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A TIME-DRIVEN, ACTIVITY-BASED COSTING ANALYSIS OF ALTERNATIVE ED TRANSPORT OPTIONS: TREATMENT-IN-PLACE AND TRANSPORT TO ALTERNATIVE DESTINATION

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ABSTRACT

Background: Reducing acute care utilization (i.e., Emergency Department (ED) visits and hospitalizations) is critical to reducing total costs of care. Offering alternatives to ED transport for many lower acuity Emergency Medical Services (EMS) calls is a promising pathway toward reducing acute care use. We used a Time-Driven Activity-Based Costing (TDABC) method to analyze the costs of implementing two Alternative Care Pathways (ACPs) for EMS treatment that seek to reduce ED transport: treatment-in-place and transport to an alternative destination in a midwestern ambulance service.

Methods: Publicly available costs per unit of time were determined for needed equipment and personnel resources, including a fully staffed and equipped ambulance, an emergency physician, an ED nurse, and an emergency dispatcher. Process maps were developed to estimate resource times for four treatment outcomes: usual care (transport to the ED), treat-in-place, transport to an alternative destination, and an unsuccessful ACP attempt with transport to the ED. Costs were estimated for each treatment outcome.

Results: The least expensive pathway was treat-in-place, costing $1,559 per intervention, followed by transport to an alternative destination ($2,151), and usual care ($3,677). Thus, each successful completion of treat-in-place could offset the costs associated with 6.5 attempted but failed ACP interventions (that culminated in ED transport). Each successful transport to an alternative destination offset 4.7 attempted but unsuccessful ACP interventions.

Conclusions: ACP implementation can result in substantial cost savings, though results will need to be validated in other settings.

COST ANALYSIS OF ALTERNATIVE ED TRANSPORT OPTIONS

Emergency department (ED) visits and hospitalizations are major drivers of total healthcare costs and incur substantial burden on patients and healthcare systems. Many lower acuity ED visits and hospitalizations can be avoided if patient care needs may be effectively met through alternative care pathways (North et al., 2023). However, multiple barriers to ED avoidance exist. Alternative treatment options have not been historically incorporated into emergency medical services (EMS) workflows, particularly in settings where care fragmentation precludes collaboration and partnership between EMS and other care providers. Additionally, ambulance services in the US have historically been reimbursed only when they transport a patient to an ED (Rubin, 2021). This reimbursement structure creates a financial incentive for EMS agencies to transport patients to the ED, even when lower acuity care options might be appropriate and effective (Harrison, 2017). As a result, EDs often serve as the default destination for a wide range of medical concerns, including conditions that can be safely, effectively, and even preferentially managed in non-emergency settings. This practice contributes to ED overcrowding and drives up costs for patients, health systems, and society at large (McKenna et al., 2019).

To address this inefficiency, some EMS systems are adopting innovative care models that allow paramedics to either treat patients at the scene (treat-in-place) or transport them to an alternative care site (transport to an alternative destination) (Neeki et al., 2016). Examples of alternative destinations include primary care clinics, urgent care centers, community-based mental health facilities, and alcohol and drug treatment centers. Treat-in-place models may involve paramedics or community paramedics working in collaboration with physicians or advanced practice providers, often using telehealth, to assess and manage patients on-site without transport. These alternatives, which often fall under the umbrella of mobile integrated health (MIH), aim to provide appropriate care in a more efficient and patient-centered manner, while reducing unnecessary ED utilization, preventing hospitalizations, and reducing total costs of care (Mechem et al., 2020). Indeed, several studies have shown that MIH alternative care pathway (ACP) programs can successfully reduce ED and hospital utilization (Thurman et al., 2021; Lurie et al., 2023; Adibhatla et al., 2024; Boland et al., 2023; Leyenaar et al., 2021). With greater interest in total cost of care models, it is important to assess the financial impacts of different ED substitutional efforts such as treat-in-place and transport to an alternative destination.

