Evaluation of TEMS Support Efficacy in Four Representative Tactical Units

A thesis submitted to the University of Arizona College of Medicine- Phoenix
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ABSTRACT

Background/Significance: Tactical Emergency Medical Support (TEMS) is a service modified from military tactical medicine to encompass the complex environment and mission set of current law enforcement agencies. Physicians and certified personnel acting as TEMS must be able to provide medical care under stressful and dangerous conditions as well as train police to be able to care for themselves when needed. A physician on-scene during a mission can provide deeper medical knowledge and abilities in the event that injuries or the complications thereof go beyond the training of paramedics. By working closely with the operational team, TEMS also have the opportunity to foresee possible risks and advise the team leader during planning stages. Tactical medicine also allows for preventative medical training, advising on anything from diet, hydration, and exercise plans to treatment of acute hemorrhage in the field.

Research Question: In an analysis of Law Enforcement tactical teams, are TEMS physicians more effective than other certified TEMS providers in delivering training and operational medical support?

In a selection of active SWAT teams within Arizona, we aim to determine (1) team members' confidence in their own ability to perform self-care and buddy-care methods in the field, (2) team members' confidence in their medical support personnel (EMT, Paramedic, or Physician), (3) team members' medical knowledge of how best to perform self-care and buddy-care in the field.

In a selection of medical professionals working with active SWAT teams within Arizona (EMT, Paramedic, or Physician), we aim to compare medical resources and training to determine which combination of support personnel provides the highest level of medical care during an operation, and the perceived strengths and weaknesses of each group, as well as changes that could make TEMS groups more effective.

Methods: The purpose of this project is to analyze the importance of having a TEMS physician in comparison to the more traditional TEMS paramedic or EMT. We sampled a selection of active SWAT teams within Arizona to determine effectiveness of their TEMS in three categories:

training the SWAT team members, SWAT team member confidence in personal ability to render care in the field, and SWAT team member confidence in on-scene medical care by their provider. To do this, we surveyed 130 SWAT team members on their medical training (self-care and buddy care) and SWAT team member confidence in medical care by a TEMS professional during an operation. We also analyzed interviews of a selection of 6 tactical medical personnel.

Results: A total of 130 SWAT team members were surveyed in this study. Our analysis revealed that teams with a physician were more likely to see an operational role and highly rate the importance of having a physician on the team (0.91 with and 0.14 without physician, p-value <0.001). SWAT team members with a TEMS physician also rated their confidence in their medical care in the field more highly (3.9 ± 0.27 with and 3.00 ± 0.62 without physician, p-value <0.001), although confidence was high for all types of TEMS physicians on all teams. When SWAT operators were asked about their own ability to perform self- and buddy-care in the field, confidence was high for all respondents (3.4 ± 0.67 with and 3.59 ± 0.59 without physician, p-value 0.1), but those without a TEMS physician had higher confidence in some tasks. The tasks with significantly higher confidence for teams without physicians were placing a chest seal on a teammate (2.56 ± 1.06 with and 3.13 ± 0.88 without physician, p-value 0.003) and using needle decompression (1.1 ± 0.89 with and 1.7 ± 1.28 without physician, p-value 0.014). When tested on their medical knowledge, teams with a TEMS physician scored higher than those without on similar topics (Average score 70.90% correct with and 56.02% correct without physician, p-value 0.001).

Conclusion: This project investigates the scope and impact of the tactical subspecialty of Emergency Medicine. Analysis of these tactical teams will help us identify the efficacy of utilizing trained physicians in various roles of Tactical Emergency Medical Support. This data will help to better inform other police departments and help them determine if their department would benefit by utilizing available physicians in their tactical units. The details of the roles in which physicians could be utilized by tactical teams is explored in the text.

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INTRODUCTION/SIGNIFICANCE

Background of Tactical Emergency Medical Support Physicians

Special operations units in the military have long had medical support, both preventative and operationally. "Medical Support" in this context is embedding medical personnel into an operational unit who have been specially trained in combat tactics and skills. Medical support can change a risk/benefit analysis to allow for much more successful missions in many areas of the military[1]. In the mid-1990s a Special Operations medical research project investigated combat trauma and medical care, producing "Tactical Combat Casualty Care", or TCCC, guidelines for military use on the battlefield. These guidelines included care under fire, tactically appropriate interventions, and the increased use of tourniquets. Since that time, there have been improvements in TCCC guidelines resulting from increased use and successes in combat in Iraq and Afghanistan and TCCC has become the current U.S. standard of care in combat medicine. Aspects of these tactical combat casualty care guidelines can be used in many civilian areas including urban or rural emergency medical services, wilderness medicine, and tactical emergency medicine [2,3].

