Department of Public Health*, www.mass.gov/dph/oems (August 17, 2004).
[14] BLS assistance includes establishing the airway, breathing support, and circulation support. ALS assistance includes diagnosing the victim's condition, administering drugs, electrocardiography, and defibrillation.
[15] 105 CMR 170.215: Service License and Vehicle Inspection Fee.

Response Time

First responders are expected to respond to emergencies more rapidly than ambulances. The National Fire Protection Agency (NFPA), which develops standards and codes for fire-safety matters, recommends that fire agency first response time be no more than 4 minutes to arrive at a medical emergency, from time of dispatch to arrival on scene.[16] The NFPA established this response-time standard based on the American Heart Association's (AHA) recommendations that a cardiac arrest victim be administered CPR or early defibrillation no more than 5 minutes after cardiac arrest begins.[17] Defibrillation consists of administering electrical shocks to the victim to restore the heart's normal rhythm. According to medical studies, every minute that elapses from the beginning of cardiac arrest decreases the victim's chance of survival by 10%.[18] While NFPA and AHA standards are not mandatory, they serve as useful guides and communities may adopt these standards for assessing first response systems.

As shown in Graph 3, the WFD average response time in 2005 was three minutes and 39 seconds. The WFD measures its response time from the time of dispatch to the arrival of the first unit on scene. The reduced response time in 2005 may be due to improvements in call processing and the closing of fewer fire companies compared to prior years.[19]

Graph 3: 2002-2005 Worcester Fire Department Average Response Times

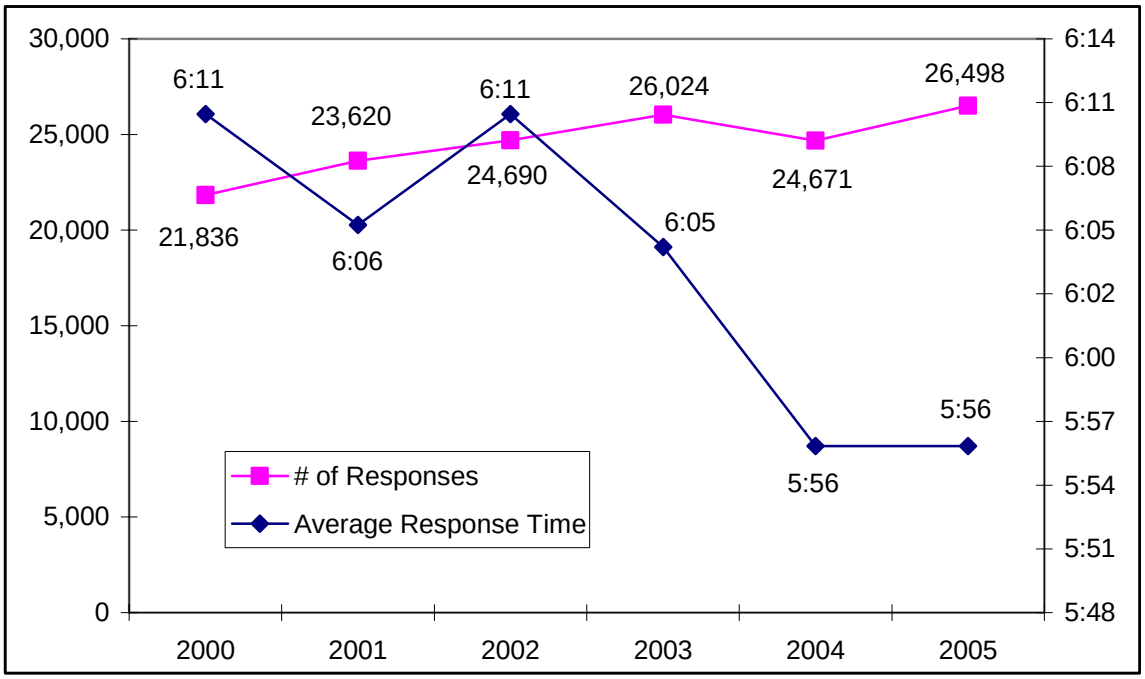


Note: This response time average includes both medical emergency and fire response time.
Source: Worcester Fire Department

[16] "Appeal of New Fire/EMS Deployment Standards Denied," *National Public Employer Labor Relations Association*, www.npelra.org (May 2006).
[17] Mary Hazinski, MSN, Vinay Nadkarni, MD, Robert Hickey, MD, Robert O'Connor, MD, Lance Becker, MD, Arno Zaritsky, MD, "Major Changes in the 2005 AHA Guidelines for CPR and ECC," *Circulation*, http://circ.ahajournals.org/content/vol112/24_suppl/ (June 2006).
[18] "What is Early Defibrillation?" *Early Defibrillation Program*, www.ci.rochester.mn.us/departments/police/defibrillation/index.asp (July 2006).
[19] "Benchmarking Public Safety in Worcester: 2006," *The Research Bureau*, No. 06-03.

The Commission on Accreditation of Ambulance Standards (CAAS), which sets standards for the medical transportation industry, prescribes that for "life-threatening requests, the total response-time standard will be eight minutes and fifty-nine seconds, or less, 90% of the time."[20] In 2005 Worcester's average EMS response-time for Priority 1 calls was 5:51, as noted in Graph 4. Like the WFD, UMass Memorial EMS measures its response time from the time of dispatch to the arrival on scene.

Graph 4: EMS Calls and Average Response Times, 2000-2005



Source: UMass Memorial EMS

Emergency response times are measured differently nationwide. For some systems, response time measurements begin the moment the call is received by the communications center, while others begin when the responder is dispatched. Assessments of arrival times also vary—some record the time the responder arrives on the scene, while others count to the moment when the responder actually locates the victim or emergency. UMass Memorial EMS and the WFD measure response time from the time of dispatch until arrival on scene. The National Association of EMS Physicians (NAEMSP) suggests that response time intervals be defined, and response times be calculated according to fractile measurements instead of averages. Fractile time "indicates that a predetermined response interval is being met for a defined percentage of events," most commonly in the 90th percentile.[21] This measure, unlike averages, would provide the percentage of cases where the community had failed to meet the recommended response time.

[20] "Accreditation," *Commission on Accreditation of Ambulance Services*, 2000, 201.05.02: Response Time Standards, p. 9.

[21] David Bailey, MD, Thomas Sweeney, MD, "Considerations in Establishing Emergency Medical Services Response Time Goals," *National Association of EMS Physicians*, July/September 2003, Vol. 7, No. 3, p. 398.

Cost Analysis

What is the cost of the first responder system to the City? According to the president of Worcester Fire Fighters Local 1009, the Worcester Fire Department's duty as first responder "costs the city no money" because the firefighters and trucks are "already there."[22] This statement, however, ignores the cost of first responder time, vehicle and fuel use, vehicle replacement, first-responder training, supplies, and personnel costs including an annual $250 stipend for firefighters for carrying defibrillators. These costs may result in a greater number of firefighters than the City might need if the firefighters did not have first-responder duties. Additionally, it disregards potential liabilities to the City from having large fire trucks racing through streets to address medical problems that could more efficiently be handled by ambulances. Analyzing the cost of first-responder service to the City is difficult because of the number of agencies involved and the WPD and WFD's use of existing resources for this purpose.

