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Deriving Costs and Effectiveness Data for U.S. Army Training-Garrison Pre-Hospital U.S. Army Emergency Medical Services

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Abstract

This article reports on preliminary efforts to derive accurate cost-effectiveness data for US Army training-garrison installations' Pre-Hospital Emergency Medical Services (PH-EMS) pursuant to "best practices" in the research literature. Recent attempts to collect US Army training-garrison PH-EMS effort (i.e., activity) measures revealed disparate cost accounting, thus giving rise to concerns and mobilizing exploratory studies on accurately, comparably, and comprehensively measuring these costs. A civilian PH-EMS project's (the EMS Cost Analysis Project (EMSCAP)) vetted costing tool chest was generously borrowed from and conceptually adapted. Considerations of costs naturally and logically led to further consideration of performance outcomes (i.e., effectiveness). Pursuant to "best practices" in the research literature, the American College of Surgeons Outcomes measuring approach was generously drawn on. It is hoped that the preliminary work reported herein will not only answer questions about cost-effectiveness and inform policy decisions, but also serve as a road map for others similarly challenged.

Keywords: EMS; Cost-effectiveness; Methods; Measurement; U.S. Army; Garrison; Training; Installation

List of Acronyms/Abbreviations:

COL-Colonel; EMSCAP-Emergency Medical Services Cost Analysis Project; Ground-EVAC-Ground Medical Evacuation; LTC-Lieutenant Colonel; MEDCOM-Medical Command; MEDEVAC-Medical Evacuation; MTF-Medical Treatment Facilities; PH-EMS-Pre-hospital Emergency Medical Services; U.S.-United States; USARPAC-United States Army Pacific Command

Introduction

Pre-Hospital Emergency Medical Services (PH-EMS) constitute a substantial proportion of medical care costs, and medical care costs have been increasing at an alarming rate with universal and growing concern over medical costs [1,2].

The Surgeon General's office has the responsibility and accountability to scrutinize both the costs of PH-EMS systems and their effectiveness [2].

Considering resource constraints, concern about how best to spend and shift funds will become more persistent, pronounced, and pernicious [3,4].

Therefore, answering these crucial questions appropriately requires systematic and prudent evaluation of costs and effects of PH-EMS in accordance with standardized systems for their calculation that follow best practices and are informed by science [5].

At the least, the end-product should demonstrate a grasp of good stewardship over public dollar/resource expenditures and outcomes for US Army training-garrison PH-EMS services; at most, it can inform prudent (re-)allocations to improve upon outcomes.

The purpose of this commentary and review is to report exploratory considerations regarding the collection and compilation of cost and effectiveness data for US Army training-garrison installations' PH-EMS-in accordance with best practices and informed by empirical research.

It is hoped that this report will provide a road map for others confronted by similar challenges of generating reliable and valid cost-effectiveness measures and apprehending accountability.

Literature Review

Background and effort measures

Research and Program Evaluation of PH-EMS is a relatively new discipline in the civilian sector and even more formative in the military [6,7].

Cost-effectiveness analysis is a key component of evaluating the performance of services and service delivery [4,5]. It encompasses three logically sequential components:

- Effort measures, that is, 'things done and done to standard,
- Costs of 'those things done, and
- Outcomes or effects of 'the things done [4] (Figure 1).

The aim is accounting for what was attained versus what was spent [4,5].

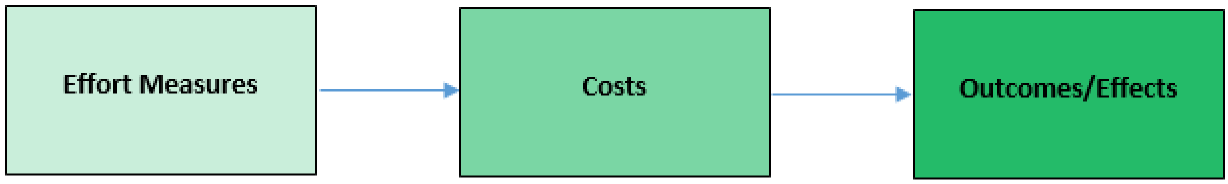

Figure 1: Logical progression of cost-effectiveness measurement.