With the increasingly violent tactical missions faced by law enforcement, their adaptation of this military-style medical support is unsurprising. Police departments have created special operations units, commonly known as Special Weapons and Tactics, or SWAT, teams. Operators on these teams have missions involving barricaded suspects, hostage situations, and high risk arrests of members of organized and dangerous groups[4]. Recently we have also seen an increase in active shooters in schools and public spaces as well as acts of domestic terrorism[5]. With the increase in risk that these SWAT operators are facing, came Tactical Emergency Medical Support (TEMS) to provide medical support and training for the operators. TEMS were originally paramedics or EMTs, often provided by the local fire department. Physician involvement in TEMS provides a higher level of medical expertise, and has become more common in the last 20 years[6,7]. However, physicians are still rare due to the voluntary

nature of their association and the required time commitments and operational availability.

The benefit of operational actions by TEMS is well documented[8]. Injuries sustained by operators, perpetrators, or bystanders may prolong or cease an operation to allow time to assess the patient and remove them from danger. It is not safe for standard emergency medical personnel to go to the patient until law enforcement determines that the "scene is safe". Without immediate medical care mortality and morbidity increases[9,10]. TEMS are trained as members of the SWAT team and allowed to enter more dangerous situations alongside of the tactical operators, allowing for immediate care as needed[11,12]. Medical care by TEMS is most commonly given for training activities (29%), followed by high risk search warrants (24%). TEMS must be able to treat non-life threatening injuries during training activities, but must also be prepared for the less common situations with higher morbidity and mortality[13]. Common causes of preventable combat deaths are extremity bleeding, tension pneumothorax, and airway obstruction, with extremity bleeding covering 61% of preventable deaths[14]. As a result of this, TEMS focuses on tourniquet application for rapid control of bleeding, needle decompression, and placement of the nasopharyngeal airway (NPA). While many techniques are beyond the scope of a SWAT team member, with training they are able to perform basic lifesaving maneuvers in a tactical environment. More advanced techniques require a physician on location- a TEMS doctor.

A "National Consensus for TEMS Training Programs" sought to create uniform competencies, with learning objectives, to create a universal agreement on the minimum knowledge base for providers and operators. The modifications to the previously used TCCC recommendations are unclear, but directed more specifically for civilian law enforcement tactics and common injuries[15,16]. The guidelines differ from standard prehospital care learned by either Emergency Physicians or paramedics: they include "Care Under Fire"[17], recommending that medical support "return fire and take cover" in addition to keeping "the casualty from sustaining additional wounds". To say that the mindset and training of TEMS differ from their traditional counterparts would be an understatement, and TEMS must train with combat skills and equipment in addition to maintaining current medical knowledge.

Using a physician in a TEMS position would give more medical options as well as a higher level of medical training available. Medical support is also used in preventative medicine to train SWAT operators in basic medical care for themselves and teammates in the event that medical support is unavailable. In general, TEMS provide education on injury prevention, immediate self- and buddy-care, and offer medical consultation on tactical operations. Operational consultation often includes a plan for stabilization and evacuation of possible casualties, which differs operation-to-operation. Some urban environments may allow teams to "throw and go" in which they load a casualty into a truck and drive to the nearest trauma center which may be as close as minutes away. Other, more rural, environments may require carrying or dragging an injured officer to an acceptable landing site for a helicopter. Each operation must have contingency plans in effect, and if no reasonable contingency can be found the operation itself is altered[13].

Variance in TEMS for different tactical teams

Tactical Emergency Medical Support traditionally encompasses a triad of activities: training and education, consulting on planning operations, and operational medical care. Tactical teams also have a variety of TEMS providers: EMT, paramedics, physicians, or a combination thereof. TEMS physicians are traditionally volunteers and participate in training and operations with the team as available; EMT and paramedics are usually paid members of the team. Different teams use their TEMS in any one or combination of the three aspects[16], and their use corresponds to the degree to which they train with the SWAT team. Confidence in TEMS tactical abilities, and not their medical knowledge, may determine the extent of their use operationally, but there are other factors. Each team has a different geographic responsibility. Some law enforcement covers a specific town, but others may cover a county or state. With different areas of geography, they also have different mission sets: urban, rural, wilderness. TEMS must know location of medical centers in the area, how far they are, and how long it would take the get there. Additionally, each operation could require a very different set of medical skills and tools. Assault weapons, methamphetamine

laboratories, improvised explosive devices, and tracking suspects through extremes in temperature are common operations and present different medical risks that TEMS must recognize and plan accordingly[13,18].

Rationale

Every TEMS support is trained to a specific tactical standard of care, based on TCCC guidelines. As such, any tactically trained support should be able to perform the same basic care in the field. The differences lie in the additional training physicians have before becoming TEMS. Physicians have more years of training and have the legal ability to provide a higher level of medical care, including different medications and techniques, as compared to EMT or paramedic. These additional options available to physicians in the field may not be needed in most operations, but will provide more effective care in the more complex cases. Tactically trained, volunteer TEMS physicians have also been found to be significantly more cost effective [19,20]. These advantages are tempered by the disadvantage of consistency of availability both for training and operationally, which could be remedied with a larger population of TEMS physicians. However, TEMS is a largely unrecognized subspecialty of Emergency Medicine. We do recognize that surveying different tactical teams will add variability to the data, and that different teams cannot perfectly replicate operational experiences. From this investigation we can learn how tactical operators perceive the level of care and training they are receiving from their medical support. By analyzing a sample of operational medical plans we can begin to understand the level of planning provided in different tactical teams. A broad understanding of the efficacy of TEMS physicians in relation to other types of TEMS providers can bring understanding of the relevance of this subspecialty of medicine.