Worcester Fire Department

The information in Table 4 shows that the cost of first responder as estimated by the WFD is $17,400 annually. The WFD does not report any costs relating to vehicle use, maintenance, repairs, or depreciation, because they contend that all apparatus purchased and maintained by the WFD would be necessary regardless of any first responder responsibilities. The WFD spends $76,000 per year on vehicle fuel, approximately $3,800 of which the WFD states is fuel for first responder calls. The cost of supplies annually is $13,600, which includes $3,600 for oxygen tanks and $10,000 for medical gloves. All automated external defibrillators on WFD vehicles were donated, and UMass Memorial covers any costs associated with maintenance of the AEDs. The WFD does not report any costs associated with training, time spent on first responder calls, or any salary expenditures for performing first responder duties. To offset first responder costs, the WFD also receives $6,000 a year in revenue from UMass EMS for driving ambulances; the City is reimbursed $20.00 for every instance in which a police or fire officer drives an ambulance to the hospital.[23]

Table 4: Annual WFD First Responder Cost Analysis

Resources Used	Cost
Vehicle cost, insurance	-
Maintenance, depreciation, repairs	-
Fuel use for first responder calls	$3,800
Supplies	
AEDs	-
Oxygen tanks	$3,600
Gloves	$10,000
First responder training	-
Salary and benefits	-
TOTAL	**$17,400**

Source: Worcester Fire Department

In addition to these costs mentioned, the City pays each firefighter a $250 stipend annually for defibrillator use (a total of $102,500 for FY07).[24] It is difficult to quantify the amount of salary or benefits police or fire officers receive for first responder because of their multiple

[22] Shaun Sutner, "Report Outlines Money Savers," *Worcester Telegram & Gazette,* May 16, 2006, p. B1.
[23] Agreement between the City of Worcester and UMass Memorial Medical Center for Ambulance Service and Dispatch for the City of Worcester, Massachusetts, November 25, 2002, p. 12.
[24] City of Worcester FY07 Budget.

responsibilities. In addition, to calculate salary costs, information concerning the daily activities, such as inspections and fire and crime prevention, of the WFD and WPD would be needed.[25]

Table 5, provided by the City of Worcester's Budget Office, shows WFD vehicle cost per mile covered, estimated by dividing the total cost of vehicle depreciation and maintenance per year by the average annual mileage. The costs of an engine and a ladder are approximately $600,000 and $300,000, respectively. Engines and ladders have a lifespan of approximately 15 years. Currently 8 out of 15 of the WFD's engines and 3 out of 6 of the WFD's ladders have been utilized for more than 15 years. Depreciation, which is calculated only on vehicles under 15 years old, is approximately $448,315.[26] Combined with $527,198 for maintenance costs, the total annual vehicle cost is approximately $945,625. As shown in Table 5, approximate cost per mile to operate WFD vehicles is $9.02.

Table 5: WFD Total Vehicle Cost Per Mile

Apparatus (Ladders & Engines)	Cost
Replacement cost ladder (estimate)	$600,000.00
Lifespan of vehicle	15
Annual depreciation of replacement cost	$59,775.36
Vehicles under 15 Years Old	4
Annual Depreciation of Ladders (59,775.36 X 4 Vehicles)	*$239,101.43*
Replacement cost engine (estimate)	$300,000.00
Lifespan of vehicle	15
Annual depreciation of replacement cost	$29,887.68
Vehicles under 15 Years Old	7
Annual Depreciation of Engines ($29,887.68 X 6 Vehicles)	*$209,213.75*
Total Annual Depreciation Costs	**$448,315.19**
Maintenance Costs[1]	
Diesel fuel costs	$108,534.00
Salary cost for maintenance division	$185,914.26
Health insurance for maintenance division	$49,440.00
Other Costs (supplies and purchase of services)	$183,309.36
Total Maintenance Costs	**$527,197.62**
Total Annual Cost Estimate	**$975,512.81**
Total Annual Mileage Estimate	108,152
Cost Per Mile[2]	**$9.02**

[1]Maintenance costs are not currently tracked by vehicle (being implemented in FY07).

[2]Cost Per Mile for all WFD vehicles and mileage.

Source: City of Worcester Budget Office

[25] Without sufficient information to calculate salary costs, this box is left blank in Table 4.

[26] The City of Worcester buys WFD vehicles with a multi-year payback schedule; this annual payment is the Annual Depreciation of Replacement Cost, as shown in Table 5. Payback schedules may be for 5, 10, or 15 years; after that, the City no longer pays depreciation costs.

Because the WFD does not record how many miles per year are covered for first responder calls, first responder vehicle costs can only be estimated. Table 6: Estimated Annual WFD First Responder Vehicle Costs shows 5 different scenarios, based on the percentage of annual miles covered for first responder calls. If there were a direct correlation between the percentage of first responder calls (currently 66%) to miles covered, then two-thirds of all miles driven would be for first responder calls. Under that scenario, total WFD first responder vehicle costs would be more than $643,850 annually. If only 10% of the total miles covered were for first responder calls, then annual WFD vehicle costs would be more than $97,553.

Table 6: Estimated Annual WFD First Responder Vehicle Costs

Mileage	% First Responder	Cost Per Mile	Total Vehicle Cost
108,152	66%	$9.02	$643,850.49
108,152	50%	$9.02	$487,765.52
108,152	33%	$9.02	$321,925.24
108,152	25%	$9.02	$243,882.76
108,152	10%	$9.02	$97,553.10

Source: City of Worcester Budget Office
Prepared by: The Research Bureau

Worcester Police Department

Including fuel use and salary and benefit costs, the WPD estimates that the cost of first responder in 2005 was $176,186.[27] (See Table 7.) In addition, the WPD reports that first responder training costs $393 per officer, a total cost of $128,983 to train all 328 officers. However, because first responder training is a state requirement and is a one-time and non-recurring cost, it is not included in Table 7. Worcester police officers do not carry defibrillators and do not receive defibrillator stipends.

Table 7: 2005 WPD First Responder Cost Analysis

Resources Used	Cost
Vehicle cost, insurance	-
Maintenance, depreciation, repairs	-
Fuel use for first responder calls	$1,600
Supplies	-
AEDs	-
Oxygen tanks	-
Gloves	-
First responder training	-
Salary and benefits	$174,586.08
TOTAL	**$176,186.08**

Source: Worcester Police Department
Prepared by:The Research Bureau

[27] Salary and benefit costs for first responder in 2005 were estimated by multiplying the number of first responder calls in 2005 (5,224) by the average amount of time spent on a first responder call (.5 hours), by the number of officers sent to a call (2), by the average hourly rate including fringe benefits ($33.42).

Observations

While their medical emergency responsibilities are interrelated, the Communications Center, UMass Memorial EMS, the WFD, and the WPD operate relatively independently. This results in an absence of clearly defined protocols and performance measurement. A study of EMS systems nationwide by the *Institute of Medicine* found that many systems suffer from "severe fragmentation, an absence of systemwide coordination and planning, and a lack of accountability."[28] In addition, confusion between the WPD and the WFD regarding the appropriate level of response to medical incidents can create tension between two agencies that should be working together to provide the best emergency medical service possible to Worcester residents. The following sections of this report examine how medical emergency systems function in other cities.

[28] *Institute of Medicine of the National Academies,* p. 4.

PART II: FIRST RESPONDER OPERATIONS: A Comparison with Other Cities

To understand how Worcester might improve its medical emergency first response system, we examined first-response systems in 35 other cities. (See Appendix A.) Medical emergency systems nationwide differ in organization, response time, degree of training, medical oversight, and responsibility. The cities in this study were selected for a variety of reasons. Cities such as Rochester, MN, Kansas City, MO, and Seattle, WA, have high cardiac-arrest survival rates (43%, 33%, and 30%, respectively). Others have employed Global Positioning Systems (GPS) to identify the location of the first response vehicle closest to the scene of the emergency. These cities include Austin, TX, Des Moines, IA, Phoenix, AZ, and Rochester, MN. Other cities were contacted because their population is similar to Worcester's, so the nature of the problems they face may be similar as well. Others operate with a hospital-based EMS system like Worcester's. Massachusetts cities were contacted because they function under the same state requirements as Worcester concerning first-responder training and service-zone plan implementation.