However, for alternative care pathway (ACP) programs such as treat-in-place and transport to alternative destination interventions to scale and succeed, health systems and EMS agencies must co-develop integrated and financially sustainable pathways that address not only the clinical appropriateness of ED alternatives but also the logistical, financial, and regulatory challenges that currently impede real-time decision-making and access to care. This study uses time-driven activity-based costing (TDABC) to estimate the actual resource costs of implementing treat-in-place and transport to alternative destination interventions within a large, advanced life support ambulance service in the upper Midwest. (Kaplan & Anderson, 2004; Kaplan & Porter, 2011). By analyzing the time and resource demands of treat-in-place and transport to alternative destination interventions, this study provides a transparent cost framework to inform decision-making by EMS leaders, health systems, and policymakers seeking to redesign emergency response systems for value-based care (Heaton et al., 2019). The project objective was to determine if adoption of EMS-based alternative care pathways, including treatment-in-place and transport to an alternative destination, can provide a cost-efficient approach to reducing acute care utilization and total cost of care.

METHODS

Setting

Mayo Clinic Ambulance service provides advanced and critical patient care and transport via ground transport (74 ambulances) and air ambulance (4 helicopters and 1 airplane) to a service area spanning 6,894 square miles of urban, suburban, and rural areas across southeast and north central Minnesota and northwest Wisconsin. The counties served have a total population of 1,473,366 based on the 2020 American Community Survey (United States Census Bureau, 2022). Mayo Clinic Ambulance service responds to approximately 100,000 requests for service annually, including 75,000 calls through the 911 system. Although first responders from police and/or fire departments also respond to a subset of 911 calls in this catchment area, their associated costs were excluded from analysis because they are not impacted by ACP implementation.

Medical direction to Mayo Clinic Ambulance is provided by physicians affiliated with Mayo Clinic, an integrated health care delivery system serving local, regional, national, and international patients with a clinical and administrative hub in Rochester, Minnesota. Mayo Clinic Rochester is a tertiary referral center that includes an ED (equipped with telehealth capabilities), two hospital campuses, ambulatory specialty referral practices, and comprehensive primary care practices that specifically care for residents of Olmsted County and the surrounding areas. Olmsted Medical Center is the only other health system in the county and includes ambulatory clinics, an ED, and hospital. Mayo Clinic Health System (MCHS) is an integrated network of community-based clinics, hospitals, and health care facilities that provide both primary and specialty care to the residents of the other communities (outside of Olmsted County) served by Mayo Clinic Ambulance service. There is a standalone Veterans Health Administration outpatient facility in Rochester as well as one urgent care center not affiliated (Centers for Medicare & Medicaid Services, 2025) with either health system. Mayo Clinic Ambulance is the sole EMS provider in its service areas.

The ACP programs were initially implemented in two primary service areas under the Centers for Medicare & Medicaid Services (CMS) pilot Emergency Triage, Treatment and Transport (ET3) program: Rochester and Mankato, Minnesota. In Mankato, MCHS operates a hospital with an ED, as well as urgent care, ambulatory specialty, and primary care clinics. Implementation of ACP programs in Rochester began January 1, 2021, and in Mankato on February 1, 2022, with telehealth support provided by emergency medicine physicians at Mayo Clinic Rochester. Data for this study were collected between January 1, 2021, and December 31, 2021.

Ethics Review

This retrospective study was deemed exempt by the Mayo Clinic Institutional Review Board.

Alternative Care Pathway Programs

Mayo Clinic Ambulance ACP programs included two treatment options, treat-in-place and transport to an alternative destination, and four potential treatment outcomes: successful treat-in-place, successful transport to an alternative destination, attempted ACP but unable to complete, and usual care (i.e., ACP not attempted). The service had telehealth access to Mayo Clinic emergency medicine physicians 24 hours a day, 7 days a week. The Nationally Registered Paramedics (NRP) and Emergency Medical Technicians (EMTs) registered by the National Registry of EMTs were empowered to offer telehealth services to any patient 18 years and older with decision-making capacity or with a medical decision-maker present based on their clinical expertise. The decision to proceed with an ACP was made collaboratively by the on-scene EMS personnel, the Mayo Clinic emergency medicine physician, and the patient and/or caregiver.

