Providing Acute Care at Home: Community Paramedics Enhance an Advanced Illness Management Program—Preliminary Data

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Models addressing urgent clinical needs for older adults with multiple advanced chronic conditions are lacking. This observational study describes a Community Paramedicine (CP) model for treatment of acute medical conditions within an Advanced Illness Management (AIM) program, and compares its effect on emergency department (ED) use and subsequent hospitalization with that of traditional emergency medical services (EMS). Community paramedics were trained to evaluate and, with telemedicine-enhanced physician guidance, treat acute illnesses in individuals' homes. They were also able to transport to the ED if needed. The CP model was implemented between January 1, 2014, and April 30, 2015 in a suburban–urban AIM program. Participants included 1,602 individuals enrolled in the AIM program with high rates of dementia, decubitus ulcers, diabetes mellitus, congestive heart failure, and chronic obstructive pulmonary disease. Participants had a median age of 83 and an average of five activity of daily living dependencies (range 0–6). During the study period, there were 664 CP responses and 1,091 traditional EMS transports to the ED among 773 individuals. Only 22% of CP responses required transport; 78% were evaluated and treated in the home. Individuals that community paramedics transported to the ED had higher rates of hospitalization (82.2%) than those using traditional EMS (68.9%) ($P < .001$). Post-CP surveys showed that all respondents felt the program was of high quality. Results support the potential benefits of CP and invite further evaluation of this innovative care model.

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DOI: 10.1111/jgs.14484

Key words: Community Paramedicine; community paramedics; Mobile Integrated Healthcare; Advanced Illness Management; acute care

New models are needed to improve the quality and costs of care for older adults with multiple advanced chronic conditions. Two out of three older Americans have multiple chronic conditions, and treatment for this population accounts for 66% of the country's healthcare budget.[1] Homebound older adults are a particularly costly and vulnerable subpopulation. Constituting 5.6% of the community-dwelling Medicare population (~2 million people), they tend to be older, female, nonwhite, and less affluent than those who are not homebound, and only 11.9% receive primary care services at home.[2] Homebound individuals are often unable to access outpatient care and forgo needed treatment for extended periods of time. Faced with an exacerbation of a chronic illness or a new acute problem, their only option is to dial 911 and seek treatment in the emergency department (ED).[3]

Evidence supports an overreliance on hospital services for older adults and homebound individuals. More than one-third of Medicare beneficiaries who are evaluated and treated in the ED (without hospital admission) may be safely treated in a lower-acuity setting,[4] and homebound individuals are significantly more likely than those who are not homebound to have been hospitalized in the last year (52.1% vs 16.2%).[2] Intervening in the prehospital space could result in significant cost savings—an estimated $560 million per year for Medicare beneficiaries alone[4]—while also improving individual experience and avoiding iatrogenic harms that older adults often incur.[5–7]

Preventing hospitalization of older adults will require a multifaceted approach. Efforts to date include engaging and educating specialists and identifying important research

0002-8614/16/$15.00

frontiers, use of alternative management approaches (e.g., Hospital at Home), screenings by prehospital providers, and creation of geriatric EDs, all of which show promise and, in some cases, have had a beneficial effect.[8–10]

Community Paramedicine (CP) is a model for healthcare delivery that uses emergency medical service (EMS) providers to deliver care that is integrated with other healthcare entities.[11] A CP model using paramedics as physician extenders to provide urgent in-home healthcare for homebound individuals with multiple chronic illnesses is described here, but CP is being explored around the country for varying functions, including hospital postdischarge visits, monitoring of chronic conditions, and home safety assessments.[12–14] Important characteristics of all programs include provision of care that is integrated into the current healthcare system, person-centered, and physician led.[11] Results of CP programs have been promising, with programs reporting reduction in costs, use of 911, and ED visits.[15]

This prospective observational study explored the feasibility of in-home evaluation and treatment of acute illnesses by paramedics within an Advanced Illness Management (AIM) program. The ED transport rate after a CP response was examined, and the subsequent hospitalization rates for individuals transported after a CP response were compared with those transported by traditional EMS. Clinical reasons for CP deployment and operational metrics are also reported in hopes of informing the growth of this field.