All departments and EMS administrators contacted were asked similar questions concerning their first-response system: response time and standard of measurement, cardiac arrest survival rate, first responder training, performance measures, costs, automatic external defibrillators (AEDs) in the community, medical director oversight, and use of GPS systems. (See Appendix B for a list of questions.) First responders were also asked whether they consider their emergency response system to be successful and how they would improve operations.

Performance Measurement

There are few performance measurements in place for first responders. Many cities measure response time without setting specific standards or expectations of what that response time should be. In fact, the *Journal of Emergency Medical Services* 2006 study found that almost three-quarters (73.1%) of the 200 most populous cities in the country have no external agency or outside organization objectively monitoring first responder response time.[29] A *USA Today* study found that some cities refuse to say how long their average response time for EMS or first response is.[30]

Two performance standards were assessed in this study—response time and cardiac arrest survival rates. A majority of the agencies contacted (20 out of 35) measure response time from the time of dispatch to the arrival of the first unit on scene. Typically, the first responders contacted arrive on scene on average between 3 and 5 minutes, while EMS response times varied from 4-10 minutes. (See Table 8.) The Police Department in Rochester, MN, was the only first responder to report measuring response time from the time of the call to the moment when the cardiac-arrest victim is shocked with a defibrillator.

[29] David M. Williams, "2005 JEMS 200 City Survey," *Journal of Emergency Medical Services*, February 2006, p. 58.
[30] Robert Davis, "The Price of Just a Few Seconds Lost: People Die," *USA Today*, www.usatoday.com (May 2006).

Table 8: Response Time Comparison

City	FR Response Time	EMS Response Time	FR Response Time Measure	EMS Response Time Measure
Austin, TX	4:38	7:59 min 87% of the time	First keystroke to arrival on scene	Same
Charlotte, NC	4:30	10:59 min 90% of the time	Dispatch to arrival on scene	Same
Chattanooga, TN	4:00	7:30 min	Dispatch to arrival on scene	Call received to arrival on scene
Dayton, OH	4:30	5:30	Wheels rolling to first unit on scene	Same
Des Moines, IA	N/A	N/A	N/A	N/A
Fort Collins, CO	4:18	7-9 min	Call received to arrival on scene	Same
Grand Rapids, MI	3:30	7:59 min 90% of the time	Dispatch to arrival on scene	Same
Hartford, CT	4:00	N/A	Call received to arrival on scene	Same
Jersey City, NJ	4:00	7:59 min 90% of the time	Call received to arrival on scene	Same
Kansas City, MO	N/A	8:59 min 90% of time	N/A	1st keystroke to arrival on scene
Lubbock County, TX	4:00	5:00	Dispatch to arrival at patient	Same
Phoenix, AZ	5:04	5:04	Dispatch to arrival on scene	Same
Pittsburgh, PA	3:18	7:55, 8:30	Dispatch to arrival on scene	Same
Rochester, NY	3-3:30 min	8:59 min 90% of the time	Dispatch to arrival on scene	Same
Rochester, MN	5:42 3 min	N/A	Call to shock Dispatch to arrival on scene	N/A
San Diego, CA	5:20	12:00 min 94% of the time	Dispatch to arrival on scene	Same
Seattle, WA	3:39[1]	3:43	Dispatch to arrival on scene	Same
Sunnyvale, CA	5:21 90% of the time	7:38 min 90% of the time	Dispatch to arrival on scene	Same
Syracuse, NY	3:00	N/A	Dispatch to arrival on scene	N/A
White Plains, NY	4:00	7 min or less	Dispatch to arrival on scene	Same
Massachusetts Cities				
Agawam, MA	4:20	4:20	Time of call to arrival on scene	Same
Attleboro, MA	N/A	N/A	N/A	N/A
Boston, MA	3:00	N/A	Dispatch to arrival on scene	Same
Brockton, MA	3:30	5:00	Wheels rolling to first unit on scene	Same
Cambridge, MA	4:00 90% of the time	4:00 90% of the time	Dispatch to arrival at patient	Same
Chicopee, MA	N/A	N/A	N/A	N/A
Fall River, MA	4:00	4-5 min	Dispatch to arrival on scene	Same
Lawrence, MA	3-5 min	6-8 min	Dispatch to arrival on scene	Same
Lowell, MA	3-5 min	5-7 min	Dispatch to arrival on scene	Same
Lynn, MA	3:00	ALS: 5 min, BLS: 3-4min	Dispatch to arrival on scene	Same
New Bedford, MA	5-6 min	6-8 min	Time of call to arrival on scene	Same
Newton, MA	5:00	6 min 85% of the time	Dispatch to arrival on scene	Same
Quincy, MA	3-4 min	3-6 min	Time of call to arrival on scene	Same
Springfield, MA	3:00	Under 10 min	Dispatch to arrival on scene	Same
Worcester, MA	3:39	5:56	Dispatch to arrival on scene	Same

[1]Seattle measures its first-responder response time separately from its response time for fire emergencies, whereas most other first responders average their fire and medical emergency response times together.

Source: Information collected from appropriate departments of each city listed above.

Rapid defibrillation is critical to the survival of cardiac arrest victims. According to a *USA Today* study, "the best test of an emergency medical system is how many "savable" victims of sudden cardiac arrest it actually saves. These patients must be reached and shocked with a defibrillator within six minutes, or they almost always die."[31] The national average for out-of-hospital cardiac arrest survival rate is 6% or less.[32] As with response time, cities measure their cardiac arrest survival rate differently. One method, the Utstein method, counts only those victims with a chance to be saved and counts only those survivors who subsequently leave the hospital without severe brain damage.[33] Victims who go into cardiac arrest in the presence of other people, or "witnessed," have a significantly greater chance of being saved than those who do not. Also, sudden cardiac arrest can cause different types of heart rhythm abnormalities. Ventricular fibrillation is the abnormal rhythm of the heart that can be reversed with the use of an AED; AEDs are not effective for other rhythm abnormalities.

As part of The Research Bureau study, all emergency response systems contacted were asked their cardiac arrest survival rate. Rochester, MN, reported the highest cardiac-arrest survival rate at 43%. Rochester measures its cardiac-survival arrest rate as the number of cardiac-arrest survivors who leave the hospital neurologically intact out of the total number of cardiac-arrest victims of "witnessed" ventricular fibrillation. Seattle and Kansas City come in second and third with 33% and 30%, respectively. Worcester has the fourth-best survival rate of all cities contacted, with a 16% survival rate. Worcester's rate is determined by the number of survivors out of all types of cardiac arrest, not just ventricular fibrillation. Other cities with rates higher than the national average include Austin (11%,) Pittsburgh (10%), and Lubbock (7-9%). Most of the other cities contacted do not record enough information to measure their cardiac arrest survival rate.[34]

Organization

Medical Director

Eighty percent of the 35 cities have a single medical director who oversees both first responder and EMS operations. According to the National Academy of Emergency Medical Services Physicians, a medical director "should be involved in establishing or modifying dispatch training and protocols…and criteria for dispatch of first responders."[35] In Austin County, Texas, one medical director supervises EMS, the fire department, and 30 first responders throughout the county. He establishes uniform protocols and dictates how the system will operate. All members of the emergency response system, including dispatchers and administrators, must pass a standardized test at a proficient level. After passing the test, they wear a badge that distinguishes them as first-responder trained.

