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Systematic Review of Community Paramedicine and EMS Mobile Integrated Health Care Interventions in the United States

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Abstract

Emergency medical services (EMS) in the United States are frequently used for nonurgent medical needs. Use of 911 and the emergency department (ED) for primary care-treatable conditions is expensive, inefficient, and undesirable for patients and providers. The objective is to describe the outcomes from community paramedicine (CP) and mobile integrated health care (MIH) interventions related to the Quadruple Aim. Three electronic databases were searched for peer-review literature on CP-MIH interventions in the United States. Eight articles reporting data from 7 interventions were included. Four studies reported high levels of patient satisfaction, and only 3 measured health outcomes. No study reported provider satisfaction measures. Reducing ED and inpatient utilization were the most common study outcomes, and programs generally were successful at reducing utilization. With reduced utilization, costs should be reduced; however, most studies did not quantify savings. Future studies should conduct economic analyses that not only compare the intervention to traditional EMS services, but also measure potential cost savings to the EMS agencies running the intervention. Most cost savings from reduced utilization will be to insurance companies and patients, but more efficient use of EMS agencies' resources could lead to cost savings that could offset intervention implementation costs. The other 3 aims (health, patient satisfaction, and provider satisfaction) were reported inconsistently in these studies and need to be addressed further. Given the small number of heterogeneous studies reviewed, the potential for CP-MIH interventions to comprehensively address the Quadruple Aim is still unclear, and more research on these programs is needed.

Keywords: community paramedicine, mobile integrated health care, systematic review, Quadruple Aim

Introduction

Reducing the use of emergency departments (EDs) for nonurgent medical needs is a priority of the Centers for Medicare & Medicaid Services.[1] Inappropriate ED use is responsible for an estimated $38 billion in health care spending annually[2] and the average ED visit is 4 times more expensive than a physician office visit ($1045 vs $248).[3] Approximately 16% of patients treated in the ED arrive by ambulance from 911 responses and 16% of Medicare ED transports are estimated to be treatable outside the ED.[4] Given that there is a great opportunity to realize cost savings from diverting patients from ambulance transport and ED care when medically appropriate, emergency medical services (EMS) agencies are recognized as a key agent in a health care system that desperately needs reform.[4]

It is difficult to know the true burden of low-acuity medical calls seen by EMS agencies and EDs because there is no consensus on the definitions of avoidable or non-emergent ED visits. A study using 2005–2011 National Hospital Ambulatory Medical Care Surveys data found that 3.3% of all ED visits met the researchers' purposefully

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conservative definition of an avoidable visit: a discharged ED visit not requiring any diagnostic tests, procedures, or medications (over-the-counter and prescription medications administered or prescribed).[5] Per the study's data, 15% of all ED visits required no administered or prescribed medications, 30% required no diagnostic or screening services, and 53% required no procedures. It is easy to see why others have suggested that the percentage of all ED visits that are avoidable or nonurgent is much higher, with estimates ranging from 8%–62% of all ED visits.[6]

There are multiple issues at various levels that need to be addressed to reduce inappropriate 911 and ED use. Many insurance plans require that ambulances transport patients to hospitals in order to be reimbursed, which incentivizes EMS to transport all patients, regardless of their medical needs. The Emergency Medical Treatment and Labor Act (EMTALA) requires all Medicare participating hospitals to screen every patient who presents to the ED. If the medical issue is an emergency, the ED must treat and stabilize the patient without consideration of the patient's ability to pay for services. Some research has found that patient awareness of EMTALA is associated with greater ED use[7] and that patients prefer the ED to their primary care provider because it is more convenient[8,9] and does not require payment at the time of care.[10] In general, patients use the ED because of the perceived seriousness of their illness, because their doctor is not available, or because of a lack of access to other providers.[11] Compared to nonurgent or low-acuity (ie, Emergency Severity Index of 4 or 5) patients who arrive at the ED independently, low-acuity patients arriving by ambulance have higher misperceptions of their illness severity, may not understand the scarcity of EMS resources, and more often lack private transportation.[12]

Community paramedicine (CP) and mobile integrated health (MIH) programs are innovative models for using EMS agencies to provide care to low-acuity patients outside of the ED. CP-MIH programs should be tailored to the population they serve and driven by a local needs assessment/gap analysis of services to maximize their potential for success.[13] EMS agencies with CP programs allow paramedics and emergency medical technicians to operate in expanded roles outside their normal scope of practice to provide routine health care services.[14] MIH programs are an expanded version of CP programs that usually incorporate primary care teams and other community-based providers and social service agencies to provide comprehensive care for both disease-specific programs and general catch-all programs.[15] EMS agencies are perfect settings for this type of intervention because they are available almost everywhere, operate 24 hours/7 days, and already own vehicles equipped to provide basic medical care.

