

Vaccine Administration by Paramedics: A Model for Bioterrorism and Disaster Response Preparation

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Abbreviations:

CDC = Centers for Disease Control and Prevention
EMS = Emergency Medical Services
EMT = Emergency Medical Technician
MOU = Memorandum of Understanding
US = United States of America
WMD = weapon of mass destruction

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Abstract

The events of 11 September 2001 have had a profound effect on disaster planning efforts in the United States. This is true especially in the area of bioterrorism. One of the major tenets of bioterrorism response is the vaccination of at-risk populations. This paper investigates the efficacy of training emergency medical services paramedics to administer vaccines in public health settings as preparation for and response to bioterrorism events and other disaster events.

The concept of vaccination administration by specially trained paramedics is not new. Various programs to provide immunizations for emergency services personnel and at-risk civilian populations have been reported.

Vaccination programs by paramedics should follow the guidelines of the National Vaccine Advisory Committee of the Centers for Disease Control and Prevention (CDC). This paper compares the seven standards of the CDC guidelines to routine paramedic practice and education. It is concluded that paramedics are adequately trained to administer vaccines. However, specific training and protocols are needed in the areas of administrative paperwork and patient education. A proposed outline for a paramedic-training program is presented.

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Introduction

The events of 11 September 2001 have had a profound effect on disaster planning efforts in the United States (US). This is especially true in the area of bioterrorism. As an example, the Centers for Disease Control and Prevention's (CDC's) Advisory Committee on Immunization Practice and the CDC Strategic Planning Workgroup have issued recommendations and plans related to biological and chemical terrorism with the intention of encouraging states and other jurisdictions to include this material in their disaster plans.^{1,2}

One of the major tenets of bioterrorism response is the vaccination of at-risk populations, or in the case of anthrax, prophylactic antibiotic therapy. This

was seen with the mail-borne anthrax exposures during the fall of 2001. At-risk US Postal Service employees were administered antibiotics through a large-scale program involving federal and state health officials. To accomplish this, Disaster Medical Assistance Teams, part of the National Disaster Medical System, were utilized. Medical and allied health personnel, including paramedics, administered antibiotics. (Personal Communication, Levy M, November 2001). Because of the success of this approach, the value of training prehospital response paramedics to administer vaccines and prophylactic medications in a disaster situation warrants investigation.

Cognitive Objectives	
1-7.2	Differentiate among the chemical, generic (nonproprietary), and trade (proprietary) names of a drug
1-7.11	Discuss special considerations in drug treatment with regards to pregnant, pediatric, and geriatric patients
1-7.20	Describe the process called pharmacokinetics, pharmacodynamics, including theories of drug action, drug-response relationship, factors altering drug response, predictable drug responses, iatrogenic drug responses, and unpredictable adverse drug responses
1-7.22	Discuss considerations for storing and securing medications
Psychomotor Objectives	
1-8.12	Discuss medical asepsis and the differences between clean and sterile techniques
1-8.16	Describe the equipment needed and general principles of administering oral medications
1-8.21	Describe the equipment needed, techniques used, complications, and general principles for the preparation and administration of parenteral medications
Psychomotor Objectives	
1-8.33	Use universal precautions and body substance isolation (BSI) procedures during medication administration
1-8.36	Demonstrate clean technique during medication administration
1-8.37	Demonstrate administration of oral medications
1-8.41	Demonstrate preparation and administration of parenteral medications
1-8.43	Perfect disposal of contaminated items and sharps

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Table 1—Paramedic curriculum objectives supporting paramedic knowledge of drugs and drug administration

This paper investigates the efficacy of training emergency medical service paramedics to administer vaccines in public health settings in preparation for and in response to bioterrorism and other disaster events.

Educational Background of Paramedics

Paramedic education involves didactic, laboratory, clinical, and field instruction totaling approximately 1,200 hours beyond that required by entry-level emergency medical technician-basic instruction. In addition, paramedic candidates usually are required to complete a college-level anatomy and physiology course prior to, or concurrent with, the instructional program.³ The educational model for paramedic education includes instruction in preparatory areas such as general principles of pathophysiology, pharmacology, and venous access and medication administration. In addition, paramedics receive instruction in airway management and ventilation, medical emergencies, patient assessment, traumatic injuries, special medical considerations including pediatrics and geriatrics, emergency medical services (EMS) system operations, and assessment-based management.

In the specific areas of pharmacology and medication administration, students receive a median of 22.5 hours of pharmacology and eight hours of medication administration didactic instruction along with eight hours of pharmacology laboratory and nine hours of medication administration laboratory. Students receive additional practice in medication administration during approximately 600 hours of clinical and field practice.