The US Army's Medical Command (MEDCOM) recently conducted an assessment at US Army training-garrison installations regarding PH-EMS systems focused on systems effort (i.e., activity) measures (Effort Measures: 4 survey items) and those Effort Measures meeting standards (10 survey items) [2,8]. Part of this effort has been led by the US Army Pacific Surgeon General's office [8]. This survey also serendipitously revealed poor integration ("patchwork") and accounting of expenditures (i.e., "costs"), especially between the senior garrison commanders and the local military treatment facility (MTF) commanders [8]. This was especially true for a significant gap or "seam" between PH-EMS support in training areas/event and cantonment areas [2,8]. Nevertheless, this seam raised tacit concerns regarding the way in which costs for PH-EMS systems are measured and the accuracy, comparability, and comprehensiveness of those measures [8].

Deriving costs

The following are abbreviated considerations borrowed from the EMS Cost Analysis Project (EMSCAP) [1,3,9] that formulated and published a framework (i.e., tool chest) for deriving an array of costs and total costs of PH-EMS systems [3,4,10,11]. This study attempts to conceptually adapt them to the US Army's training-garrison PH-EMS systems. The need to use a vetted and generally accepted third-party universal approach to measure cost is dictated by various agencies' differentiated resources and competing alternatives, rendering it difficult to generate a local definition of what costs to consider in decision making [3,8]. In such cases, the authors of the EMSCAP recommend documenting costs using standardized e-spreadsheet templates with instruction and columns devoted to each item that tally up in individual totals and a grand total for the sake of unity, comparability, and simplicity [1,9,12].

- First, naturally, training-garrison PH-EMS systems must be limited to the US Army and all funding streams supporting PH-EMS systems should be identified. When a proportion of PH-EMS systems is related to PH-EMS, only that proportion/percentage should be included (rather than the total cost). Conversely, only the proportion/percentage of PH-EMS systems devoted to PH-EMS can be counted-anything outside of the PH-EMS role should be omitted. Downstream costs (e.g., post-PH-EMS medical care) should not be included and double counting must be avoided. Also, contract charges may exceed actual services rendered. Thus, the total cost must be accounted for as opposed to the contract cost.
- Second, costs must be considered according to one agreed-upon metric (e.g., US dollars, English pounds, Japanese yen) and the year the costs were incurred must be included (e.g., 1920 dollars *vs.* 1990 dollars); earlier costs must be adjusted to a selected year [12,13].
- Third, for all workers involved in PH-EMS, the total number of hours worked and direct (hourly/salary) and indirect costs (benefits) must be calculated [14].
- Fourth, physical plant costs related to all facilities used to house and support activities related to PH-EMS must be calculated. For shared buildings, the percentage of sharing must be determined [1,14,15].
- Fifth, any modes of transportation for PH-EMS are considered vehicles. Vehicle costs should be derived by cost of the vehicle, minus any depreciation, plus annual maintenance, insurance, and fuel usage.
- Sixth, the costs of PH-EMS direct equipment (patient medical care) and indirect equipment (support such as computers) and consumable/expendable items should be calculated, including units discarded due to expiration or damage [14].
- Seventh, any shared/contracted services not previously identified should be included.
- Eighth, all continuous training that PH-EMS undergoes should be included, as should any training PH-EMS provide to outsiders [14].

NOTE: What should not be included are any costs associated with revenue generation as this constitutes an "income transfer" [1]. This is not a cost associated with PH-EMS service delivery [1,16-18].

Some Army units may have difficulty calculating these costs due to lack of data or inability to account for their costs [1]. Thus, there is potential for reporting bias as these methods require diverse sources [1]. Simply put, doing it right involves a lot of work.