Although previous research looking at various types of ED diversion programs has focused on cost savings, there are potentially other significant benefits to reducing use of 911 and ED visits for low-acuity medical patients. Responding to high volumes of low-acuity medical calls can put EMS workers and all citizens on the road in potential unwarranted danger when emergency responders race to respond to low-acuity 911 calls, desensitizes workers to the point where they may respond slower to true emergencies, and decreases EMS morale because workers may feel they are doing work outside of their true purpose of saving lives and property.[16] The average wait time in EDs for patients presenting with nonurgent conditions is 54 minutes,[17] and crowded EDs stress staff, which diminishes care quality.[2] By nature, EDs are designed for medical emergencies and are not intended to provide patient-centered, continuous care for low-acuity patients.[2] Therefore, it is vital that any attempt to quantify the benefits of CP-MIH interventions capture outcomes beyond cost savings. The Quadruple Aim, which focuses on controlling health care costs while improving population health and both provider and patient satisfaction, is an appropriate framework to use to evaluate CP-MIH interventions.

Purpose

The purpose of this systematic review is to determine the effectiveness of CP-MIH interventions at addressing the Quadruple Aim. Given the emerging nature of both the Quadruple Aim and CP-MIH interventions in the United States, this review fills a gap in the literature by reviewing recently published work about these EMS-led interventions. Previous related systematic reviews have included interventions outside of the United States[18,19]; focused on any outcomes from expanded paramedic practice, but do not include publications beyond 2011[18]; or included all types of ED visit reduction programs, but without a focus on or inclusion of CP-MIH publications in their analysis.[19,20] This review is intended to inform policy makers, hospitals, EMS agencies, and their health care system partners about the current state of the evidence supporting CP-MIH interventions in the United States.

Methods

Data sources and search strategy

The study team conducted a systematic review of the literature to identify evidence regarding the ability of expanded paramedic practices (ie, CP-MIH programs) to address the Quadruple Aim. The process used followed PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines and the formal review protocol was registered with PROSPERO (registration number CRD42018084408).[21] PubMed, CINAHL, and Scopus databases were searched in January 2018 for all relevant articles. The search strategy included 2 main search terms: ''community paramedicine'' or ''mobile integrated health/health care/healthcare.'' Because this is a new field of practice and it was expected that there would be a limited number of published manuscripts on these topics, no secondary search terms were used to further screen articles at this point. No date restriction was specified, but all search results were articles published after 2000, which is expected given the recency of this topic. Additional articles were identified by hand-searching bibliographies of all included articles and some excluded articles (ie, related systematic reviews). The study team did not consider gray literature for this review because it was judged to be of lower quality according to the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) criteria.[22]

Data selection and extraction

All research articles that measured a Quadruple Aim-related outcome from a CP or an EMS MIH intervention in

the United States were included. Two investigators (JT, ML) reviewed all abstracts independently. Because of the small number of publications pulled during the search process, the title and abstract review steps were combined into 1 review step. Commentaries, opinion articles, letters to the editor, and any gray literature were excluded. Abstracts labeled as ''include'' or ''undecided'' by at least 1 investigator were reviewed by a third investigator (AG) for a decision about their inclusion. The first 2 investigators completed independent reviews of included abstracts for later full article review. Disagreements at this stage were resolved by the third investigator. The first 2 investigators then completed independent reviews of the full articles with the third investigator resolving disagreements on article inclusion. The Rayyann web application (Rayyan QCRI, Doha, Qatar) was used to conduct the title/abstract and article blinded screenings.[23]

After finalizing the articles to include in the qualitative review, 2 investigators (JT, AG) abstracted the following information from each article: study design, target population, geographic location, intervention description, and outcome data related to the Quadruple Aim. Two investigators (ML, AG) separately reviewed each article using the GRADE criteria and assigned a quality score. Any disagreements on data abstraction or quality score were resolved through consensus between the 2 reviewers.