METHODS

Northwell Health, a large integrated health system, operates an AIM program consisting of 11 primary care providers (nurse practitioners and physicians), five social workers, and five medical coordinators who annually provide home-based primary care to more than 1,200 people in Queens and Long Island, New York.

Based in Northwell's Center for Emergency Medical Services (CEMS), CP uses paramedics trained in critical care as physician extenders to provide on-demand urgent care in an individual's home. Designed to fit within current New York State EMS regulations, the program allows collaboration between paramedics and the individual's comprehensive care team to leverage appropriate resources based on individual need.

Community paramedics are a group of experienced paramedics who have received an additional 40 hours of instruction in geriatrics and home-based primary care through didactic training (expanded assessment skills, electrocardiogram interpretation, program-specific workflows), and physician observation (in the ED and on home visits with AIM providers). Educational materials were developed in conjunction with subject matter experts and prior literature and were based on program-specific needs; the CEMS Medical Director provided credentialing. Northwell Health provided cost of paramedic training. CP capabilities include physical examinations, end-tidal carbon dioxide measurements, electrocardiograms, blood glucose monitoring, medication administration (oral, intravenous, intramuscular, inhalational), and transport to the ED when indicated. An AIM physician who is certified to provide New York State Online Medical Control and has received additional training in CP capabilities and programmatic workflows directly oversees all care telephonically or through secure videoconference.

The AIM program encourages individuals and caregivers to call at any time of day with medical concerns. Emergency calls are routed to a nursing clinical call center where they are triaged using emergency communication nurse system de-escalation algorithms. After triage, the nurse can deploy an ambulance, activate a CP response, connect with an AIM provider (who can deploy a CP response), or dispense protocol-driven telephonic advice (Figure 1).

In this observational study, individuals were classified in the intervention group if they were evaluated at least once by CP and in the usual care group if they received only traditional EMS responses during the study period (January 1, 2014 to April 30, 2015). In addition to activity of daily living (ADL) dependencies and advanced care planning status, which clinicians routinely update, information on chief complaint (entered by physicians after every CP response) and participant demographic characteristics were extracted from electronic health records. Information on response time, time on scene, and medications administered were collected from CEMS records. Postvisit feedback was solicited by mail. Surveys were sent within 1 week of all CP responses; a survey was not sent to individuals who died before the mailing. The Northwell Health institutional review board approved the research with a Health Insurance Portability and Accountability Act waiver and exemption from written consent. Cross-sectional univariate analyses were used, treating each individual or each call as an independent event. Chi-square tests were used for categorical variables and *t*-tests for continuous variables. All statistical analyses were performed using Stata version 14 (Stata Corp., College Station, TX).

RESULTS

Table 1 shows characteristics of the 1,602 individuals enrolled in the AIM program during the study period. Two-thirds were female, median age was 83, and median number of ADL dependencies was 5 (range 0–6). The study population had high rates of chronic conditions: dementia (44%), decubitus ulcers (29%), diabetes mellitus (26%), congestive heart failure (24%), and chronic obstructive pulmonary disease (15%).

Of enrolled individuals, 773 (48.3%) had at least one emergency response during the study period; 404 (52.3%) used CP at least once, and 369 (47.7%) used only traditional EMS. Individuals seen by community paramedics were significantly more likely to be older, have more ADL dependencies, and have a do-not-resuscitate order than those using only traditional EMS responses. Both groups had high rates of advance care planning.

One thousand seven hundred fifty-five events (CP responses and traditional EMS transports) occurred during the study period, with a median of 2 responses per person; 664 (37.8%) were CP responses, and the remaining 1,091 (62.2%) were traditional EMS responses. In 78% of CP responses, individuals were evaluated, treated, and remained at home. Average CP response time (call initiation to paramedic in home) was 21 minutes, and average time on scene was 70 minutes. The most common medications given in