METHODS

Study Population and Design

The 130 tactical operators included in this study were surveyed using the anonymous online survey collection site RedCap, with 100% participation. They were from 4 different law enforcement agencies in the greater Phoenix, Arizona area. Also included was qualitative data from interviews with 6 tactical medical providers, including paramedic, EMT, and physician members, with at least one representative from each of the 4 departments. Interviews were conducted of tactical medical professionals individually and were audio recorded and transcripted. The transcript was deidentified of personal information and the recording destroyed. Each transcript was identified by the level of TEMS (EMT, Paramedic, or Physician) only.

Consent forms were signed by participants of the survey and interviews indicating voluntary participation and understanding of confidentiality and the purpose of the study in accordance with IRB review and applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research.

This research plan is in two stages, each stage having its own measured outcome.

Data Collection

In Part 1 of this study, we utilized a survey of the tactical operators in four SWAT teams in Arizona who use different types of Tactical Emergency Medical Support to perform a prospective analysis. These four teams gave a sample size of 130 participants. The text of the recruitment email communication sent to each SWAT commander to forward to the members of their team is listed here:

> "My name is Kimberly Weidenbach and I am a student at the University of Arizona, College of Medicine- Phoenix working with Dr. Jasjeet Somal. We are conducting an anonymous survey of tactical operators to determine the degree of confidence in various forms of TEMS personnel. To participate you must be a member of an active

tactical team in the greater Phoenix area. By taking part in this study, you will be asked to fill out a brief survey indicating your level of confidence in medical personnel as well as self-care and buddy-care. Your participation will only require answering a single survey, which can be completed in under 10 minutes. The results will be reported at conferences you are welcome to attend. Your participation is voluntary. You may choose not to participate in this study without penalty or loss of benefits to which you are otherwise entitled. By clicking the link below you will access a full disclosure statement before choosing whether to continue to the survey. The survey access will remain active for 2 weeks. Thank you for your time and consideration."

If this initial communication was insufficient information, or any potential participant had further questions, they were encouraged to contact the researcher for follow up as needed.

The following survey questions were collected from each participant, full survey with correct answers, as applicable, is available in Appendix 1:

1. Signature indicating understanding and agreement to participate in the study
2. What department are you with?
3. Which of the following medical personnel are used by your SWAT team (more than one answer is acceptable)?
4. Do you believe there is an important operational role to be served by a tactically trained physician integrated into your SWAT team?
5. Is your designated "medic" (or doc or EMT) a member of the tactical team, carrying a firearm on callouts?
6. Do you rely on outside Fire/EMS support for TEMS support?
7. Which medical personnel (or combination) would you prefer for your team?
8. How important to you is each of the following?
9. How confident are you in each of the following?
10. Your teammate was shot in the upper arm. While remaining in a tactical environment, which of the following would you be most likely to do first?

11. You are treating a casualty while under fire, with your team suppressing the threat. Which of the following can you perform before moving the casualty to a place of safety?
12. You applied a tourniquet to a teammate about eight hours ago. The tactical situation does not allow the casualty to be evacuated. Should you loosen the tourniquet and try to control the bleeding with a pressure dressing before evacuating the casualty?
13. Which one of the following statements gives a proper rule for tightening a tourniquet?
14. A teammate has suffered a wound to the chest. You are not sure if the chest wall has been penetrated. What should you do?
15. You have treated a casualty with a chest wound who does not want to sit up. How should they be positioned?
16. A casualty with an open chest wound has diminished breath sounds, increasing difficulty breathing with bluish skin tint and distended neck veins. You should:
17. If you were to insert a needle to relieve tension pneumothorax, you should choose an insertion site that is:
18. Once you have penetrated the plural space with a large bore needle/catheter, you should:
19. While on a lengthy mission, hydration can become important. Which option is best for rehydration?
20. A teammate has suffered a penetrating wound to the abdomen. What should you do?

In addition to the survey, we performed a qualitative interview six tactical medical professionals working with our selected SWAT teams to determine the perceived strengths and weaknesses of each group, as well as changes that could make TEMS groups more effective. The text of the recruitment email communication sent to each medical professional is listed here:

> "The University of Arizona, College of Medicine- Phoenix (UA COM-P) would like to conduct a research project entitled, "Evaluation of TEMS Support Efficacy in Four

Representative Tactical Units." We are inviting your participation, which will involve completing a short interview. The study objectives include evaluating a medical professional's perceived strengths and weaknesses of each group, as well as changes that could make Tactical Emergency Medical Support (TEMS) groups more effective. The duration of this study is expected to be approximately one and a half years to two years. The Principal Investigator, Dr. Jasjeet Somal and the Co-Investigator, Mrs. Kimberly Weidenbach are conducting this investigation which have been reviewed and approved by The University of Arizona Institutional Review Board (IRB) that is responsible for human subjects' research. The IRB ensures that this research project conforms to all applicable state, federal and University regulations and policies that are designed to protect the rights and welfare of human subjects participating in research and that the research team has received proper education and training in the conduct of responsible research.