Results

Search yield

Figure 1 illustrates the review process, from preliminary database searches to identification of the articles comprising the final review. Initial searches of the scientific literature returned 250 individual results with mention of CP or MIH interventions. After removing duplicates and reading the abstracts and publication information of each item, the study team thoroughly assessed 20 remaining research articles for inclusion based on EMS involvement in the intervention and measurement of a Quadruple Aim outcome. Eight of these articles were found to meet full review criteria for analysis. Two of these articles report on the same intervention, but include different outcomes so both articles are included.[24,25]

Study design and overall quality

The quality of 8 studies of EMS CP-MIH interventions were assessed using GRADE criteria. Following GRADE guidelines, all studies received an initial quality score of ''low'' because they were observational studies.[22] Four of the 8 studies received scores of ''moderate quality'' and 4 received scores of ''low quality'' (Table 1). Reasons for upgrading a score to ''moderate quality'' included having a large sample size with strong attempts to control differences between intervention and control groups; use of precise, reliable, and valid measurements of outcome variables; the authors' recognition, discussion, and attempts to eliminate bias within their study; and/or a strong magnitude of treatment effect.

Five programs included some form of comparison control group[24–29] and 2 programs lacking a control group compared each individual's outcomes in the intervention group before and after program implementation.[30,31] Notably, intervention and control groups often were selected retrospectively, and none of the studies reported random assignment of groups. Among the studies using control groups, 4 programs employed matched case designs in which control participants resembled intervention participants on salient characteristics such as demographics, geographical location, and primary health complaint.[24–27,29] Abrashkin et al's study, which used a non-matched random control group that received the traditional EMS response for a heart failure admission, reported no statistical differences with regard to age, sex, or race between study groups.[28] Across all studies, intervention cohort sizes ranged from 43 individuals[29] to 5570 individuals[24,25] with similar or identical control group sizes. The sophistication of matching in the case-control designs varied between the programs, and is an important consideration when assessing the strength of their outcomes.

The simpler case-control designs matched groups on fewer variables or used a random control sample. The program described by Langabeer et al matched on patient age, sex, approximate dates of treatment, and chief complaint, but does not report if there are statistical differences between the groups.[24,25] Bennett et al used age, sex, race, and insurance type in a matching algorithm, and reported that the control group did differ to the comparison group because of the limited number of control patients without insurance.[26] McTernan et al states that the intervention group was matched to a random like group of patients, but does not provide detail on the matching characteristics.[29]

The Roeper at al study analyzed 2 years of preintervention claims data using proprietary software to identify individuals at high risk for potentially avoidable ED and inpatient costs. This intervention then targeted individuals in the 2 highest risk groups for inclusion into their program. Individuals who chose not to participate were put in a control group pool, and propensity score matching selected controls who were statistically equivalent to the intervention cohort on the following dimensions: hierarchical condition categories risk score, age, probability of an ED visit, probability of an inpatient admission, sex, number of chronic conditions, congestive heart failure, diabetes, dementia, chronic kidney disease, coronary artery disease, and cerebrovascular accident/transient ischemic attack.[27]

Studies characterized participants and assessed outcomes by collecting patient data from various sources. Six programs analyzed patient medical records from hospitals and/or emergency service agencies affiliated with the project.[24–26,28–31] The remaining program relied on claims data from an insurance organization.[27] Four programs also reported administering validated survey instruments to access participants' self-reported health information.[26,27,29,30] Four programs examined patient satisfaction with the intervention services. Of these, 3 programs administered various customized survey forms.[26–28] One program assessed participant experience via a follow-up phone call from caseworkers affiliated with the city.[24]

Intervention location and patient population

The location and target population of the interventions reviewed vary considerably as shown in Table 2. Only 1 is located in a rural location[26] and 3 of the articles describe