The terminal objective for the pharmacology section of the curriculum states:

At the completion of this unit, the paramedic student is be able to integrate pathophysiological principles of pharmacology and the assessment findings to formulate a field impression and implement a pharmacologic management plan.³

Specific objectives supporting paramedic knowledge of drugs and drug administration are presented in Table 1.

Paramedic Field Practice

Once licensed as a paramedic and functioning in the pre-hospital setting, the paramedic routinely practices drug administration. Common to most EMS protocols are such activities as subcutaneous administration of epinephrine and intramuscular injection of diphenhydramine, glucagon, diazepam, and morphine sulfate.⁴ Additionally, the paramedic routinely administers oral medications such as aspirin and nitroglycerin. Although dependent upon the level of medical oversight, paramedics routinely administer many drugs per protocol or by standing orders.⁵

Paramedic-Based Vaccination Programs

The concept of vaccination administration by specially trained paramedics is not new. In 1990, West and Yuras⁶ reported on an intra-departmental program for paramedics to provide hepatitis B vaccinations for members of a county fire department. Eleven paramedics were given a one-day training session on hepatitis B, the pharmacology of the vaccine, and a review of intramuscular injection techniques. The authors made no mention of problems related to the actual vaccine administration by paramedics. However, administrative problems with the overall program were discussed.

Packer *et al*⁷ developed the MEDICVAX Project to test the efficacy of paramedics administering vaccines to the general public. This was a multi-agency trial with 90 paramedics participating. Paramedics successfully immunized 2,075 adults against influenza with no adverse effects reported. The authors concluded that this trial "demonstrated the feasibility of EMS agencies to safely provide influenza immunization." Both studies reported the major public health advantage was the ability to cost-effectively reach populations that otherwise would be difficult to immunize.

In Indian River County, Florida, 28 career, county paramedics have been an integral part of the county's well-child vaccination program for 10 years. The program provides mobile, on-site screening and vaccination for children, some of whom may not have other access to the public

- Central location in community
- Communications backbone capable of interaction with law enforcement, fire service, utility companies, public health officials, and hospitals
- Public acceptance and awareness
- Familiarity with incident command system
- Knowledge of local resources and capabilities
- Ability to provide care in unfamiliar surroundings
- At least basic training in disaster, terrorism, and hazardous materials response

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Table 2—Paramedics' characteristics related to disaster response

health system. To date, more than 10,000 children have been immunized, and no problems have been noted. Outreach programs such as "Be Wise Immunize" and "Shots for Tots", took the stigma out of going to the local health department for vaccinations. In addition, paramedics provide testing for tuberculosis, hepatitis B vaccinations, and rabies inoculations to animal control officers.

In Alameda County, California, paramedics from the fire department and EMS were trained to administer childhood vaccinations as a means to reach under-served populations. The original pilot program was deemed successful and used to support changes to the California paramedic scope of practice. The project developer, Alameda County Fire Department Deputy Chief Sheldon Gilbert, as quoted in the June 1998 Alameda County Courier, stated: "Fire department paramedics are identifiable and trusted." This points to another advantage of using paramedics: there is public acceptance. Paramedics often are the link between citizens and health care in many communities and enjoy a positive reputation. Thus, citizens may be more trusting of paramedics than they are of other healthcare providers, especially during the uncertainty of a real or potential weapon of mass destruction (WMD) event. Paramedics participating in the pilot study received 16 hours of classroom training and four hours of field training at an immunization clinic.

Other paramedic activities related to immunization administration include EMS participation in "Shots Across Texas"⁸ and scope of practice authorization for New Mexico paramedics.⁹ The Maryland Health and Medical WMD Response Plan,¹⁰ developed to guide hospital, EMS, and state responses to a WMD event, includes the following section^{4,5} related to EMS administration of vaccines:

Each EMS jurisdiction and EMS personnel should assist with public outreach and administration of antibiotics, prophylaxis, immunizations and administration of medications that may be needed by the general public as the result of the threat of or actual use of weapons of mass destruction.¹⁰

On a national level, the American Public Health Association, the National Association of EMS Physicians, and the National Association of State EMS Directors formulated the Emergency Medical and Public Health Response to Terrorism: Memorandum of Understanding (MOU) in October of 2001.¹¹ This MOU contains the following points in support of EMS-administered antibiotics and vaccines:

- "Emergency Medical Services should collaborate with public health to define the EMS provider's role in...distribution of medications and immunizations..."
- "EMS and Public Health should develop guidelines for prophylaxis and treatment of biological and chemical threats, including those that address the management of special needs groups such as infants, children, pregnant women, and the elderly."
- "EMS and Public Health should consider how EMS providers and Public Health workers should be cross-trained and certified in order to expand personnel capabilities in the medical/public health response to terrorism and to rapidly emerging public health threats."