Alternative destinations included two primary care clinics, three urgent care clinics, a 16-bed crisis behavioral health hospital, and a 22-bed health care facility with acute detoxification services. Only the crisis behavioral health hospital and acute detoxification service provided support 24 hours a day, 7 days a week.

Analysis

TDABC, as described by Kaplan and Porter (Kaplan & Porter, 2011), was used to quantify the hospital and ambulance service's costs for providing all care services to the patient. TDABC combines process mapping and activity-based costing to capture the full scope of personnel time and other resource utilization involved in delivering these interventions. Data were analyzed using Microsoft Excel. We followed the STROBE guidelines (Strengthening the Reporting of Observational Studies in Epidemiology) to report study findings (von Elm et al., 2007).

We estimated activity times from a combination of observations, interviews, and data time stamps generated by the Mayo Clinic Ambulance dispatch system. Total direct costs were calculated by multiplying each resource's (personnel and equipment) capacity cost rate (described below) by the minutes that the resource was used during the intervention. Costs were summed across all resource types to obtain the cost over the full response cycle (Salary.com, 2023).

Costs used in the TDABC analysis were gathered from publicly available websites, articles, and databases. The website Salary.com (Salary.com, 2023) provides distributions of salaries for positions based on a specified location. For this analysis, we reviewed data including benefits from Salary.com for the hub location (Rochester, Minnesota) and used the median salary (cost/hour) for each position in TDABC calculations during the year of program implementation: emergency dispatcher (Salary.com, 2023), $30; emergency department nurse (Salary.com, 2023), $72; and emergency department physician (Salary.com, 2023), $195.

The cost of an ambulance includes its operating expense, equipment, depreciation, and personnel staffing. Ambulance costs were calculated using published annual budgetary expenditures and ambulance run numbers for a midwestern city (Woodbury, Minnesota) (City of Woodbury, 2022). The average cost per transport was $703, including all budgeted costs divided by the total number of ambulance transports (defined as calls in which a patient was taken from the scene to a destination, as distinct from total ambulance runs which include all responses). Woodbury, Minnesota budgetary data were used because comparable publicly available itemized ambulance budget data were not available for Mayo Clinic Ambulance at the time of this analysis; this represents a limitation, as noted below. Using Mayo Clinic Ambulance data, a typical call takes an ambulance out of service for 67 minutes, leading to a per-minute cost of $11. Although miles traveled per call varies, an estimated average transport distance of 10 miles was used to simplify calculations. Personnel per-minute costs reflect time-on-task for paramedics (time on call) and, for ED physicians and nurses, time per shift regardless of caseload, consistent with standard TDABC methodology.

Care costs for EDs were based on national averages of ED encounters regarded by the UnitedHealth Group to be treatable at a lower cost care location, such as a primary or urgent care center (UnitedHealth Group, 2019). These encounters included 10 common conditions that are often treated in the ED but can be treated equally well in primary or urgent care settings: bronchitis, cough, dizziness, flu, headache, low back pain, nausea, sore throat, strep throat, and upper respiratory infections. Urgent care costs were based on published UnitedHealthcare data for average costs when patients were treated at a UnitedHealthcare owned and contracted service provider (UnitedHealthcare, 2023): ED treatment after transport (UnitedHealth Group, 2019), $2,032; urgent care treatment after transport (UnitedHealthcare, 2023), $180.

RESULTS

Resource Time and Costs

The Mayo Clinic ACP programs had potential treatment outcomes for all emergency 911 calls: 1) respond to the scene and transport the patient to the ED without implementing a substitution program (usual care), 2) implement treat-in-place, 3) implement transport to alternative destination, and 4) attempt to implement an ACP but find it necessary to transport the patient to the ED. The fourth outcome, attempted but unsuccessful ACP with ultimate ED transport, accounted for the added cost of the telehealth consultation plus the standard transport costs; this pathway was included in cost modeling to enable calculation of how many failed attempts could be offset by each successful ACP.