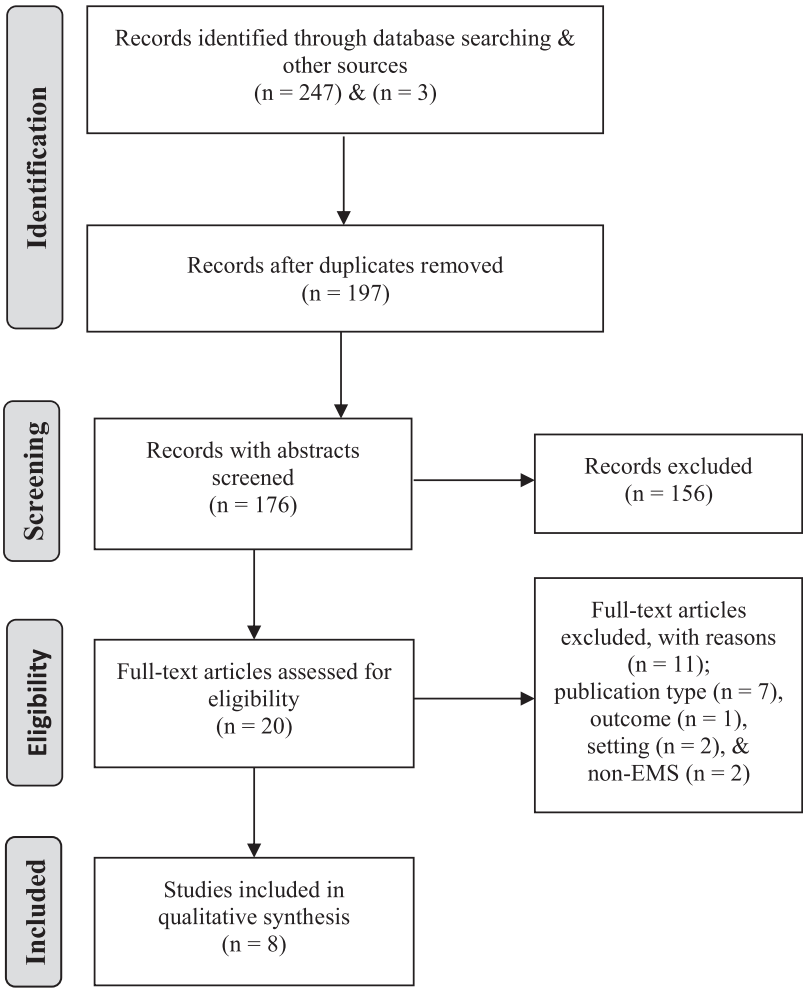

FIG. 1. Review process flowchart. EMS, emergency medical services.

interventions in Texas.[24,25,30] Most interventions target populations based on the presence of a chronic disease or frequent use of ED services; only the Langabeer et al articles described an intervention that intercepted any type of low-acuity patient who called 911 for EMS.[24,25] Patients treated by this program typically expressed acute primary care complaints, such as abdominal pain or a nonserious injury or wound. All studies excluded patients who were mentally incapacitated or unable to communicate with providers.

The remaining 6 programs located and recruited prospective participants during their stay in a hospital, or by their membership in an insurance plan or community resource group.[26–31] Common recruitment criteria included frequent ED visits (eg, ≥4 ED visits during a recent 1-year period), having at least 1 chronic illness, extensive medical claims records, and high-risk status for continued service use as designated by computerized algorithms taking into account multiple demographic and health factors. These interventions saw patients with cardiac and pulmonary conditions, such as acute myocardial infarction, heart failure, pneumonia, and chronic obstructive pulmonary disease (COPD) – all diagnoses that are included in the Hospital Readmissions Reduction Program.[32]

Patients treated by these programs typically suffered from 1 or more chronic illnesses, which often were poorly managed. The most frequent illnesses reported across studies included cardiovascular disease, pulmonary disease, diabetes, asthma, and dementia. For each article, the primary health conditions/complaints are listed by prevalence in the intervention target population, when reported by the study authors. The health conditions and health complaints targeted by these interventions were primarily physical health in nature and not behavioral conditions. However, several studies also remarked on the frequency of psychosocial difficulties among participants. One program observed that neurological and psychiatric complaints were the second most common problem encountered by the community paramedics (though this category included altered mental status as well as stroke and seizure symptoms).[28] Three programs included some formal screening of mental health issues as part of their intervention.[26,29,30] One of these studies with a sample of 68 patients found that 2 individuals primarily presented with depression while 2 others presented with post-traumatic stress disorder. Most of the sample (39 patients) reportedly displayed a combination of health issues, but the authors did not comment on how many of these individuals displayed a problem with mental