Also, unfortunately, doing all this may involve the onerous task of breaching cost data silos [12].

Deriving effectiveness

Any analysis of performance measures and costs inexorably and logically entails the inclusion of performance outcomes, specifically, measures of effectiveness [1,4]. Simply put, this means "are we getting our money's worth?" At the risk of oversimplification, PH-EMS outcomes become the numerator, while costs become the denominator in any cost-effectiveness equation [15]. However, determining appropriate and equitable outcomes for PH-EMS can be tricky and controversial [19].

Nevertheless, systematic evidence-based measures have been developed to benchmark outcomes [20]. Despite questionable uniformity, and the currently raging debate about the value between "scoop and run" vs. "treat-in-place," the classic and proven measures for PH-EMS systems performance ubiquitously and quintessentially have been and continue to be response-time intervals and survival to hospital/trauma center admission, in particular for cardiac arrest and respiratory distress/failure [19-31]. One reason for this is that these data are easily quantifiable, objective, and readily understood by various audiences [20].

Regardless of how on-site clinical services actually factor into time to arrival, stabilization time, and patient transport time to a hospital/trauma center, the expectation of an emergency situation is that this will be done with all due speed and with the patient surviving the ride [20]. Another reason is that recent research has revealed that, despite innovations in on-site treatment, the vital contribution of PH-EMS services in terms of improved prognosis and outcomes is rapid stabilization and evacuation to a hospital/trauma center [20,26,32]. Indeed, some research even suggests that delays due to on-site pre-hospitalization EMS interventions may be related to high mortality rates, though the rate does not necessarily contraindicate the importance of the intervention [33]. Put differently, research shows that PH-EMS best serves by arriving to patients' locations, stabilizing patients, and transporting them quickly to a hospital/trauma facility [20,34-38]. This is especially true in the case of trauma, which has classically constituted the majority of PH-EMS medical emergencies [39-41]. Nevertheless, other research shows the value of limited on-site PH-EMS treatment in that it relieves patients' discomfort and aids in stabilizing patients' medical conditions so as to better ensure transport survival [20,42].

Note that delimiting the time-interval outcome to survival upon arrival at a hospital/trauma center in terms of measuring PH-EMS effectiveness increases the ability to draw conclusions about PH-EMS absent confounding influences from post-acute hospital arrival interventions [32,42]. This prevents complications of erroneously attributing patient survival rates to PH-EMS, when in fact they are due to subsequent hospitalization [20,32,42].

Additionally, in the interest of measurement uniformity and analytic comparison, as Army military installations vary in size, topography, and density, these factors must be controlled to make reasonable comparisons [43-45]. Furthermore, whether the transport is air-medevac or ground evacuation must be accounted and controlled for in terms of analyzing transport time outcomes [46].

According to the Consortium of the American College of Surgeons, a best practices approach for measuring PH-EMS performance outcomes must incorporate the following criteria [20,40]:

- Time-interval arrival to the medical emergency from notification/dispatch.
- Time on-site for stabilization not to exceed 10 minutes unless documented exception (e.g., entrapment, scene safety, authorization).
- Transport time to designated hospital/trauma center with documented delays (e.g., weather, traffic, diversion).
- Proviso: Air-transport time must not exceed that by ground.
- A Post-hospitalization Injury (Condition) Severity Score and patients' age should be obtained and controlled for in any algorithm model measuring outcomes/effectiveness to ensure uniformity for comparison [41,47-49].