Your participation in this study is voluntary. You have the right not to answer any question, and to stop participation at any time. If you choose to withdraw from the study there will be no penalty and will in no way impact your current position or your ability to participate in future informational sessions that the UA COM-P may undertake. If you choose to take part in this study, you will be helping the research team collect valuable information that can be applied to SWAT teams. To be eligible for participation you must be a medical professional within an active SWAT tactical team in the greater Phoenix area.

Your responses to the 5 questions will be asked will be kept confidential. When the recording is completely transcribed the recording will be destroyed. Thus, the transcription will not contain any identifiers that is traceable back to your identity. Your name nor your SWAT team will never be associated with any of the data you provide. The interview will be conducted at a time and location of your choice and cannot interfere with your normal duties. The interview will take approximately 30 minutes and will be recorded so that the answers to the questions accurately reflect your responses. The interview consists of a series of questions related to SWAT team

strengths and weaknesses. Your participation in this research will be concluded once the interview is completed.

The data collected from this interview will be transcribed and transferred to data collection sheet on a password protected computer. The recording will be destroyed once transcription is completed. All data from this study including this interview will be stored on a password protected computer with access limited to only the Principal Investigator and Co-Investigator. All files generated in this study will be stored in a locked cabinet in the Research Office located in Building 1 Room 1165 which is a secured area that has been identified for the storage of scholarly project activity.

There are no foreseeable risks or discomforts to your participation in the interview. No personal health information nor questions of a sensitive nature are included in this interview. We realize there is a commitment of time in being interviewed and this cannot interfere with your duties on the SWAT team. If you clicked I agree this will indicate your willingness to participate in this research. You will receive another email from the Co-Investigator, Mrs. Kimberly Weidenbach to arrange for a time and location of your choice for taking the interview.

Your participation is voluntary. Participating in this study will not be of direct benefit to you, but will allow this investigation to gather important information on strengths and weaknesses as well as changes that could make TEMS groups more effective. Upon completion of the study it is anticipated that it might provide important information that can enhance the function and safety of team members. The results of this study will be used in reports, presentations, or publications but the results will only be shared in their aggregate form and your name or SWAT team will not be used nor are there identifiers that can link reports to the participant's identity.

You may also choose not to participate in this study without penalty to your current positon or loss of benefits to which you are otherwise entitled. Your decision to not participate will also not affect any relationship with the University of Arizona or the UA COM-P and the participation in any future research. We are very grateful that you took the time to consider participating."

The following interview questions were collected from each participant:

1. What makes a TEMS provider effective in a tactical environment?
2. Do you feel you are an effective medical care provider in the field? If not: in those situations, what are your barriers?
3. Do you feel prepared to give complete medical care in the field? What would make you feel more prepared to give medical care?
4. How do you feel the medical care you offer is different from other TEMS medical care providers? (Example: if speaking to a physician, "how is the care you offer different from EMTs and paramedics?")
5. Would you prefer to work with a team using only TEMS of your type (EMT, Paramedic, or Physician) or a mixture? Why?

Each participant in the interviews had the ability to add any additional information they felt would be important and assist in our analysis of the use of TEMS professionals.

Statistical Analysis

Once collected, the survey data was separated by question category (e.g. "confidence using medical supplies") and each category analyzed in relation to the type of TEMS used. Survey characteristics were assessed using means, standard deviations for ordinal responses and frequencies, proportions for the binary responses. The Fisher's exact test was conducted to ascertain any relationships between two categorical variables. The Wilcoxon Rank Sum was used to ascertain differences in ordinal responses between MD vs No MD utilization. All p-values were 2-sided and $P<0.05$ was considered statistically significant. All data analyses were conducted using STATA Version 14 (College Station, Tx).

Each interview was transcribed, coded and qualitatively analyzed to determine trends and patterns including categorizing common statements made among medical professionals.

RESULTS

Survey of SWAT team members:

Background Information:

Each of the 130 participant members of the representative SWAT teams were asked background information indicating their department, the medical personnel used, and specific questions regarding their use. Of the 130 participants, 50 utilized a TEMS physician and 80 did not. Of those who utilized a TEMS physician, all respondents also utilized other typed of TEMS support personnel including EMT, paramedic, or medic. Each participant was also asked which medical personnel (or combination) they preferred for their team. This information is presented in Table 1.