Table 1. Study Design and Overall Quality Assessment

Citation	*Design*	*Sample size*	*Quality*
Langabeer et al (2016)[24], (2017)[25]	Retrospective case-control observational study with intervention cohort compared to control group of traditional EMS patients	Intervention (n = 5570) and control (n = 5570)	Moderate
Roeper et al (2017)[27]	Retrospective observational study with intervention cohort compared to propensity score-matched control group	Intervention (n = 1074) and control (n = 1241)	Moderate
Abrashkin et al (2016)[28]	Prospective observational study of an intervention cohort compared to individuals receiving traditional EMS services	Intervention (n = 404) and control (n = 369)	Low
Nejtek et al (2017)[30]	Retrospective observational study of pre- and post-implementation data from an intervention cohort	Intervention (n = 64)	Low
McTernan et al (2016)[29]	Retrospective observational study with intervention cohort compared to a randomly selected control group	Intervention (n = 43) and control (n = 48)	Low
Siddle et al (2017)[31]	Retrospective observational study of pre- and post-implementation data from an intervention cohort	Intervention (n = 203)	Low
Bennett et al (2018)[26]	Retrospective observational study with intervention cohort compared to matched control group	Intervention (n = 68) and control (n = 125)	Moderate

EMS, emergency medical services.

Table 2. Location and Target Population of Community Paramedicine-Mobile Intergrated Health Care Interventions

Citation	*Geographic location*	*Target population*	*Primary health conditions/complaints managed*
Langabeer et al (2016)[24], (2017)[25],	Houston, Texas (urban)	911 callers who were determined to be low acuity by an EMS assessment (stable vital signs; no acute, urgent, or life-threatening conditions)	Abdominal pain, injuries, generalized sickness, pain
Roeper et al (2017)[27]	Florida; statewide, but most patients resided in urban areas	High-risk or chronically ill Medicare Advantage enrollees; high risk determined by claims data and risk prediction algorithms	Heart failure, COPD, diabetes, dementia, chronic kidney disease, coronary artery disease, cerebrovascular accident/transient ischemic attack
Abrashkin et al (2016)[28]	Queens and Long Island, New York (suburban–urban)	Enrollees in an Advanced Illness Management Program	Pulmonary complaints, neurological and psychiatric problems, generalized malaise or weakness, cardiac concerns
Nejtek et al (2017)[30]	North Texas metroplex community (urban)	Patients transported to ED ≥4 times within a 1-year period for treatment of a nonemergent or emergent/primary care-treatable condition	Respiratory, cardiovascular, endocrine, neurological, nephrological, pain, psychiatric
McTernan et al (2016)[29]	Elizabeth, New Jersey (urban)	Patients previously hospitalized with heart failure	Heart failure
Siddle et al (2017)[31]	Indianapolis, Indiana (urban)	Hospitalized patients with chronic health conditions	COPD, pneumonia, myocardial infarction, heart failure
Bennett et al (2018)[26]	Abbeville, South Carolina (rural)	Frequent users of ED (≥2 times within a 1-month period) and ≥1 chronic disease	Hypertension, diabetes, COPD, asthma, depression, post-traumatic stress disorder, blindness

COPD, chronic obstructive pulmonary disease; ED, emergency department; EMS, emergency medical services.

Table 3. Summary of the Interventions' Quadruple Aim Outcomes*

		Utilization and cost						
Citation	*Health*	*ED use*	*ED costs*	*Inpatient use*	*Length of stay*	*Inpatient costs*	*EMS costs*	*Patient satisfaction*
Langabeer et al (2016)[24]	–	Reduced	–	–	–	–	–	No difference
Langabeer et al (2017)[25]	–	–	Reduced	–	–	–	Reduced	–
Roeper et al (2017)[27]	PAM: improved	Reduced	Reduced	Reduced	–	Reduced	–	Yes
Abrashkin et al (2016)[28]	–	Reduced	–	Increased	No difference	–	–	Yes
Nejtek et al (2017)[30]	Improved	Reduced	–	Reduced	–	–	–	–
McTernan et al (2016)[29]	–	–	–	Reduced	–	–	–	–
Siddle et al (2017)[31]	–	No difference	–	Reduced	Reduced	–	–	–
Bennett et al (2018)[26]	Improved	Reduced	Reduced	Reduced	Reduced	Reduced	–	Yes