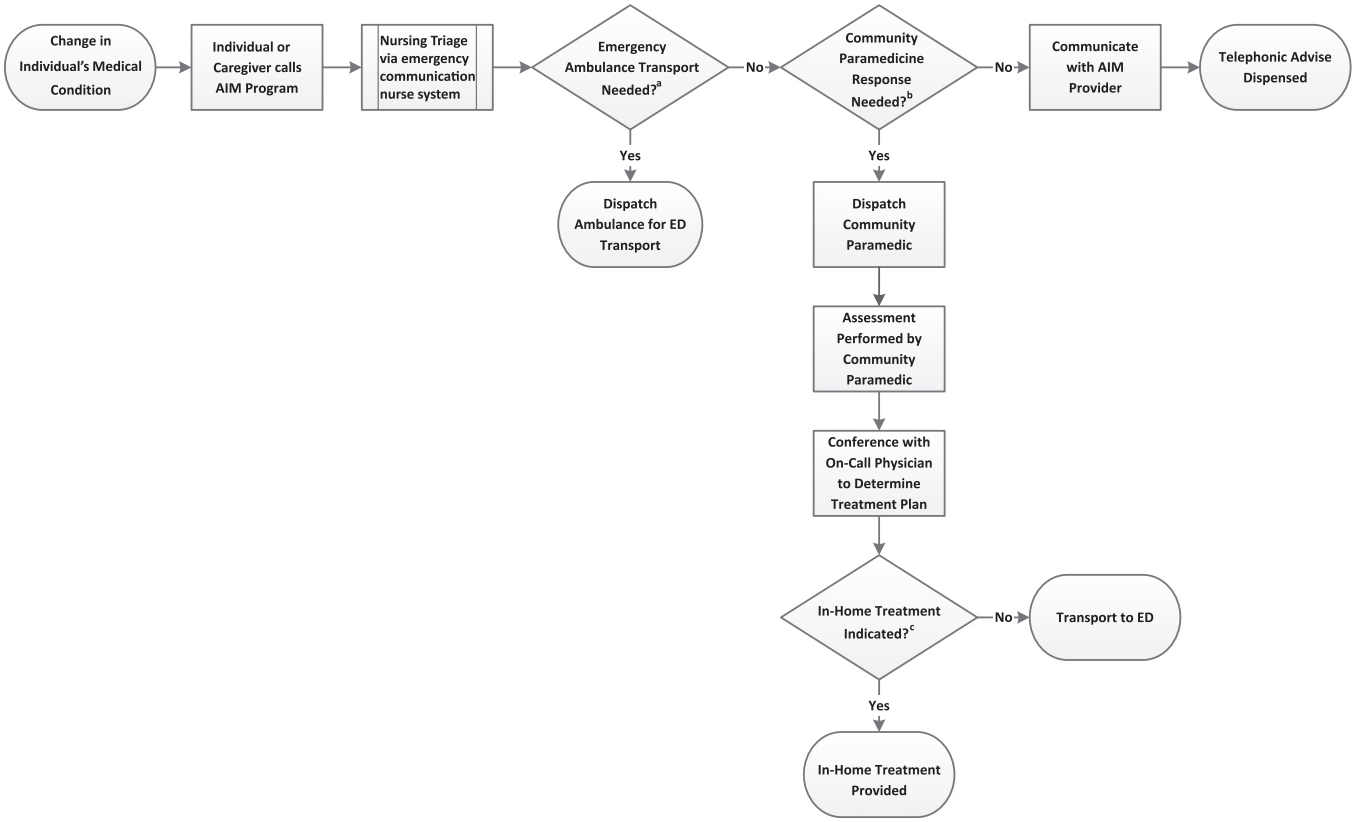

Figure 1. Change in condition: workflow. Flow showing result of individual or caregiver calling Advanced Illness Management program and selecting option for medical emergency. [a]Individual would not benefit from Community Paramedicine response, for example if response time is too long or in cases in which in home treatment is not possible. [b]In-home treatment could be reasonably attempted, individual has do-not-hospitalize order, or provider needs additional clinical information before deciding on locus of care. [c]Community paramedics can provide more than 20 medications (intravenous, intramuscular, inhalational) in the home without hospital transport. ED = emergency department.

the home were normal saline, albuterol, ipratropium bromide, furosemide, ondansetron, and methylprednisolone.