Multiple types of practitioners participated in at least one of the four treatment outcomes. Emergency medical dispatchers received 911 calls, dispatched appropriate ambulance service resources, and tracked these resources throughout the response. NRPs and EMTs traveled to the scene in ambulances, assessed the patient, provided treatment, conducted telehealth interactions at their discretion, and treated the patient in place or transported the patient to the ED or to an alternative treatment site. Ambulance costs were calculated based on a 2-paramedic crew because all Mayo Clinic ambulances have at least one NRP, and ambulances are dispatched equivalently whether they are staffed by two paramedics or by one paramedic and one EMT. A registered nurse working in the Admissions and Transfer Center received all requests for interventions and coordinated connections with the on-duty ED telehealth physician, who then connected via an audiovisual telehealth link to the paramedic in the field. Patients who were transported to the ED were evaluated and treated by ED staff including physicians, advanced practice providers (nurse practitioners or physician assistants), and nurses.

Time spent on patient care tasks was estimated in minutes for each personnel type. These cost and time estimates were then compiled into a swimlane process map for each of the four treatment outcomes, with urgent care designated as the destination for the transport to alternative destination pathway option (Figures 1 and 2).

Using the process maps, costs were estimated for each of the four treatment outcomes (Table 1). A successful treat-in-place activation cost 28% of the traditional response and transport ambulance intervention. A patient transported to a primary or urgent care center cost 50% compared to a traditional response with ED transport. If the patient was transported to the ED after an attempted ACP intervention, the incremental cost for implementing treat-in-place or transport to an alternative destination was 17%. Cost savings from treat-in-place were equivalent to the additional costs of 6.5 attempted but failed ACP interventions or 4.3 standard ED transports, while transport to alternative destination savings were equivalent to 4.7 attempted but failed ACP interventions or 3.0 ED transports.

	Respond and Transport to ED	Treatment-in-Place	Transport to Urgent care	Transport to ED
Dispatch and arrive at scene	$132	$132	$132	$132
Conduct intervention	N/A	$467	$467	$467
Ambulance transport	$605	$165	$605	$605
Treat in ED	$2,032	N/A	N/A	$2,032
Treat in urgent care	N/A	N/A	$180	N/A
Total	$2,769	$ 764	$1,384	$3,236

Table 1. Cost associated with each treatment intervention.

DISCUSSION

We examined the costs associated with two alternative care pathway strategies: treatment in place (treat-in-place) and transporting patients to an alternative destination. The results demonstrate that cost savings from treat-in-place offset the additional costs of 6.5 attempted but failed ACP interventions or 4.3 standard ED transports, while transport to an alternative destination offset the cost of 4.7 attempted but failed ACP interventions or 3.0 ED transports. Importantly, while both ACP models show net savings, these savings accrue differently across stakeholders.

These findings build on a growing body of literature examining prehospital alternatives to default ED transport for low-acuity patients (Gingold et al., 2022). Community paramedicine and MIH programs have demonstrated that expanding the role of EMS to include on-scene assessment, triage, and care coordination can reduce avoidable ED visits and hospital admissions (Thurman et al., 2021; Lurie et al., 2023; Adibhatla et al., 2024; Boland et al., 2023; Leyenaar et al., 2021). These programs often integrate EMS with primary care, behavioral health, or social services to address patient needs more holistically and potentially prevent unnecessary use of high-cost emergency care. For example, interventions targeting frequent 911 users through in-home evaluations and longitudinal follow-up have shown reductions in both ED utilization and total medical spending (Korczak et al., 2019). However, scalability and impact of these programs have been limited by misaligned reimbursement models, inconsistent telehealth integration, lack of interoperability between EMS and outpatient health systems, and variable support from regional healthcare partners. Beyond clinical integration, EMS clinicians should also be integrated into the social services ecosystem, equipped with awareness of available community resources and able to connect patients with non-healthcare supports such as housing assistance, food security programs, and transportation services—to more comprehensively address the social determinants of health that often underlie 911 utilization.