*Provider satisfaction was not an outcome measured or reported formally in any study.
ED, emergency department; EMS, emergency medical services; PAM, patient activation measure.

health.[26] Another program administered pre- and post-intervention EQ-5D-5Ls (EuroQol 5-dimension, 5-level questionnaires) to participants, assessing the severity of combined depressive and anxiety symptoms. Among 64 patients, 43 endorsed moderate-to-severe depression or anxiety. Of these, 40% experienced symptom improvement post intervention.[30] Finally, the third study administered the Patient Health Questionnaire-9 to participants during the intervention visit, finding that more than half of the sample experienced some degree of elevated depression.[29]

The variable features of these interventions, including their design and outcomes measured, are summarized by major themes in the following sections and are described in detail in Supplementary Table S1. A summary of the significant findings related to the Quadruple Aim is presented in Table 3.

Intervention design

CP and MIH program components varied considerably across studies; however, all 7 interventions examined relied primarily on paramedics to deliver on-site services in an effort to reduce unnecessary ED use or hospital admission. Other health personnel commonly involved in the planning and execution of programs included emergency physicians, nurses, social workers, care coordinators, and community health workers. Paramedics often performed in-home medical assessments as part of the intervention, such as phlebotomy or monitoring of vital signs including blood pressure, pulse rate, and respiration. Two programs mentioned some onsite treatment of acute medical issues with medication or injections administered by the paramedic.[28,30] Most interventions recruited patients based on their medical conditions at hospital discharge or by identifying patients at risk for ongoing high utilization or readmission; only 1 intervention was designed to intercept any type of low-acuity patient from using the ED.[24,25]

Four programs described additional requirements for paramedics implementing the intervention to be trained in the following topics: in-depth clinical training for specific populations,[28,31] community health worker duties,[29] and didactics that covered patient communication and education.[26] Five programs reported providing some form of health education for patients, including information on disease management and medication use.[26,27,29–31] Four programs provided assessment and/or education regarding patient living conditions and home safety.[26,29–31] Two programs implemented telehealth consultations between the paramedic and patient on the scene and a remote physician offering guidance via secure technological device.[24,25,29] An additional program offered patients a 24-hour, 7-day hotline for unplanned care needs, which provided telephonic consultation with a physician, social worker, or pharmacist and the possibility of scheduling an in-home visit.[27] Finally, 5 programs described implementing social services to provide follow-up appointments for specific needs or referrals to local resources that could serve to deter future emergency services use (eg, outpatient primary care centers).[24–27,30,31]

Quadruple Aim outcomes

All studies measured at least 1 outcome indicative of the Quadruple Aim, which encompasses (1) reductions in health care costs, (2) better health outcomes, (3) improved patient

experience, and (4) improved provider experience. Each program addressed the first aim, and found significant intervention benefits of reducing service utilization. No studies reported measuring provider satisfaction with the intervention.

Health care costs

Results collectively suggested that compared to control group or pre-implementation period, programs reduced transport to EDs and admissions rates to inpatient hospitals. EMS agency records, hospital records, and claims data (rarely) were used by studies to evaluate utilization trends. Several studies noted significant decreases in ambulance transports to the ED[24,26,30] and decreased ED visits.[25–27] Half of the studies reported decreases in inpatient utilization[26,27,30,31] and 2 studies also saw that intervention patients who were admitted had shorter lengths of stay than control group patients who were admitted.[26,31] After admission, an intervention group also had shorter intensive care unit stays than the control group.[31] Three studies also noted that 30-day readmission rates decreased significantly.[26,27,29] Abrashkin et al's study noted that after ED transport, hospital admission was higher for intervention patients than control patients, suggesting that the program's paramedics were successful in identifying patients who needed a higher level of care and were successfully treating nonemergent patients at home.[28]