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[31] Robert Davis, "Only Strong Leaders Can Overhaul EMS," *USA Today*, May 20, 2005.

[32] Mary Hazinski, MSN, Vinay Nadkarni, MD, Robert Hickey, MD, Robert O'Connor, MD, Lance Becker, MD, Arno Zaritsky, MD, "Major Changes in the 2005 AHA Guidelines for CPR and ECC," *Circulation*, http://circ.ahajournals.org/content/vol112/24_suppl/ (June 2006).

[33] Robert Davis, "The Method: Measure How Many Victims Leave the Hospital Alive," *USA Today*, www.usatoday.com (May 25, 2006).

[34] Survival rates may also be affected by the quality of hospital care in a given city.

[35] Hector Alonso-Serra, Donald Blanton, Robert E. O'Connor, "Physician Medical Direction in EMS," *National Association of EMS Physicians*, Prehospital Emergency Care, April/June 1998, Vol. 2, No. 2, p. 154.

Emergency Medical Dispatch

There are three major aspects of an Emergency Medical Dispatch (EMD) program: determining what kind of emergency response to send, providing the caller with instructions for helping the victim, and consistently measuring the quality of the information given by EMDs to the caller.[36] As noted earlier, the most widespread method used in communications to determine the type of emergency is the Medical Priority Dispatch System developed by Dr. Jeff Clawson, and now controlled by the National Academy EMD. Some call centers use cards issued by the Association of Public-Safety Communications Officials (APCO).

Dr. Clawson's dispatch protocols include key questions to the caller, instructions for the caller to assist the victim, and determination of the response necessary for the emergency.[37] The purpose of the protocols is to assist call centers in determining which medical calls need an ALS unit, a BLS unit, first responders, or a non-emergency response; some calls may not even require the use of vehicle warning lights or sirens. These clearly defined protocols help limit the number of vehicles responding to an emergency, and reduce the number of EMS or fire department vehicle accidents.[38]

Thirty-two out of thirty-five, or 91%, of the communications centers in the cities contacted use the Medical Priority Dispatch System. Three MA cities, Agawam, Chicopee, and Quincy do not have any formal dispatch system in place, leaving emergency response decisions to the call takers' discretion. The City of Newton recently implemented a Medical Priority Dispatch System and trained its call takers as EMDs. This new tiered approach will allow call takers in Newton to dispatch a variety of responses depending on the type of emergency. Implementation of the new communications guidelines and training in Newton cost the city $300 for the certification and $45 per call taker trained.

Of the cities contacted for this study, the method for dispatch varies. (See Table 9: EMD Protocol and Response Type.) Some cities send the first responder only to priority 1 calls/life-threatening calls; some send first responders to all medical emergencies; a majority send firefighters as first responders, while others send the police or both the fire and police. In a number of cities—Chattanooga, TN, Jersey City, NJ, Lubbock, TX, Rochester, NY, San Diego, CA, New Bedford, Newton, and Springfield, MA—first responders are dispatched only for life-threatening, priority 1 calls. In Boston, the Fire Department is dispatched as first responder only to medical emergencies involving cardiac arrest, respiratory problems, and unconsciousness; the police department is dispatched only for crime-related medical emergencies. In Boston, Dayton, and New Bedford, the medical director assists in selecting the medical response appropriate for the type of medical emergency.

[36] "EMD Resources," *Dispatch Monthly*, http://www.911dispatch.com/info/emd/index.html (June 2006).
[37] B.S. Zachariah and P.E. Pepe, "The Development of Emergency Medical Dispatching in the USA," *National Academy of Emergency Dispatching*, www.emergencydispatch.org (July 2006).
[38] *Ibid.*

Table 9: Emergency Medical Dispatch Protocol and Response Type

City	EMD Protocol	Fire: Incidents Dispatched	Police: Incidents Dispatched
Austin, TX	EMD: Clawson	Priority 1 & 2[1]	Some
Charlotte, NC	EMD: Clawson	All medical calls	None
Chattanooga, TN	EMD:APCO	Life-threatening, special request	Life-threatening, special request
Dayton, OH	EMD:Clawson & Medical Dir.	All medical calls	None
Des Moines, IA	EMD	All medical calls	Accident, crime-related[2], mental illness
Fort Collins, CO	EMD	All medical calls	N/A
Grand Rapids, MI	EMD	Priority 1 & 2	None
Hartford, CT	EMD:Clawson	All medical calls	None
Jersey City, NJ	EMD	Life-threatening	Life-threatening
Kansas City, MO	EMD:Clawson	N/A	Safety concerns
Lubbock County, TX	EMD	Life-threatening	None
Phoenix, AZ	EMD	All medical calls	None
Pittsburgh, PA	EMD: Clawson	Cardiac arrest, choking, drowning	None
Rochester, NY	EMD	Life-threatening	Within vicinity
Rochester, MN	EMD	All medical calls	Life-threatening, crime-related
San Diego, CA	EMD	Life-threatening	None
Seattle, WA	EMD	All medical calls	None
Sunnyvale, CA	EMD:Clawson	All medical calls	Cardiac arrest, life-threatening
Syracuse, NY	EMD: APCO	All medical calls	None
White Plains, NY	Some EMD	Extrication, building collapse	All medical calls
Massachusetts Cities			
Agawam, MA	No formal	All medical calls	Most
Attleboro, MA	EMD	All medical calls	Life-threatening
Boston, MA	EMD & Medical Dir.	Cardiac arrest, respiratory, unconscious	Crime-related
Brockton, MA	EMD	All medical calls	Child, motor vehicles
Cambridge, MA	EMD: Clawson	All medical calls	Cardiac arrest, suicide
Chicopee, MA	No formal	All medical calls	Life-threatening, scene management
Fall River, MA	EMD: APCO	Cardiac arrest, respiratory, drowning, electrocution	All medical calls, 77% arrive
Lawrence, MA	EMD (in training)	ALS calls	Varies
Lowell, MA	EMD:Clawson	All medical calls	Cardiac arrest, crime-related, trauma, fall
Lynn, MA	EMD:Clawson	All medical calls	All medical calls
New Bedford, MA	EMD: APCO & Medical Dir.	Life-threatening	Life-threatening
Newton, MA	EMD: Clawson (in training)	Life-threatening	Life-threatening, trauma
Quincy, MA	No formal	Life-threatening	Life-threatening
Springfield, MA	EMD	Life-threatening	Life-threatening
Worcester, MA	EMD: Clawson (recertifcation)	Priority 1 & 2	Priority 1 & 2

[1]Priority 1: life-threatening, Priority 2: non life-threatening emergency, Priority 3: non emergency

[2]Examples of crime-related medical calls include calls related to mental illness, injuries to public property, and child abuse.

Source: Information collected from appropriate departments of each city listed above.

Training

Most cities in the survey require first-responder training, which includes first aid and CPR or EMT-Basic. EMT-Basic skills include CPR, first aid, airway management, oxygen administration, spinal immobilization, bleeding control, and splinting. The First-Responder National Standard Curriculum created by the US Department of Transportation, outlines the national standards for first responders. The first responder is expected to recognize the severity of a patient's condition and administer "appropriate emergency medical care for life threatening injuries relative to airway, breathing, and circulation."[39]

Some cities, such as San Diego, train a portion of their first responders as paramedics. However, there are no studies that show that a higher number of paramedic first responders improves performance. In fact, a recent study by *USA Today* of twelve of the nation's biggest cities found that "victims of cardiac arrest are more likely to be revived in cities that spend fewer taxpayer dollars on paramedics."[40] The cities with some of the lowest number of paramedics in their population, such as Boston with .86 paramedics per 10,000 residents and Seattle with 1.48 per 10,000 residents, have the highest cardiac arrest patient survival rates.[41] Rather than sending a paramedic first responder, the study indicated that it is more important to train first responders and citizens in defibrillator use and CPR because they can get to the patient more quickly than a paramedic, and speed in administering CPR is the most important factor in cardiac arrest survival. The *USA Today* study suggests that more research needs to be done on the effectiveness of training first responders as paramedics.