Table 1: Background Information

	Using a TEMS Physician	Without a TEMS Physician	p-value
Total	50	80	
Do you believe there is an important operational role to be served by a tactically trained physician integrated into your SWAT team? (Yes/No)	50 (100%)	63 (79%)	<0.001
Is your designated "medic" (or doc or EMT) a member of the tactical team, carrying a firearm on callouts? (Yes/No)	45 (90%)	63 (79%)	0.14
Do you rely on outside Fire/EMS support for TEMS support? (Yes/No)	34 (68%)	19 (24%)	<0.001
Which medical personnel (or combination) would you prefer for your team? (More than one answer possible per respondent)			
Separate EMS/Fire support staging or available to be called (Yes/No)	6 (12%)	2 (2.5%)	0.11
Tactically trained and team integrated medic/paramedic (Yes/No)	39 (78%)	73 (91%)	0.01
Physician staging or available to be called (Yes/No)	9 (18%)	19 (24%)	0.1
Tactically trained and team integrated physician (Yes/No)	43 (86%)	12 (15%)	<0.001

Level of importance of the level of medical support available and self-care and buddy-care.

Each of the 130 participant members of the representative SWAT teams were asked how important they felt it was to have different levels of medical support available on callouts, and the importance of knowledge of self- and buddy-care. They were also asked the rank the level of importance on a scale from not at all important to very important. All ranking was done on a scale of 0-4 with 4 bring the highest level of importance. This information is presented in Table 2.

Table 2: Importance of Medical Care

	Using a TEMS Physician	Without a TEMS Physician	p-value
How important to you is it for SWAT teams to have a trained medic available onsite at callouts or high-risk warrant searches	3.96 ± 0.2	3.75±0.69	0.05
How important to you is it for SWAT officers to understand basics of self-aid in a tactical environment	3.9 ± 0.33	3.78 ± 0.47	0.12
How important to you is it for SWAT officers to understand the basics of buddy-care in a tactical environment	3.9 ± 0.33	3.78 ± 0.47	0.12

Level of confidence in the medical care given by TEMS and their own ability to render self-care and buddy-care.

Each of the 130 participant members of the representative SWAT teams were asked how confident they felt in the medical care given by their TEMS personnel, and how confident they felt in their own ability to render specific types of self-care and buddy-care. They were asked to rank the level of confidence on a scale from not at all confident to very confident. All ranking was done on a scale of 0-4 with 4 bring the highest level of confidence. This information is presented in Table 3.

Table 3: Confidence in Medical Care

	Using a TEMS Physician	Without a TEMS Physician	p-value
How confident are you in the care given to you by your medical support in the field	3.9 ± 0.27	3.00 ± 0.62	<0.001
How confident are you in your ability to correctly place a tourniquet on yourself	3.4 ± 0.67	3.59 ± 0.59	0.1
How confident are you in your ability to correctly place a tourniquet on your teammate	3.62 ± 0.56	3.74 ± 0.47	0.24
How confident are you in your ability to place a chest seal on your teammate	2.56 ± 1.06	3.13 ± 0.88	0.003
How confident are you in your ability to correctly use needle decompression	1.1 ± 0.89	1.7 ± 1.28	0.014

Level of knowledge to use specific medical tools and methods in the field.

Each of the 130 participant members of the representative SWAT teams were asked to answer 11 medical knowledge questions. These questions were each multiple choice, intended to determine the participant's level of understanding of self-care and buddy-care in operational situations. Each question was assessed by percent of correct responses by teams that either used or did not use a TEMS physician. The average number of correct responses for teams utilizing a TEMS physician and those without a TEMS physician was also calculated. This information is presented in Table 4.

Table 4: Situational Medical Knowledge

Question topic, number (percent) correct	Using a TEMS Physician	Without a TEMS Physician	p-value
Use of tourniquet on extremity wound	40 (96%)	70 (87.5%)	0.11
Care under fire	49 (98%)	76 (95%)	0.13
Intent to loosen tourniquet before evacuating the casualty	47 (94%)	63 (78.75%)	0.019
Rule for tightening a tourniquet	15 (30%)	24 (30%)	0.28
Chest wound care	37 (74%)	44 (55%)	0.75
Chest wound positioning	20 (40%)	17 (21.25%)	0.11
When to use needle decompression	42 (84%)	63 (78.75%)	0.052
Insertion site for needle decompression	38 (76%)	40 (50%)	0.003
How to use a large bore needle/catheter for needle decompression	27 (54%)	24 (30%)	0.52
Best option for rehydration	40 (80%)	51 (63.75%)	0.048
Penetrating abdominal wound care	27 (54%)	21 (26.25%)	0.002
Average	35.45 (70.90%)	44.82 (56.02%)	0.001

Interview of Tactical Emergency Medical Support personnel:

Each of the six TEMS medical professionals interviewed were asked to answer five specific questions and given time to add any additional comments they felt were pertinent to the study. Each interview was transcribed and coded for common responses to each question. These common responses or themes were qualitatively groups and analyzed based on whether the interview participant was EMT, paramedic, or physician. This information is presented in Table 5.