Studies also noted that these programs increased professionals' potential productivity by decreasing the time before emergency units could go back in service.[24–26] However, most studies did not attempt to quantify the cost savings from reducing utilization or increasing EMS efficiency. Three studies that did conduct an economic analysis of their program reported the following estimates: annual savings to the local health care system of $18,198 (based on county medical center cost reports),[26] annual savings to the community of $928,113 (based on reductions in ED visits and EMS service costs),[25] and a return on investment proportion of 2.97 ($2,407,612 savings compared to $810,000 cost of implementation) in a statewide insurance group over 6 months.[27] One study that evaluated an intervention in a rural county reported that the program cost more than $90,000 to implement in the first year, but had only an approximately 20% return on investment.[26]

Health outcomes

Three studies examined whether programs were associated with improved patient health outcomes.[26,27,30] Using the EQ-5L-5D, one study observed increases in mobility and self-care, better performance in usual activities, diminished pain or discomfort, and less depression or anxiety from pre- to postintervention implementation.[30] Using the Patient Activation Measure, the other study found increases in intervention participants' degree of engagement and confidence in pursuing their own health care.[27] Bennett et al's study reported significant decreases in fasting blood glucose among patients with diabetes, significant decreases in blood pressure among patients with hypertension, and fewer ED admissions for shortness of breath among COPD participants. Two studies also observed improved patient access to useful community resources besides the ED, while also noting persistent challenges to accessing services such as primary care because of financial barriers and other factors.[26,31]

Patient satisfaction

High percentages of patients across multiple studies agreed or strongly agreed that they had received quality services. Four programs measured satisfaction among patients, and all of them found programs to be highly appealing with the population served.[24,26–28] One study did not find a difference in satisfaction between intervention patients and patients served by traditional EMS, but satisfaction with services was still high.[24] Individual studies also found that large majorities of patients reported that they would use the program again, would recommend the program to a friend, or would have sought emergency care had the program not been an available option.

Discussion

This systematic review resulted in 8 articles describing 7 CP-MIH interventions in the United States. All of the studies were observational in design, and therefore automatically of lower quality according to GRADE criteria. Several studies used strategies to reduce bias and control for confounding factors, but more studies with stronger designs and larger sample sizes are needed to confirm the direction and magnitude of utilization and cost outcomes. Nonrandom assignment of individuals to intervention groups adds potential bias to these studies, but case-control observational design with retrospective matching may be most feasible given the nature of some of these interventions within the traditional EMS response.[24] The small number of articles included in final narrative synthesis is not unexpected because EMS CP-MIH intervention is a recent concept in the United States. Many articles describing these types of interventions in other countries were excluded because it was decided a priori that the health care systems in other countries are too dissimilar for intervention outcomes to be truly comparable.

The intervention types could generally be described as either (1) targeted case management services that identified high utilizer patients or those at risk for preventable utilization, or (2) a diversion service that identified 911 callers who could be treated outside of the ED and/or did not require ambulance transport. The small number of studies and the variety in intervention designs and evaluations complicated the narrative synthesis. Although most studies found significant decreases in either ED or inpatient utilization, there is less conclusive evidence about the cost savings of CP-MIH programs and the 3 other Quadruple Aims of health improvement, patient satisfaction, and provider satisfaction. Nevertheless, it is clear that these types of interventions have the potential to significantly decrease the use of EMS and the ED for primary care treatable conditions. What is less clear is whether the cost savings from utilization can offset intervention implementation costs.

It also is still unknown whether the type of intervention implemented is related to Quadruple Aim outcomes, most

especially utilization and cost. By targeting patients at high risk of readmission, programs can prevent extremely costly hospitalizations, but must deliver high-intensity case management services in order to do so. The targeted case management interventions specifically worked with individuals with acute myocardial infarction, heart failure, pneumonia, or COPD – all diagnoses included in the Hospital Readmissions Reduction Program,[32] which penalizes hospitals for excessive readmission rates. With only 1 ED diversion intervention article included in this review, it is unknown if an intervention that targets a larger volume of patients with smaller cost savings is a more cost-effective option than targeted case management services. It also must be recognized that almost all reported outcomes in these studies were positive. It is entirely possible that other CP-MIH interventions that did not achieve positive outcomes were not accepted for publication, falsely boosting the evidence supporting this concept.