Other Health Care Professionals

In addition to the traditional role of nurses and physicians administering vaccinations, pharmacists have been approved to perform vaccinations in 26 states. The American Pharmaceutical Association has developed a national certificate-training program for pharmacists.^{12,13}

Immunization Programs in Non-traditional Settings

The National Vaccine Advisory Committee of the CDC has issued quality standards and guidelines for evaluation of adult immunization programs in non-traditional settings.¹⁴ Non-traditional settings include locations other than medical offices, clinics, and hospitals. Examples may include shopping malls, the work place, churches, fire stations, and pharmacies. Benefits associated with the use of such settings include access and convenience, reduced cost for vaccinations, and increased awareness for vaccinations among adults. Challenges cited by the report include adverse reactions to vaccines, record keeping, liability of healthcare providers, legal regulations, integrating vaccine programs into non-traditional and traditional settings, and quality of service. To mitigate these challenges, the report lists seven standards to be used as guidelines for non-traditional immunization programs.

EMS Compliance with CDC Guidelines for Non-traditional Settings

Given that no national standards exist for quality control of non-traditional sites, the CDC-suggested guidelines for quality are based on similar standards for traditional settings.¹⁴ It is important to realize that there is more to a vaccination program than administration of the vaccine. Patient education, informed consent, and monitoring are equally as important; however, these are areas in which EMS providers have limited experience and training.¹⁵

- Pharmacology of vaccine
- Storage and handling of vaccine
- Dosage and route of administration
- Contraindications for administration
- Possible adverse effects, including CDC, Vaccine Adverse Events Reporting System (VAERS)
- Identifying persons eligible / ineligible for vaccination
- Information on risks and benefits of immunization and techniques for patient education
- Program documentation including recording consent, vaccination or refusal, acceptable forms of identification, adverse events, providing documentation to patients and primary-care providers
- Laboratory review of intramuscular and subcutaneous medication administration
- Clinical practice at traditional immunization site (optional)

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Table 3—Outline of major topics for paramedic vaccination training program (CDC = Centers for Disease Control and Prevention)*Standard 1: Information and Education for Vaccinees*

The emergency setting usually does not provide sufficient time to fully educate a patient about the risks and benefits of a drug or procedure. However, paramedics have a basic understanding of consent, which could be expanded to include use of the CDC Vaccination Information Statements and other appropriate information. Paramedics usually know the cultural and social norms of the local population, and therefore, can tailor consent information as well as general healthcare information to meet a population's needs.

Standard 1 also suggests that the provider discuss the importance of having a "medical home" and proper medical care. Given the overcrowding seen in most urban emergency departments in the US and its effect on EMS, paramedics would have a compelling interest in encouraging participants to utilize traditional primary-care services such as private physicians and clinics.

Standard 2: Vaccine Storage and Handling

Paramedics are responsible for maintaining the medications carried on their response vehicle. Therefore, they are aware of drug storage concerns, especially the need to maintain a proper temperature range for drugs stored in a vehicle or station.

Standard 3: Immunization History

Paramedics are taught to perform a systematic patient assessment, which includes obtaining a medical history. The CDC Guidelines list as a minimum, obtaining a vaccination history, allergies, and any adverse reactions from previous vaccinations. Although a vaccination history is not routinely obtained in the EMS setting, personnel do inquire about allergies and the nature of the allergic reaction, specifically the causative agent. Therefore, obtaining the information outlined in the CDC guidelines should be straightforward for paramedics participating in a vaccination program.

Standard 4: Contraindications

Basic instruction for paramedics includes knowing the contraindications of all medications they administer. Participation in a vaccination program likewise would require knowledge not only of the contraindications, but basic drug information such as dosage and route, indications, possible interactions, and pharmacology of the vaccine.

Standard 5: Record-keeping

All paramedic-level EMS systems require paramedics to complete a run report or trip sheet for any call involving patient contact, including refusals of service. Emergency medical services systems have established policies and procedures for processing such reports, as well as a mechanism to utilize the data collected. These reports are based on the Uniform, Pre-hospital Emergency Medical Services, Data Set.¹⁶ Now, EMS systems are coming into compliance with the US Health Insurance Portability and Accountability Act requirements that will ensure patient confidentiality. Transition to a form specific to a vaccination program would seem straightforward for EMS personnel. However, West and Yuras reported that paperwork compliance and lost documentation was a problem in an EMS organization vaccination program.⁶ This may be an area needing special emphasis in a vaccination-training program.