Defibrillators

As part of this study, cities were asked whether their first responder vehicles were equipped with defibrillators or if automatic external defibrillators (AEDs) were placed in publicly accessible community locations. All cities reported that their fire department first responders are equipped with defibrillators, while only a few cities have police vehicles equipped with defibrillators. The lack of defibrillators on police vehicles, however, adversely affects a city's ability to resuscitate cardiac arrest patients. When Rochester, MN, equipped its police with defibrillators, the city's survival rate increased.[42] Of the 200 largest cities studied by Fitch & Associates for a *Journal of Emergency Medical Services* article, "91.6% of first responder units are equipped with AEDs and are accompanied by personnel who are trained and authorized to use it."[43]

Community defibrillation programs have been implemented in Austin, TX, and Sunnyvale, CA. As part of these programs, AEDs are strategically placed in community locations such as government buildings, schools, and airports; private businesses are also encouraged to purchase AEDs. Members of the community attend free training sessions on defibrillator use. A supportive local government, leadership, and public support are all important

[39] "First Responder: National Standard Curriculum, Instructor's Course Guide," *United States Department of Transportation,* http://www.nhtsa.dot.gov/people/injury/ems/pub/frnsc.pdf (July 2006).
[40] Jack Gruber, "Paramedics Not Always the Saviors of Cardiac-arrest Patients," *USA Today*,
[41] *Ibid*.
[42] Jane Jerrard, "How to Launch a Community Early Defibrillation Program," *Journal of Emergency Services*, August 2001, p. 4.
[43] Williams, p. 58.

factors of a successful program. For a community defibrillation program to be maintained, AEDs in the community must be inspected regularly and members of the public must be willing to be educated in AED use. The benefits of a community-wide, early-defibrillation program are substantial: "the average survival rate of witnessed sudden cardiac arrest in the United States is 5%, but in areas that use early defibrillation programs the local survival rates jump as high as 20%."[44] The Police Department in Rochester, MN, has implemented an Early Defibrillation Program which focuses primarily on reducing response time. Through the use of automatic vehicle locators and the installation of emergency vehicle traffic signal pre-emption equipment, the Police Department now boasts an average response time of 3 minutes to any emergency and a call-to-shock response time of 5:42.[45] Traffic signal pre-emption equipment overrides normal traffic signal cycles to favor emergency vehicles.[46]

In order for AEDs to be utilized in emergency situations, 911 call takers need to know the location of all AEDs in the community and relay that information to 911 callers. All of the cities contacted have AEDs located somewhere in the community—either in schools, government buildings, airports or senior centers. However, out of all the cities contacted, only Austin keeps detailed information about the location of every AED, including those located in private businesses. The location details of every AED are electronically entered into the Communications Center's Computer Aided Dispatch (CAD) system. The moment a caller's address is entered into the CAD system, the computer identifies the closest AED to the caller and provides this information to the call taker. He can then aid the caller in locating the AED and assisting the victim as quickly as possible.

In Worcester, while both the WFD and the WPD are trained in defibrillator use, as noted above, only the WFD first responders are equipped with AEDs. Worcester firefighters receive a $250 a year stipend for defibrillator use. The City attempted to equip police vehicles with AEDs as well, but the Worcester Police Local 378 refused to have defibrillators in police vehicles without also receiving a stipend. It is common in Massachusetts for firefighters to receive a stipend for defibrillator use—firefighters in Attleboro, Brockton, Cambridge, Fall River, Lawrence, and Newton all receive defibrillator stipends. Cambridge firefighters, on top of the defibrillator stipend of $635 per year, also receive $800 annually for being first responders. Fall River police officers receive $425 per year for defibrillator use. Boston police officers also receive specialty pay for being first responders, which is .7% of their base salary. With the exception of firefighters in Jersey City, none of the first responders in the cities contacted outside of Massachusetts receive defibrillator stipends.[47] In these cities, defibrillator use is considered an integral part of being a first responder and part of a public safety official's responsibilities.

Cost Analysis

An overwhelming number of the first responders contacted for this study do not calculate their first-responder costs separately from other public safety departmental costs. Table 10 shows the first responder costs reported by the cities contacted; for those cities that do not calculate cost, that column is labeled as 'Unknown.' Sunnyvale's Public Safety Department estimates first

[44] Jerrard, p. 2.
[45] The Police Department's average response time is measured from time of dispatch to arrival on scene.
[46] "Early Defibrillation Program," *City of Rochester, Minnesota*, www.policedefib.com (July 2006).
[47] Jersey City awards its firefighters an extra day of pay for defibrillator use.

Table 10: First Responder Cost Comparison

City	Type of First Reponder	First Responder Cost
Austin, TX	Fire & Police Dept	Unknown
Charlotte, NC	Fire Dept	N/A
Chattanooga, TN	Fire & Police Dept	Reimbursed by EMS for supply cost
Dayton, OH	Fire Dept	Unknown
Des Moines, IA	Fire & Police Dept	Combined cost with EMS costs
Fort Collins, CO	Fire Dept	$400,000
Grand Rapids, MI	Fire Dept	Unknown
Hartford, CT	Fire Dept	Unknown
Jersey City, NJ	Fire & Police Dept	Unknown
Kansas City, MO	Fire Dept	N/A
Lubbock County, TX	Hospital & Fire Dept	$60,000 (FD)
Phoenix, AZ	Fire Dept	Combined cost with EMS costs
Pittsburgh, PA	Hospital & Fire Bureau	Unknown
Rochester, NY	Fire & Police Dept	Unknown
Rochester, MN	Fire & Police Dept	Unknown
San Diego, CA	Fire Dept	Unknown
Seattle, WA	Fire Dept	Combined cost with EMS costs
Sunnyvale, CA	PS Dept & AMR	$2,260,000
Syracuse, NY	Fire Dept	Training: $30,000, Operational: $45,000
White Plains, NY	PS Dept	Unknown
Massachusetts Cities		
Agawam, MA	Fire & Police Dept	Combined cost with EMS costs
Attleboro, MA	Fire & Police Dept	Unknown
Boston, MA	Fire & Police Dept	N/A
Brockton, MA	Fire & Police Dept	Unknown
Cambridge, MA	Fire & Police Dept	Combined cost with EMS costs
Chicopee, MA	Fire & Police Dept	Unknown
Fall River, MA	Fire & Police Dept	Unknown
Lawrence, MA	Fire & Police Dept	Unknown
Lowell, MA	Fire & Police Dept	Unknown
Lynn, MA	Fire & Police Dept	Unknown
New Bedford, MA	Fire & Police Dept	Unknown
Newton, MA	Fire & Police Dept	Unknown
Quincy, MA	Fire & Police Dept	Unknown
Springfield, MA	Fire & Police Dept	Unknown
Worcester, MA	Fire & Police Dept	$193,586

[1]Worcester's cost for first responder is calculated by adding costs reported by the WPD ($176,186) and the WFD ($17,400).