Table 5: Common Themes in Interview Responses

TEMS Physician	TEMS EMT or Paramedic
What makes a TEMS provider effective in a tactical environment?	
- Ability to provide medical care to the team, public, and potential suspect - Basic skills and training to perform job - Ability to function in hostile, low light, unclean environment - Ability to coordinate/integrate with pre-hospital and hospital teams	- Ability to provide medical care to the team, public, and potential suspect - Basic skills and training to perform job - Ability to function in hostile, low light, environment - Ability to function with little/no backup or support.
Do you feel you are an effective medical care provider in the field? If not: in those situations, what are your barriers?	
- Yes, I feel effective, barriers include: - Limited access to tactical training - Limited time to join team on calls or training	- Yes, I feel effective, barriers include: - No additional help, usually only one medic per call - Limited medical supplies - Limited room to work - Limited light
Do you feel prepared to give complete medical care in the field? What would make you feel more prepared to give medical care?	
- Yes, I feel prepared, however we could use: - More integration into tactical operations - More operational training with the team	- Yes, I feel prepared, however we could use: - More medical personnel - More supplies - Available ambulance for extraction
How do you feel the medical care you offer is different from other TEMS medical care providers?	

- Ability to make own decisions on best practice in the field - Ability to give higher level of care and medications as needed - Deeper medical knowledge base to allow treatment of rare/complex injuries in the field	- Basic care necessary for the majority of injuries in the field - Well practiced in the span of practice determined by medical directors - More time with the tactical team, giving more experience with tactical environment
Would you prefer to work with a team using only TEMS of your type (EMT, Paramedic, or Physician) or a mixture? Why?	
- Prefer a mixed team - Each member of a medical team brings individual benefits - No one member can do everything	- Prefer a mixed team - Each member of a medical team brings individual benefits

DISCUSSION

One of the aims of this research was to determine the importance of having a TEMS physician as a member of the tactical team. By surveying active SWAT team members within Arizona, we were able to obtain data on (1) team members' confidence in their own ability to perform self-care and buddy-care methods in the field, (2) team members' confidence in their medical support personnel (EMT, Paramedic, or Physician), (3) team members' medical knowledge of how best to perform self-care and buddy-care in the field. The research shows that more team members that use a physician believe that there is an important operational role for a physician on the team (p-value <0.001). This is reasonable considering that these teams have seen physicians in a tactical environment and are likely more comfortable with their role on the team. Additionally, more teams with a physician would prefer to have an integrated physician (p-value <0.001) while more teams without a physician would prefer to have an integrated medic/paramedic (p-value 0.01) even considering that team members could choose a combination including both types of TEMS personnel. Of note, the SWAT team respondents far preferred tactical integration of the medical personnel to staging or availability approach. Historically, medical personnel would all stage at a distance until the environment was made safe by law enforcement. It has only been with the increasing use of TEMS providers that integration has become an option for tactical teams.

SWAT team members were also surveyed on their belief in the importance of medical care in the field. All respondents believed it was important or very important to have team members understand the basics of self-care and buddy-care with no statistically significant difference (p-value 0.12). However, when asked how important it is for SWAT teams to have a trained medic (including all forms of TEMS medical support) available onsite for callouts or high-risk warrant searches, all respondents believed it was important or very important, but more teams with a physician ranked the importance higher (p-value 0.05). Teams with a physician on the team felt it was more important to have some form of TEMS medical support in the field.

In the section on confidence, SWAT team members were asked to rate their confidence in the medical care their received from their TEMS personnel and confidence was higher for

teams using a TEMS physician (p-value <0.001). This is a significant difference in the confidence SWAT operators have in the care they will receive in the field. SWAT team members were also asked to rate their confidence in their own ability to perform self-care and buddy-care in the field. All respondents had high confidence in their own ability to place a tourniquet on themselves or on a teammate (p-value 0.1 and 0.24 respectively) but there were statistically significant differences in the level of confidence in placing a chest seal or needle decompression of a teammate. In both instances, team members without a TEMS physician were statistically more confident in their own capabilities, although the averages for these tasks showed lower confidence in general. When asked their confidence in placing a chest seal, respondents were not very confident to somewhat confident, with those without a physician on the team rating their confidence higher (p-value 0.003). When asked their confidence to correctly use needle decompression, respondents were not confident at all to not very confident, with those without a physician on the team rating their confidence higher (p-value 0.014). No respondents had high confidence in their ability to perform either task. This lack of confidence fits with the expected levels of self- and buddy-care seen in growing teams. Many tactical operators are not trained in the higher levels of medical care, especially in needle decompression which is an invasive treatment.

In the final survey section assessing medical knowledge with situational questions, SWAT team members were asked to answer multiple choice questions to determine their ability to provide self-care and buddy-care in the field. On average, 71% of responses by team members with a physician and 56% of responses by team members without physician support were correctly answered (p-value 0.001). This indicates that, on average, tactical operators on teams with a TEMS physician are more likely to use correct medical knowledge for a given situation. When analyzing the individual question responses, there was a statistically significant difference in the percent of correct responses in 5/11 questions. Tactical team members were more likely to correctly choose not to loosen a tourniquet (p-value 0.019), know when needle decompression is appropriate (p-value 0.052), know where to inset a needle for needle

decompression (p-value 0.03), know to rehydrate with a mixture of electrolyte solution and pure water (p-value 0.48), and choose a pressure dressing for a penetrating abdominal wound (p-value 0.002). Even considering needle decompression as an advanced skill not always taught to SWAT operators, the use of tourniquet, rehydration, and treatment of abdominal wounds are recurrent concerns in the tactical environment in Arizona.