More evidence also is needed on how these interventions can improve patient health, patient satisfaction, and provider satisfaction. There is some evidence that efforts to reduce 30-day readmissions may have unfortunately increased mortality rates for patients with heart failure.[33] CP-MIH programs focused on decreasing utilization also should attempt to measure patient health status to verify that decreases in utilization are indeed appropriate. Patient satisfaction is an important quality of care indicator and health care provider satisfaction is now a priority within the health care system as evidenced by the transition from the Triple Aim to the Quadruple Aim. Resource scarcity resulting from ED overcrowding is associated with physician dissatisfaction[34] and responding to nonemergency 911 calls reduces job satisfaction for EMS workers,[16] so CP-MIH interventions could be especially beneficial for providers in multiple settings.

Only 1 intervention in this review took place in a rural setting.[26] For many reasons, including lack of access to primary care caused by provider shortages and transportation barriers, rural communities have been described as having a ''culture of overutilization'' of the ED for primary care services, and stakeholders from one rural state estimated that up to 90% of one rural hospital's ED visits were for nonemergencies.[35] As insurance payers look to reduce reimbursements to EDs for treating nonemergent patients in the ED setting, this could be a financial disaster for rural hospitals. Rural hospitals across the country are struggling financially, and reimbursement changes that hurt rural hospitals' bottom line will contribute further to rural hospital closures, which in turn will reduce rural communities' access to emergency care when it is truly needed.[35] Interventions that reduce unnecessary ambulance transports could prove especially beneficial to rural communities where EMS agencies have limited numbers of transport-capable ambulances and personnel, but also must transport patients longer distances to reach EDs. For example, ambulance runs in Minnesota range from 2 miles in metropolitan counties up to 70 miles in more remote areas.[36] Reductions in avoidable transportations could represent both significant cost savings from more efficiently using scarce EMS resources and free up the limited EMS resources for more timely response to true emergencies. However, rural communities may hesitate to start CP-MIH interventions without more evidence of their effectiveness in rural settings and how the interventions should be adapted in order to succeed in settings with smaller patient volumes and fewer EMS personnel (who may be primarily volunteers in rural areas).[36]

Although the majority of the interventions examined included a social services component with patient education or referrals to community resources, few described any explicit efforts to address patients' mental or behavioral health needs. One study noted that only 2 patients had a chief complaint of psychiatric problems at intake, but more than half of the patients reported moderate-to-extreme anxiety or depression.[30] A few programs reported providing as-needed referrals to behavioral health resources (eg, social workers, psychologists), but also noted that offering referrals appeared to have limited impact,[30] and that less than 20% of patients accepted referrals to behavioral health resources.[29] These studies also highlighted the need for greater attention to mental health in the populations served. In particular, one of the studies speculated that psychosocial bonding between patients and their providers contributed to observed outcomes. The authors suggested that incorporating a behavioral health specialist into MIH programs to provide in-home treatment, rather than merely offering referrals, may benefit patients and improve continuity of care.[30] Another program noted that the key to their success was having a care coordinator who could address not only the medical and behavioral health needs of their patients, but also their social determinants of health.[26]

With the advent of CP, the historical focus of EMS providing care in the acute or emergent prehospital setting is beginning to see a paradigm shift toward more of a home treatment and management concept. Despite significant interest in reducing use of EMS and the ED for primary care-treatable conditions, this systematic review shows that there are limited peer-reviewed articles describing CP-MIH interventions in the United States. The concept of CP-MIH is exciting and forward thinking, but is not without challenges for all related entities that have a part in making this new concept work. CP-MIH has been met with some resistance by EMS ''traditionalists,'' primarily because physician and nursing colleagues are unfamiliar with the concept. Another challenge is that EMS is typically defined as acute or emergency prehospital care, and CP-MIH interventions do not fit into this traditional EMS definition. This leads to policy implications related to EMS provider scope of care and service reimbursement. Interventions to decrease utilization for low-acuity conditions must be evidence based and suitable for the intervention setting and target population. It is imperative that the new concept of CP-MIH be explored fully to evaluate its effectiveness in reducing unnecessary ambulance transports to EDs and reducing the financial burden associated with traditional EMS care. With more time and more high-quality studies with stronger matching designs that include larger patient sample sizes, conclusions about CP-MIH's effectiveness at addressing the Quadruple Aim will be strengthened.

Author Disclosure Statement

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Supplementary Material

Supplementary Table S1

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