Source: Information collected from appropriate departments of each city listed above.

responder as costing $2,260,000. This estimate was calculated by adding personnel costs to the maintenance cost of the fire engine for a time period of one hour and multiplying both by EMS call volume. This calculation demonstrates that the Sunnyvale Public Safety Department recognizes a personnel cost and a maintenance cost to the city when fire engines and personnel are utilized for first responder calls.[48] The Lubbock, TX Fire Department reported that first-responder supplies cost $60,000 annually, which does not include costs associated with training, trucks, and fuel. Fort Collins, CO reported that supplies cost $400,000 annually, and Syracuse NY reported that supplies cost $45,000 annually and training costs $30,000. (These cities have populations similar to Worcester's.)

Nineteen of the cities contacted have city departments that provide EMS to their citizens through an EMS department or the fire department. (See Table 11: Department EMS Costs.) Of

Table 11: Department EMS Costs

City	EMS Agency	EMS Cost	Collection Rate
Austin, TX	Austin/Travis County EMS	N/A	N/A
Charlotte, NC	Mecklenburg EMS	N/A	N/A
Chattanooga, TN	Hamilton County EMS	$7.4 million ($360,000 profit)	48%
Dayton, OH	Fire Dept	No breakdown[1]	30-40%
Des Moines, IA*	Fire Dept	$18 million	75%
Kansas City, MO	Kansas City Metropolitan Ambulance Services Trust	$29 million	53%
Phoenix, AZ*	Fire Dept	No breakdown	N/A
Pittsburgh, PA	Pittsburgh EMS	$12 million	N/A
San Diego, CA	San Diego Medical Enterprise	No breakdown	N/A
Seattle, WA*	Fire Dept	$52 million	No cost[2]
Massachusetts Cities			
Agawam, MA*	Fire Dept	$1.1million ($200,000 profit)	75-80%
Attleboro, MA	Fire Dept	N/A	60-70%
Boston, MA	Boston EMS	$30 million (lose money)	N/A
Cambridge, MA*	Fire Dept & Professional Ambulance	$33 million (lose money)	Contract
Chicopee, MA	Fire Dept	N/A	60-70%
Fall River, MA	Fall River EMS (Within Fire Dept)	$1.8 million (profit)[3]	80%
Lowell, MA	Greater Lowell EMS, Trinity	N/A	N/A
Lynn, MA	Fire Dept & Action	$2.5-5 million (lose money)	45-48%
New Bedford, MA	New Bedford EMS	$2.1 million	72%

[1]Dayton, Phoenix, and San Diego fire departments combine EMS and fire-related costs; they do not breakdown the costs of providing the two services.

[2]Seattle finances its EMS through a citywide property tax of 23 cents per thousand dollars of assessed valuation.

[3]Fall River EMS would not disclose the amount of profit made.

*EMS costs for Agawam, Cambridge, Des Moines, Phoenix, and Seattle include first responder costs.

Source: Information collected from appropriate departments of each city listed above.

[48] Sunnyvale's calculation does not include the cost of supplies.

the cities contacted, 10 had fire departments that provided EMS. EMS budgets vary greatly by city. The collection rate for an EMS agency generally does not cover the cost of ambulance transport; this discrepancy occurs because insurance companies or Medicare may cover only a portion of the cost. UMass Memorial EMS currently collects 30-50% of transport costs. In Worcester's case, however, it is UMass Medical Center which bears the remaining cost, not the City of Worcester.

Safety

The speed with which EMS or first responders travel to emergencies can be dangerous to public safety.[49] Passengers of the EMS and first responder vehicles are also at risk: "Since 1984, 20 to 25 percent of firefighter fatalities [nationwide] have resulted from motor vehicle crashes."[50]

Depending on fire departments to provide first responder assistance to medical calls may pose a risk for some cities. In Washington, D.C., studies have shown that firefighters respond more rapidly to fires than to medical emergencies.[51] If firefighters and police officers have to choose between their responsibilities to fight fires and criminal activities versus medical calls, they may choose the former when the two are occurring simultaneously. Since ambulances in Worcester generally arrive within a few minutes of the first responder, lack of response from the WFD or WPD does not necessarily harm public safety.

Automatic Vehicle Locators (AVLs)

An automatic vehicle locator (AVL) is "a device that makes use of GPS to enable a business or agency to remotely track the location of its vehicle fleet by using the Internet."[52] The purpose is to quickly locate the vehicle that is nearest to the emergency call to ensure the fastest response. The Phoenix Fire Department has AVL equipment installed on all of its vehicles at a cost of approximately $3,000 for installation and $390/yr for each unit. Thirty-seven percent, or 13 of 35 of the cities contacted have AVLs installed on either all their emergency response vehicles or just their ambulances.

[49] See "Tragedies" at www.drivetosurvive.org for newspaper articles describing recent fire truck and ambulance fatalities from driving accidents.
[50] Rick Daly, "Don't Become a Statistic," *Drive to Survive*, www.drivetosurvive.org (July 2006).
[51] Robert Davis, "Washington, D.C.: Slow Response, Lack of Cooperation Bring Deadly Delays," *USA Today*, www.usatoday.com (May 2005).
[52] "Automatic Vehicle Locator," *TechTarget Network*, http://whatis.techtarget.com/definition/0,,sid9_gci523967,00.html (May 2006).

PART III: OBSERVATIONS AND RECOMMENDATIONS

Based on the review of first responder operations in Worcester and 35 other cities, The Research Bureau makes the following suggestions:

- **The City Manager should chair the City's EMS Committee which oversees first responder and EMS operations.**

According to Worcester's charter, the City Manager is the chief public safety officer. In that capacity, he is responsible for the proper functioning of first responder and EMS. The current EMS Committee, which consists of the Communications Director who reports to the police chief, a WFD representative, and a UMass Memorial EMS representative, should be chaired by the City Manager. The leadership of the City Manager on the EMS Committee is important because of his unique authority over both public safety departments.

The Committee meets monthly to discuss EMS operations in the city. As chairman of the Committee, the City Manager bears responsibility for setting performance standards for the emergency response system, and ensuring that all aspects of Worcester's medical emergency response system satisfy federal and state requirements. The Committee should also coordinate space at fire stations or garages for ambulance parking in the City, since placing ambulances in multiple places in the City rather than just at UMass Memorial would decrease response time. Under the City Manager's direction, the EMS Committee should facilitate discussion and completion of the Service Zone Plan Application which is required by the Commonwealth.

- **The City Manager should work with the Worcester EMS Committee to develop specific criteria for dispatching first responders (based on national Emergency Medical Dispatch guidelines) that would prevent unnecessary over-response to medical emergencies.**

The first-responder dispatch criteria followed by Worcester's Communications Center requires that the police and fire departments respond to a variety of medical incidents (See Appendix C: Criteria for Dispatching First Responder). In addition, first responders are dispatched any time the UMass Memorial EMS Call Center requests a first responder. The WFD and the WPD are both trained in first response. Is it necessary for both the WFD and the WPD to respond to all of these calls? Experts in Emergency Medical Dispatching contend that "having large numbers of response vehicles arrive at single patient scenes may not be medically or fiscally sound. Medically-approved dispatch response prioritization puts accurate information into the hands of the responding EMTs and allows for planned responses, safer responses (fewer units responding in the 'red lights and sirens' mode), and fuel savings. It also saves paramedic teams for 'true' ALS emergencies."[53]

Based on the costs and danger to the public associated with sending large fire trucks to medical emergencies, the City Manager should consider sending the WFD only to life-threatening (Priority 1) emergencies, which require a quick response. The WPD should also be

[53] Jeff J. Clawson, MD, "Emergency Medical Dispatching," www.emergencydispatch.org (July 2006).

sent to life-threatening (Priority 1) calls and any calls that may be crime-related or require a police report. Because the WPD officers are patrolling the neighborhoods, there is a good chance they may arrive more quickly to the scene than the WFD. In addition, when police and fire arrive at the scene of an emergency, it is not normally necessary for both to remain. Each department should have the authority to ask the other to leave if a given emergency falls outside the other's area of specialization. For example, if there is no sign of a fire or hazardous material, the fire truck should depart.