The second goal of this research was to analyze qualitative data gained from interviews of TEMS personnel to determine the barriers to care, strengths, and weaknesses of each type of medical support. From the interviews, it appears that all TEMS providers agree that in order to be effective in a tactical environment, medical personnel must be able to care for the team, the public, and any potential suspect. They must also be trained and able to function in hostile, low light environments. Physicians also focused on the unclean nature of work in the field and their ability to assist in transitioning care to pre-hospital and hospital teams. Specifically, they mentioned that the team physician could often travel with the wounded patient and be able to give a full transfer of care at the hospital with the additional possibility of continuing care once at the hospital. Medic/Paramedics focused additionally on their ability to function with little/no backup in the field.

All TEMS personnel felt effective and prepared. Physicians felt their barriers included limited time and access to tactical training and calls. They would prefer more integration into tactical operations, which would require that they have more operational training within the team. These barriers are not necessarily of the team's making- many times the physician's work schedule prevents full participation on team training. Medic/Paramedics felt their barriers to care included limited medical supplies, room to work, and no additional help. While some people interviewed indicated they actually prefer smaller medical teams (less chaos), most would like a reliable ambulance available for extraction.

When asked if they would prefer to work with a team using only TEMS of their own type, or a mixed medical team, all interviewees responded rapidly and emphatically that they would prefer a mixed team. Each member of the team brings individual benefits to the operation and to training. Medics/paramedics are more reliably available for calls and give the majority of the training to the tactical operators. Physicians are able to give a higher level of

care on scene and their deeper medical knowledge base allows treatment of rare/complex injuries. While it may be extremely unlikely for an injury or illness to occur outside of the scope of practice of a paramedic, it is preferable to have a physician available on scene if it does occur.

FUTURE DIRECTIONS

While this research focused on four SWAT teams in Arizona and their TEMS providers, future studies should expand the research to include more teams utilizing a wider array of TEMS combinations. Additionally, using controlled educational goals for each team's operators would allow for more consistent expectations of medical knowledge. It would be interesting to compare operator medical knowledge using simulation-based scenarios rather than multiple choice questionnaires. Future research would need to be completed in order to evaluate the impact of training with and without TEMS physicians.

CONCLUSIONS

Tactical Emergency Medical Support is an underutilized subspecialty of Emergency Medicine. With its status as a volunteer position, and without a board certification, few doctors know that this community service opportunity exists. There have been very few studies comparing the efficacy of TEMS physicians in comparison to paramedics. The goal of this research was to clarify the importance of physicians in prehospital tactical care. We were also interested in giving valuable information to law enforcement agencies, many of whom have only an EMT or medic as their TEMS.

While this research showed that all teams were highly trained and prepared to provide basic self- and buddy-care in the field, there were some differences between teams with and without TEMS physicians. Teams with a physician were more likely to see an operational role and highly rate the importance of having a physician on the team. This is understandable considering the prior experience of each type of team and understanding of what a physician could add in the field. SWAT team members who had previously worked with a TEMS physician also rated their confidence in their medical care in the field more highly, although confidence was high for all types of TEMS physicians on all teams. During interviews with TEMS providers, they indicated that the differences they provided in medical care would be rarely required but it is understandable that having the option to treat more complex problems in the field could garner a higher degree of confidence.

When SWAT operators were asked about their own ability to perform self- and buddy-care in the field, confidence was high for all respondents, but those without a TEMS physician had higher confidence in their abilities to do higher levels of care including placing a chest seal and needle decompression. When these same teams were tested on their medical knowledge, teams with a TEMS physician scored higher than those without on similar topics. This implies that, although paramedics and medics teach the majority of training for all teams, those with a physician on the team have more knowledge but less corresponding confidence in their abilities. It is important to

note that all operators had adequate medical knowledge for basic self- and buddy- care and all teams had some form of TEMS provider integrated with their team.

Based on this information, the importance of this medical subspecialty is shown and more doctors, once tactically trained, could be useful volunteers serving the community through providing medical care and education to law enforcement tactical teams. This research shows that there is a tactical benefit of a TEMS trained physician within an operational SWAT team, to offer a higher standard of medical care to tactical law enforcement, and higher level of education and training to team members. TEMS paramedics and medics will always be necessary for consistency and availability, but there seems to be a role for additional medical support from a physician on a combined TEMS medical team.

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APPENDIX

Survey Questionnaire with correct answers in bold as indicated:

This will give us some background information about the medical resources of the team you work with.

1. Signature indicating understanding and agreement to participate in the study
2. What department are you with?
3. Which of the following medical personnel are used by your SWAT team (more than one answer is acceptable)?
    a. EMT
    b. Medic
    c. Paramedic
    d. Physician
4. Do you believe there is an important operational role to be served by a tactically trained physician integrated into your SWAT team?
    a. Yes
    b. No
5. Is your designated “medic” (or doc or EMT) a member of the tactical team, carrying a firearm on callouts?
    a. Yes
    b. No
6. Do you rely on outside Fire/EMS support for TEMS support?
    a. Yes

b. No

7. Which medical personnel (or combination) would you prefer for your team?
    a. Separate EMS/Fire support staging or available to be called
    b. Tactically trained and team integrated medic/paramedic
    c. Physician staging or available to be called
    d. Tactically trained and team integrated physician

We ask these questions to determine operator level of comfort asking for medical care and confidence in the medical care given by their medical support.