Finally, the research literature for best practices in terms of benchmarking PH-EMS outcomes also suggests possible additional surrogate/tracer measures, such as end-tidal carbon dioxide post-intubation, spinal/neck immobilizations, administration of supplemental oxygen, pain and respiratory distress relief, medication administration, intravenous access emplacement, and even patient satisfaction.20,50 In terms of scientific substantiation, there is little, if anything, substantiating the value of these additional measures in PH-EMS scenarios [20]. Nevertheless, further study of these supplementary/tracer measures in terms of US Army training-garrison installation PH-EMS may help determine the validity of these additional measures for monitoring the effectiveness of care. Also, it would aid in the resolution of controversies surrounding their use in terms of overall effectiveness of PH-EMS services. Thus, the US Army would find itself once again on the leading edge of the PH-EMS discipline instead of scrambling to catch up [15].

Discussion and Conclusion

Regardless of assurity or flux, the cornerstone of good public stewardship of any public trust, especially the military in a training-garrison environment, is comprehensive accountability for activities, costs, and outcomes [27,47]. This includes an accurate estimation of the costs of all infrastructure required to provide PH-EMS services to military training-garrison installations and benchmarking outcomes derived therefrom [19,47,50-53]. Thus, eventually consequent outcome measures will provide those PH-EMS systems with financial incentive to provide effective care [20,47]. Also, those PH-EMS systems will continually derive and improve their cost-effectiveness through ongoing evaluation and thus enable optimization of resources and improved care [20].

This review reported exploratory considerations regarding the collection and compilation of cost and effectiveness data for US Army training-garrison PH-EMS systems in accordance with best practices and informed by empirical research. It provides touchstones for further discussion among US Army leaders aimed at deriving and synthesizing a unified way of "costing" its training-garrison PH-EMS systems from existing data systems or adding data to those systems, and then cross-comparing effectiveness [15,17,20]. Medical care in the field is pivotal for force protection and as a force multiplier [53-55]. This means that deriving solid training-garrison PH-EMS costs as well as effectiveness data is also pivotal [1].

This circumstance has given rise to the need to identify US Army PH-EMS costs and to objectively show their value in terms of effectiveness, the next crucial steps for MEDCOM [4,10,51,52]. If the civilian sector is any gauge of the future, the ability to link costs to outcomes and quality will become central to the maintenance and development of US Army training-garrison PH-EMS. Of course, some of the necessary foundation likely exists but needs more attention. Nevertheless, the proposed systematic approach to deriving training-garrison PH-EMS costs is the second, yet critical, and yet-to-be traversed step in the process, with effectiveness measures to follow. Standardization according to the best practices and scientific research reported herein will yield reasonably accurate, comparable, and comprehensive cost-effectiveness measures [33,42].

The fact that MEDCOM—in particular the US Army Pacific—has undertaken this awesome task that can be applied to and benefit every training-garrison PH-EMS system demonstrates that continuous and exacting evaluation is the keystone for continuous quality improvement regarding those systems [15,27]. It also is an acknowledgment that uniformity of measurement and standard definitions enable comparisons across multiple and different systems [7,20,27]. The next challenge is to design and develop mechanisms to generate and efficiently transmit generalizable data [6,26].

Recommendations

Further vetting and iterative development of a universal training-garrison US Army PH-EMS cost-measurement instrument and outcome measurement approach are warranted, considering the considerations [1,8,20]. As outcomes are the numerator for the cost-effectiveness equation, once having established universal cost measures, the US Army should initiate the next logical step, that is, establishing universal performance outcome measures. Otherwise, if decisions are based solely on one factor in the absence of the other factors, the cost-effectiveness model and its inherent power will be missed [1,4,10,20,48]. Also, as this may be a first attempt to establish cost-effectiveness measures of military training-garrison PH-EMS, the process and work products must be thoroughly documented for the emergency military medicine discipline. Thus, they can serve as a road map to others facing similar challenges in the future. There is considerable potential to improve the quality and decrease the cost of emergency medicine in the PH-EMS field that also considers medical treatment from the patients' perspective [12]. Lower cost can only add value if it can be linked to acceptable outcomes [12,20]. And, of course, innovations in cost-effectiveness paradigms must be supported to create new models that disrupt and improve on current medical service paradigms [1].

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