- **If changes in emergency medical dispatch protocols lead to a decrease in WFD response to medical emergency calls, then the City Manager should consider reducing the size of the WFD staff.**

A reduction in 911 responses coupled with the historic decline in structure fires give the City Manager the opportunity to decrease fire department staffing levels. This should result in significant savings to the City.

- **The City Manager should require a more detailed cost analysis of first-responder services from the WFD and WPD.**

In order to calculate the cost of first responder, information concerning time spent on first responder calls, fuel costs for these runs, training costs, depreciation of trucks and other equipment, and salaries and benefits related to first responder should be included. However, these costs cannot be thoroughly calculated without detailed record-keeping of time spent and distance traveled for first responder and other activities. Currently the WFD and the WPD do not keep track of exact mileage or time spent on first responder, information which is vital for a thorough cost analysis.

- **The City Manager should request that all call takers at the UMass Call Center be EMD-certified as part of its contract renewal with the City, or consider having Worcester's Communications Center provide EMD.**

EMD cards guide call takers in determining the priority of medical emergencies and enable them to send the appropriate response to a medical emergency. While the UMass EMS call takers have been EMD-certified at one time or another, it is important for them to be regularly recertified and updated on changes in the Medical Priority Dispatch System.[54] Certifying Worcester's Communications Center may also be a worthy investment. If the 911 Center's call takers were EMD-certified, they could handle medical emergency calls instead of transferring them automatically to UMass, thereby eliminating the inherent 10 to 20 second delay present in the current system. Certification of the Communications Center, including initial training costs, would be approximately $25,000.[55] Total recertification costs would be $1,800 every two years. While UMass EMS currently provides this service at no cost to the City, certifying Worcester's Communication Center might decrease dispatch response time.

[54] According to *Dispatch Monthly*, "there must be an on-going review of the use of the EMD protocols by the dispatchers to ensure they are following them correctly, and that the protocols have a positive impact on the victims." *Ibid.*

[55] Cost quoted by the Association of Public-Safety Communications Officials (APCO).

- **The City Manager should consider equipping all police vehicles with AEDs.**

Because the police may be first to the scene, it is important that they are fully equipped to save a cardiac arrest victim. Currently WFD first responder vehicles are equipped with Medtronic LifePak 500 Defibrillators. The City can purchase Medtronic LifePak 500 Defibrillators for approximately $1,600-$1,700 per AED. However, because Medtronic recently introduced its new LifePak 1000 Defibrillator, Medtronic no longer makes LifePak 500s and soon they will no longer be in stock. The new LifePak 1000 Defibrillators cost $2,600-$2,800, depending on the amount purchased. The AEDs that the WFD currently uses were donated by members of the community; soliciting donations for more AEDs is an option to consider. Because police officers are already trained in defibrillator use, there will be no additional training required. Police officers and firefighters should not receive specialty pay for defibrillator use; the use of this equipment should be considered part of their duty as public safety officers as it is in other states.

- **The City Manager should request that the UMass Call Center be notified of the location of all AEDs in the community.**

AEDs are vital for saving the lives of sudden cardiac arrest victims. They are located in the community, in government buildings, schools, and private businesses. However, the UMass Call Center cannot direct bystanders or witnesses to the closest AED without knowledge of the location of these AEDs. Therefore, the Call Center should be notified of their location and use this information to help the caller identify the closest one. Eventually, this type of information can be used for communities to develop early defibrillation programs like those in Sunnyvale, CA, and Rochester, MN.

- **The City Manager should consider contracting with a local hospital to provide a medical director to supervise both fire and police first-responder medical operations, and to recommend protocols that are then approved by the City Manager.**

As noted earlier, the WFD and the WPD have different medical directors that oversee the training for each department. However, it would be beneficial for the WPD and the WFD to receive first responder training together, since it will sometimes be necessary for police officers and firefighters to work together at the scene of a medical emergency and it is important that they follow the same medical protocol and standards. As reported by most of the cities contacted for this study, the oversight of one medical director results in consistent training for first responders.

- **In order to improve performance measurement and record-keeping in the City's 911 Communications Call Center, the City Manager and the City Council should consider funding improvements to its computer-aided dispatch (CAD) system.**

Increasing the record-keeping capability of the City's Communications Center will aid the City in measuring the performance of the dispatch center and the first responders. For all 911

calls, the type of incident and the type of response unit sent should be recorded. Once the first responder arrives on scene, the Communications Center should be notified, response time recorded, and details concerning the type of incident confirmed. The dispatch center should also measure its own response time, from the time the phone rings until the time a response unit is dispatched, to determine how the Communications Center compares with the 80-second national average response time.

- **The City Manager should consider implementing response-time performance standards for Worcester's first responders.**

The WFD's average response time of 3:39 is below the four minutes that the National Fire Protection Agency recommends.[56] The UMass Memorial EMS average response time of 5:56 is also below the national 7:59 min standard. Response times for both the EMS and first responders should also be measured by the percentage that a certain response time is met.

The WPD does not keep any record of response time; this may be due to the fact that first responders are dispatched from various locations throughout the city. However, it would be possible to measure their performance from the Communications Center, particularly if the Communications Center were equipped with a GPS locating system. It could track how long it takes a police vehicle from the moment it is dispatched until it arrives at the scene. This would require that police officers check-in with the Communications Center once they arrive at the scene. In addition, clocks in the Communications Center and on all first responder vehicles should be synchronized.

- **The City Manager should propose the purchase of automatic vehicle locators (AVLs) for all first responder vehicles.**

As mentioned earlier, a number of cities have installed AVLs on first responders and ambulances to determine the closest vehicle to the location of a medical emergency. Costs for installing AVLs include the AVLs themselves, installation, maintenance, and updating the communications system that tracks all the vehicles. The cost also depends greatly on the type of AVLs used and software necessary for tracking. The WFD has 26 first-responder vehicles and the WPD has approximately 75, all of which should be equipped with AVLs.

- **The City Manager should continue increasing the number of emergency vehicle pre-emption equipment installed on traffic signals to decrease the response time of EMS and first responder vehicles, and reduce the potential risk of collisions with other vehicles.**

Through the use of wireless connections, emergency vehicles with pre-emption equipment can trigger traffic signals to favor their passage. In a study of emergency vehicle pre-emption in Houston, vehicle travel times decreased by 16% in one district and 23% in another.[57]

[56] The National Fire Protection Agency (NFPA) establishes codes and standards for fire departments nationwide. NFPA 1710 addresses response times and EMS specifically.

[57] Traffic Engineers, Inc., "Emergency Response Management System Study," *Department of Transportation*, www.itsbenefits.its.dot.gov/its/benecost.nsf (August 2006).

Because of reduced delays at intersections, Plano, Texas "can achieve the same response times with fewer fire-rescue and EMS stations than would normally be required, providing significant cost savings" to the City.[58] Pre-emption also decreases the chance of ambulance or first responder collisions with other vehicles. In Plano, Texas, emergency vehicle pre-emption reduced the number of emergency vehicle crashes from 2.3 per year to less than one crash every five years.[59] However, infrared sensors on ambulances or first responder vehicles used to trigger traffic signals can also be obtained by the general public, allowing for the potential abuse of traffic signal pre-emption.