However, most prior work has focused almost exclusively on quantifying utilization outcomes such as ED use and hospital readmissions without examining the underlying cost structures that drive those changes. Even when costs were considered, analyses have been reimbursement rather than cost-based and payer-specific, often focused on Medicare savings or return-on-investment for a single stakeholder (Munjal et al., 2019; Blodgett et al., 2021). Our analysis therefore adds a novel and important dimension by applying a TDABC framework to directly measure the real costs of ED substitution strategies, namely, treat-in-place and transport to alternative destination. This approach enabled a more granular understanding of the tradeoffs at the system level, revealing that cost savings from treat-in-place and transport to alternative destination interventions can offset multiple standard ED transports, but that the distribution of savings and costs varies significantly across stakeholders (e.g., ambulance services, hospitals, and patients).

For ambulance services, the cost burden often includes dispatch, on-scene care, coordination with clinicians (such as via telehealth), transport (if applicable), and post-call activities like documentation and restocking. Importantly, ambulance services often do not typically bear the cost of physician consultations or downstream ED care. Therefore, if reimbursement is not aligned with the increased time and complexity involved in treat-in-place or transport to an alternative destination, there may be disincentives to participation in ACPs. This highlights the need for cost-sharing models or new reimbursement structures to make ACP financially viable when cost savings are asymmetrically distributed between the prehospital and in-hospital care. Additionally, costs may differ substantially in settings where ED services are provided through contracted, for-profit arrangements rather than integrated health systems. In these contexts, the financial incentive structure may further complicate ACP adoption, as contracted EDs may have less flexibility to absorb reduced volume and may lack the organizational alignment needed to support care coordination with EMS. Health systems benefit from ACPs not only through cost savings but also by preserving ED and hospital capacity for higher-acuity patients. During periods of high demand or in the setting of ED overcrowding and boarding, alternative transport and treat-in-place strategies allow systems to redirect low-acuity cases away from crowded EDs, supporting more efficient resource use.

In addition to conserving finite resources, the ACP programs have subtly reframed the role of prehospital practitioners by increased treat-in-place and use of alternative destinations. When skilled paramedics and EMTs solely transport patients to the ED, they are often working below their capabilities and not using their extensive training and experience in providing medical care (Torres & McCoy, 2022). ACP programs therefore mobilize the capabilities of prehospital practitioners, allowing them to use their medical judgment to triage patients according to the need for ED-level care, to identify appropriate treat-in-place and/or transport to alternative destination options, and to counsel patients and caregivers about health status. Other MIH programs, such as community paramedicine, can become a means for patients to access a more flexible system for providing unscheduled health care.

Patients stand to benefit from the reduced financial burden and improved care experience when treated through an ACP. Treating patients at home or redirecting them to primary care avoids the high costs associated with ED visits, though these costs may not be paid directly by patients depending on their insurance status. Critically, the role of the patient's primary care provider (PCP) is an important and underexplored dimension of ACP integration. Some patients who access 911 services have an established PCP, and effective ACP programs must coordinate with PCPs to ensure appropriate follow-up, continuity of medication management, and longitudinal care planning after an ACP encounter. Without this coordination, the gains of an ED diversion may be offset by fragmented downstream care. Future ACP program designs should explicitly address how EMS can communicate encounter details to PCPs and facilitate timely follow-up appointments, particularly for patients with complex chronic conditions. Beyond cost-saving, successful ACP programs can support continuity of care and improve the patient's care experience. Notably, in the absence of public education about these options, some patients may be hesitant to accept non-ED care after calling 911. This would require EMS crews to provide real-time education under time pressure when an ACP does not match the patient's expectations for EMS care. The patient and caregiver experiences within the treat-in-place and transport to alternative destination models should be evaluated in future work, focusing on perceptions of met and unmet needs, responsiveness of the health care system to concerns, ability to receive care in the required timeframe, and impact on continuity of care.