8. How important to you is each of the following? For the purposes of the questionnaire, "medic" will refer to doctor, paramedic, EMT, etc.
    a. For SWAT teams to have a trained medic available onsite at callouts or high-risk warrant searches
    b. For SWAT officers to understand basics of self-aid in a tactical environment
    c. For SWAT officers to understand the basics of buddy-care in a tactical environment
9. How confident are you in each of the following? For the purposes of the questionnaire, "medic" will refer to doctor, paramedic, EMT, etc.
    a. In the care given by your medical support in the field
    b. In your ability to correctly place a tourniquet on yourself
    c. In your ability to correctly place a tourniquet on your teammate
    d. In your ability to place a chest seal on your teammate
    e. In your ability to correctly use needle decompression

We ask these questions to determine operator level of comfort using specific medical tools and methods as well as situational judgement.

10. Your teammate was shot in the upper arm. While remaining in a tactical environment, which of the following would you be *most likely* to do first?

    a. Needle decompression

    b. Apply a tourniquet

    c. Chest seal

    d. Remove their armor

    e. Wait for medical support

11. You are treating a casualty while under fire, with your team suppressing the threat. Which of the following can you perform before moving the casualty to a place of safety?

    a. Perform cardiopulmonary resuscitation (CPR).

    b. Perform needle chest decompression to relieve tension pneumothorax.

    c. **Apply a tourniquet to control severe bleeding on a limb.**

    d. Administer medications to control pain and infection.

    e. None of the above- move the casualty to cover prior to considering the above question.

    two answers considered appropriate responses to this question after discussion with TEMS professionals

12. You applied a tourniquet to a teammate about eight hours ago. The tactical situation does not allow the casualty to be evacuated. Should you loosen the tourniquet and try to control the bleeding with a pressure dressing before evacuating the casualty?

    a. Yes.

b. **No**

13. Which one of the following statements gives a proper rule for tightening a tourniquet?

    a. A tourniquet should be loose enough so that you can slip two fingers under the tourniquet band.

    b. A tourniquet should be loose enough so that you can slip the tip of one finger under the tourniquet band.

    c. **A tourniquet is to be tightened until the bright red bleeding has stopped and the distal pulse is gone; darker blood oozing from the wound can be ignored.**

    d. A tourniquet is to be tightened until both the bright red bleeding and the darker red oozing have stopped completely and the distal pulse is gone.

14. A teammate has suffered a wound to the chest. You are not sure if the chest wall has been penetrated. What should you do?

    a. Leave the wound exposed until the medic arrives.

    b. Dress and bandage the wound as you would a cut on the arm.

    c. Apply airtight material over the wound and tape down three sides of the material, then dress and bandage the wound.

    d. Apply airtight material over the wound and tape down all four sides of the material, then dress and bandage the wound.

15. You have treated a casualty with a chest wound who does not want to sit up. How should they be positioned?

    a. On his back.

    b. On his front.

    c. On his side, wounded side up.

    d. **On his side, wounded side down**.

16. A casualty with an open chest wound has diminished breath sounds, increasing difficulty breathing with bluish skin tint and distended neck veins. You should:

    a. Remove the airtight seal over the wound.

    b. **Insert a large bore needle to decompress the plural sac (Needle Decompression).**

    c. Begin cardiopulmonary resuscitation (CPR).

17. If you were to insert a needle to relieve tension pneumothorax, you should choose an insertion site that is:

    a. **On the top of the chest and on the injured side.**

    b. In the middle of the chest and on the injured side.

    c. On the top of the chest and on the uninjured side.

    d. In the middle of the chest and on the uninjured side.

    e. In the middle of the chest over the sternum (breastplate).

18. Once you have penetrated the plural space with a large bore needle/catheter, you should:

    a. Immediately tape the needle/catheter in place.

    b. Remove the needle/catheter and tape airtight material over the injection site.

    c. **Advance the needle/catheter all the way to the hub, remove the needle while leaving the catheter, and tape the catheter hub to the chest.**

    d. Advance the needle/catheter all the way to the hub, remove the needle while leaving the catheter, and tape airtight material over the injection site.

    e. Advance the needle/catheter all the way to the hub and tape the needle/catheter hub to the chest.

19. While on a lengthy mission, hydration can become important. Which option is best for rehydration?

    a. Pure water

    b. An electrolyte enhanced sports drink (like Gatorade)

    c. 50% water, 50% sports drink mixture

    d. A caffeinated drink (soda, coffee, etc)

20. A teammate has suffered a penetrating wound to the abdomen. What should you do?

    a. Pack the abdominal cavity

    b. Apply a tourniquet to the wounded area

    c. Apply a pressure dressing