Vehicle pre-emption equipment has already been installed on a number of traffic signals in Worcester. The Department of Public Works plans to continue installing pre-emption equipment during upgrades of traffic signals in the upcoming years. Sensors to trigger vehicle pre-emption are currently installed on ambulances and fire vehicles; the WPD is looking into acquiring sensors for its vehicles as well.

[58] "National Study Out on Traffic Signal Preemption," *Firehouse.Com News*, www.firehouse.com (August 2006).
[59] *Ibid.*

APPENDIX A: City First Responder & EMS Agencies

City	Population[1]	Type of First Reponder	Level[2]	EMS Agency	Level
Austin, TX	672,011	Fire & Police Dept	BLS	Austin/Travis County EMS	ALS
Charlotte, NC	771,617	Fire Dept	BLS	Mecklenburg EMS	ALS
Chattanooga, TN	154,887	Fire & Police Dept	BLS	Hamilton County EMS	ALS
Dayton, OH	161,696	Fire Dept	ALS	Fire Dept	ALS
Des Moines, IA	196,093	Fire & Police Dept	ALS	Fire Dept	ALS
Fort Collins, CO	125,740	Fire Dept	BLS	Hospital	ALS
Grand Rapids, MI	195,601	Fire Dept	ALS/BLS	Life EMS, American Medical Response	ALS
Hartford, CT	124,387	Fire Dept	BLS	American Medical Response	ALS
Jersey City, NJ	239,097	Fire & Police Dept	CFR	Hospital	ALS
Kansas City, MO	442,768	Fire Dept	BLS	Metropolitan Ambulance Services Trust	ALS
Lubbock County, TX	251,018	Hospital & Fire Dept	ALS	Hospital	ALS
Phoenix, AZ	1,388,416	Fire Dept	ALS	Fire Dept	ALS
Pittsburgh, PA	325,337	Hospital & Fire Bureau	ALS/BLS	Hospital & Pittsburgh EMS	ALS
Rochester, NY	215,093	Fire & Police Dept	BLS	Rural/Metro Medical Services	ALS
Rochester, MN	92,507	Fire & Police Dept	BLS	Gold Cross Ambulance	ALS
San Diego, CA	1,266,753	Fire Dept	ALS	San Diego Medical Enterprise & Fire Dept	ALS
Seattle, WA	569,101	Fire Dept	ALS	Seattle Fire Dept	ALS
Sunnyvale, CA	133,086	PS Dept & AMR	ALS/BLS	Santa Clara County	ALS
Syracuse, NY	144,001	Fire Dept	ALS	Rural/Metro Medical Services	ALS
White Plains, NY	55,900	PS Dept	BLS	Transcore	ALS/BLS
Massachusetts Cities					
Agawam, MA	28,528	Fire & Police Dept	BLS	Fire Dept	ALS
Attleboro, MA	43,502	Fire & Police Dept	ALS	Fire Dept	ALS
Boston, MA	581,616	Fire & Police Dept	BLS	Boston EMS	ALS
Brockton, MA	95,020	Fire & Police Dept	BLS	American Medical Response	ALS
Cambridge, MA	101,587	Fire & Police Dept	BLS	Fire Dept & Professional Ambulance	ALS
Chicopee, MA	54,992	Fire & Police Dept	BLS	Fire Dept	BLS
Fall River, MA	92,760	Fire & Police Dept	BLS	Fall River EMS (Within Fire Dept)	ALS
Lawrence, MA	72,492	Fire & Police Dept	BLS	Patriot Ambulance, LGH Paramedics	BLS/ALS
Lowell, MA	104,351	Fire & Police Dept	BLS	Greater Lowell EMS, Trinity	ALS
Lynn, MA	89,571	Fire & Police Dept	BLS	Fire Dept & Action	ALS/BLS
New Bedford, MA	94,112	Fire & Police Dept	BLS	New Bedford EMS	ALS
Newton, MA	84,323	Fire & Police Dept	BLS	American Medical Response	ALS
Quincy, MA	89,059	Fire & Police Dept	BLS	Fallon Ambulance	ALS
Springfield, MA	152,157	Fire & Police Dept	BLS	American Medical Response	ALS
Worcester, MA	175,706	Fire & Police Dept	BLS	Hospital	ALS

[1]Source: U.S. Census Bureau, 2004 Estimate

[2]BLS: Establish airway, breathing & circulation support; ALS: Diagnosis & drugs, electrocardiography, defibrillator use.

Source: Information collected from appropriate departments of each city listed above.

APPENDIX B: Questions for Cities Surveyed

1) Who performs First Responder? Do they provide ALS or BLS?
    a) Who performs EMS? Do they provide ALS or BLS?

2) Do you have a separate first responder and EMS dispatcher or one central communications center?

3) What is your protocol for sending out first responder?
    a) Do the first responders go to all medical emergencies? Which medical emergencies?
    b) Do you use EMD guidelines for dispatch (Clawson's or APCO)?
    c) Do you have AVLs?

4) How do you measure response time?
    a) Average response time for first responder:
    b) Average response time for EMS:

5) What is your cardiac arrest survival rate? How do you measure this?

6) What type of training do your first responders have?

7) Are there any performance measures/reporting in place for EMS, first responders, or dispatch operations? What are these performance measures?

8) Is there a medical director that oversees EMS or first responders?

9) How many of your first responders have defibrillators?
    a) Do you have AEDs placed in community areas?
    b) Do you keep track of where they are located?
    c) Do first responders receive extra pay for defibrillator use/training?
    d) Do first responders receive extra pay for being first responders?

10) What is the EMS budget, including dispatch, ambulances, and staff? What is your percent collection rate?
    a) Do you break even, lose money, or profit from performing EMS?

11) What is the cost of first responder operations, including dispatch, vehicle use, and staff?

12) Do you consider your emergency response system to be a success? Why?
    a) What obstacles do you face in achieving success?

13) Do you see any room for improvement in the emergency response system?
    a) What obstacles do you foresee in adopting any changes?

14) What is the current status of your Massachusetts service zone plan application?

APPENDIX C: City of Worcester Criteria for Dispatching First Responder

Chief Complaint	
Abdominal Pain	Not alert, males > 35 yrs, females > 45 yrs, pregnancy
Allergic Reactions	Not alert, difficulty breathing or swallowing
Altered Mental	All
Animal Bites	Multiple bites, severe trauma
Assault	Not alert, difficulty breathing
Back Pain	Not alert, difficulty breathing, fainting > 50 yrs, falls > 10ft
Bleeding	Not alert, difficulty breathing, severe trauma
Breathing problems	All
Carbon Monoxide	All
Cardiac Arrest	All
Chest Pain	Difficulty breathing, age > 35 yrs, palpitations, cardiac or unknown history
Choking	All
Diabetics	Not alert, difficulty/abnormal breathing
Drowning	All
Electrocution	All
Explosion	All
Falls	Not alert, difficulty breathing, height > 10ft, severe trauma
Headache	Not alert, difficulty breathing, numbness or paralysis, sudden onset of severe pain, speech or movement problems, recent head injury
Heart problem	See chest pain
Heat/Cold expsure	Not alert
Industrial accident	All
Overdose/Poisoning	Not alert, difficulty breathing, All involving child (<18 years)
Pregnancy/Childbirth	Imminent delivery, vaginal bleeding, seizure
Pschiatric/Suicidal	Not alert, difficulty breathing
Rape	Not alert
Seizure	Actively seizing, pregnant, diabetic, cardiac history, continuous seizures
Sick person	Not alert, difficulty breathing
Stabbing/Gunshot	All
Stroke/CVA	All
Traffic Accidents	All with injury
Trauma	All
Unconscious/Fainting	All

Source: City of Worcester Communications Center

Mission Statement:
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