Importantly, our ACP program and its evaluation are payer agnostic, demonstrating cost savings despite providing non-reimbursed care. The ET3 Model, implemented in 2021 as a voluntary five-year CMS payment model, offered the potential for ACP program reimbursement for Medicare beneficiaries, and was an important advancement toward efficient and sustainable pre-hospital care. Unfortunately, it ended in 2023, two years ahead of schedule, due to fewer than anticipated interventions and lack of data on cost-savings (Centers for Medicare & Medicaid Services, 2025; JEMS Staff, 2023). Our data underscore the potential efficiencies and cost-savings from ACP programs, providing much needed evidence in support of ET3 and other alternative payment models to reduce low value acute care use while meeting patient care needs in a financially sustainable way for all stakeholders.

ACP models face technological, organizational culture, and broader societal barriers beyond financial efficiency. Implementing ACP models requires EMS agencies to move beyond traditional transport-based workflows and instead adopt a more integrated, patient-centered approach to unscheduled care. This shift demands new clinical protocols, staff training, and technology infrastructure—such as telehealth capabilities, consistent access to internet (a major challenge in rural areas), point-of-care diagnostics, and treatment supplies—to make on-scene decision-making and care delivery viable. Operationally, these models also often require longer scene times, collaboration with physicians or advanced practice providers, and coordination with alternative care sites for follow-up. Yet, EMS agencies have historically emphasized the importance of minimizing time on scene and expediting calls to prepare for the next emergency, (Ito et al., 2022) necessitating a culture shift and realignment of EMS quality measures. Notably, our data show that successful interventions resulting in treat-in-place required less total time on task than transporting patients to the ED.

One of the biggest barriers to effective ACP programs is the lack of streamlined reliable processes that allow EMS to meet patients' clinical needs safely and effectively within the narrow timeframes required once 911 is activated. While EMS systems are well equipped for rapid response, they are not traditionally designed to navigate the complexities of care navigation, resource coordination, and longitudinal follow-up needed to replace a subset of ED visits (Piasecki et al., 2023). Without real-time access to alternative care sites, appointment availability, telemedicine or other physician support, or shared patient health records, EMS personnel may default to ED transport—even when it may not be clinically necessary.

LIMITATIONS

Our study was conducted within an integrated delivery system where EMS, EDs, and primary care operate under a single organization. This may limit generalizability, especially considering the heterogeneity of EMS system designs. Furthermore, costs for specific resources discussed can vary regionally and across healthcare systems, as does the availability and accessibility of alternative treatment destinations and care pathways. Our study focused on costs rather than reimbursement, which will be a critical factor in real-world adoption. Costs related to program startup, training, and infrastructure (e.g., telehealth connectivity) were also not included, as they were part of usual care processes in our healthcare system prior to ACP implementation. The setting is representative of the U.S. upper Midwest but does not generalize to large urban or highly rural areas, and has a limited number of health systems, which may affect applicability to broader populations. Additionally, Mayo Clinic Ambulance differs from many U.S. EMS systems in the absence of fragmented agency structures, the lack of overlapping fire department EMS responsibility, and the presence of an integrated telehealth system, and that these features may limit direct generalizability to other settings. It should also be noted that additional real-world outcomes exist beyond these four modeled scenarios, including patient refusal of care and calls where no care is required; these were not included in the cost modeling as they do not involve ACP-related resource utilization.

CONCLUSIONS

This study demonstrates the economic viability of treating select 911 patients outside the ED via alternative care pathways such as treat-in-place and transport to an alternative destination. These approaches offer cost savings across the health system while potentially improving patient outcomes and experience. By focusing on actual resource utilization rather than charges or reimbursements, our study helps fill a critical gap in the literature and provides a stronger foundation for policymakers and health system leaders considering scalable alternatives to traditional ED-centric models of acute care. It also underscores the importance of aligning financial incentives across the continuum of care to support the viability of prehospital substitution models. Future research should focus on broader implementation in diverse systems, patient education strategies, and the development of sustainable funding models. Additionally, further study is needed to understand long-term outcomes and the effect of these interventions on ED capacity, staff satisfaction, and continuity of care.

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