Standard 6: Vaccine Administration

This standard deals with the legal authority of healthcare providers to administer vaccines in a non-traditional setting as well as the requirement for participation in a formal training program. All of the non-disaster-related examples cited included specific training for paramedics to administer vaccinations. The legal status and medical authority to do so also was clearly defined either by statute or medical direction. The only instances in which limited training may be provided is in an emergent situation in which the immediate health of the public is at risk. Legal authority may be extended to paramedics in such situations even though vaccination is not a normal part of the paramedic scope of practice. Given that paramedics do not have authority to engage in independent practice, any and all such orders or deviations from the normal scope of practice will be under the auspices of a physician medical director. Since some areas require formal legislative changes prior to alteration or modifications of the paramedic's scope of practice, such changes should be implemented as part of the planning process.

Standard 7: Adverse Events

This is perhaps the one standard in which EMS administration of vaccinations in a non-traditional setting has a distinct advantage. In addition to requiring the vaccine provider to be trained in administration of medications such as epinephrine, atropine, and sodium bicarbonate, airway management, defibrillator use, and CPR and advanced

cardiac life support, they are required to "...be in close proximity to a telephone so that emergency medical personnel can be summoned..." As long as EMS providers have access to a fully-stocked advanced life support (ALS) ambulance while administering vaccines, they will be able to provide care for any adverse reaction that may occur; and they will do so more quickly than if they were summoned to the scene.

Suitability for Influenza Vaccine

The influenza pandemic of 1918 caused 40 million fatalities worldwide,¹⁷ including 500,000 fatalities in the US, 43,000 of which were members of the US military.¹⁸ Experts agree that a similar pandemic may be on the horizon. As soon as the next pandemic is identified, a large-scale vaccination program will be needed. Paramedics and other EMS personnel could be a valuable supplement to the public health workforce in such a situation. However, in order for such a project to be successful, early preparation, training, and, in some cases, legislative changes, must be implemented in advance of the catastrophe. In addition to the concern about influenza is the fact that >30 new infectious diseases have emerged during the past 25 years.¹⁹ As the potential need for large-scale vaccination programs increases, so too, must efforts to mobilize and train the entire healthcare workforce in vaccination procedures.

Suitability for Bioterrorism Response

Paramedics are well-suited for rapid response to disaster and terrorism-related events. This was evident during the events of 11 September 2001, at the federal office building bombing in Oklahoma City, and the 1993 bombing of the World Trade Center in New York City. Likewise, they continue to respond to both major and minor transportation crashes on a routine basis. With >70,000 paramedics in the US, paramedics are a substantial medical resource in most communities in the US.²⁰ Similar expectations can be held worldwide.

Training

The preparation and training of paramedics to provide vaccinations should include review of clinical knowledge and skills necessary to administer a vaccine, pharmacology of the vaccine(s), patient education, and recordkeeping. West

and Yuras, Packer *et al*, and Alameda County reported training as part of their program criteria. West and Yuras and Alameda County conducted training that included both didactic and clinical experience.

Paramedics routinely administer medications to patients in the field setting. A practice analysis conducted by the National Registry of EMTs listed "administer medications to a patient" as the 32nd most frequent skill out of 120 listed skills.²¹ However, most field medications routinely administered by paramedics are given via intravenous lines or orally. Thus, remediation in administration of intramuscular injection would be appropriate for a vaccination-training program.

An outline of major topic areas that should be included in a paramedic vaccination-training program is in Table 3. An area of training emphasis that must be included in any program is information about the vaccine, contraindications, and adverse effects. Techniques of patient education also may be included.

If paramedics are being trained as just a standby resource for response to a disaster or terrorism event, rather than to participate in an on-going community vaccination program, some means of refresher and update training must be instituted. This could be included in recertification training required by paramedic licensing agencies or EMS continuing education. This is critical especially as new vaccines and antidotes are developed.

Conclusion

This review supports the feasibility of utilizing paramedics to administer vaccines in non-traditional settings. Paramedics have training that is pertinent to the needs of a mass (or routine) vaccination program, needing little additional training. Paramedics also, by virtue of their training and experience, offer some advantages over other groups of healthcare professionals. They are experienced in a disaster incident command system and thus, are accustomed to being dispatched to unusual locations and working there on short notice. Likewise, they are accustomed to working in difficult environments, and have as their basic function, the task of bringing healthcare interventions to the public wherever it is, rather than depending on the public to travel to a more controlled setting. Furthermore, paramedics or their equivalent are widespread, cover a large portion of the developed world, and they have easy access to populations poorly served by fixed medical facilities.

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