After transport to the ED (total 1,237 events), hospital admission rate was significantly higher for individuals transported after a CP response (82.2%) than after a traditional EMS transport (68.9%) ($P < .001$). There was no difference in length of stay between individuals admitted to the hospital after transport by CP (5.9 days) and traditional EMS (5.2 days) ($P = .27$). Of individuals who received a CP visit and were not transported to the ED, 1.7% (9/518) were subsequently seen in an ED within 24 hours of the CP response.

Community paramedics were most often dispatched for pulmonary complaints (shortness of breath, cough) (23.6%), followed by neurological and psychiatric (most often altered mental status, less commonly stroke symptoms, seizure) (17.9%), generalized malaise or weakness (15.2%), and cardiac or blood pressure concerns (chest pain, hypo- or hypertension) (10.1%). There were no significant differences between ED transport and in-home treatment rates for any chief complaints with the exception of cardiac or blood pressure concerns; 9% more individuals were transported in this group.

Three hundred twenty-nine individuals or caregivers were mailed surveys within 1 week of the CP response, and 116 (35%) responded. All agreed or strongly agreed that CP delivered high-quality services and care, and 97% agreed that they would use the service in a future medical emergency; 91.4% reported they would have sought emergency care if CP had not been available. There were no statistically significant differences in sex or hospital transport by CP between survey respondents and nonrespondents, although surveys were more likely to have been returned for older adults (average age: respondents 85, nonrespondents 81, $P = .02$).

DISCUSSION

The authors experience suggests that this CP model, in which paramedics act as physician extenders to provide acute in-home healthcare, could enhance current treatment models for homebound individuals with advanced illness. CP can safely assess and treat medically complex individuals at home, demonstrating a low post-CP ED presentation rate. Furthermore, the significantly higher admission rate for individuals transported by CP shows that paramedic–physician teams can identify the sickest individuals who need and want inpatient treatment. This program is designed to honor individuals' goals of care, so even some of the sickest individuals were treated in the home with comfort-oriented measures, highlighting the need for high rates of advance care planning in such a model. Postvisit

Table 1. Characteristics of Advanced Illness Management (AIM) Population, Comparing Adults Using Only Traditional Emergency Medical Services (EMS) with Those Who Used Community Paramedicine (CP)

Characteristic	AIM Population, N = 1,602	Traditional EMS Group, n = 369	CP Group, n = 404	*P*-Value
	n (%)			
Sex				
Male	523 (32.6)	135 (36.6)	142 (35.2)	.68
Female	1,079 (67.4)	234 (63.4)	262 (64.9)	
Age				
<70	219 (13.7)	72 (19.5)	51 (12.6)	<.001
70–79	256 (16.0)	83 (22.5)	44 (10.9)	
80–89	531 (33.1)	108 (29.3)	146 (36.1)	
≥90	596 (37.2)	106 (28.7)	163 (40.4)	
Number of activity of daily living dependencies[a]				
0	226 (14.0)	54 (15.6)	39 (9.9)	<.001
1–2	186 (11.6)	56 (16.3)	34 (8.6)	
3–4	176 (11.0)	44 (12.7)	49 (12.4)	
5–6	935 (58.4)	192 (55.5)	274 (69.2)	
Advance care planning				
Medical Orders for Life Sustaining Treatment completed	1,271 (79.3)	290 (89.8)	346 (92.5)	.38
Do-not-resuscitate order	973 (60.7)	190 (59.0)	270 (72.4)	<.001
Chronic conditions				
Dementia	701 (43.8)	131 (35.5)	192 (47.5)	
Pressure ulcer	466 (29.1)	109 (29.5)	131 (32.4)	
Diabetes mellitus	423 (26.4)	125 (33.9)	105 (26.0)	
Congestive heart failure	378 (23.6)	92 (24.9)	137 (33.9)	
Chronic obstructive pulmonary disease	244 (15.2)	68 (18.4)	91 (22.5)	
Protein-calorie malnutrition	321 (20.0)	59 (16.0)	90 (22.3)	
Of those who died during study period, death at home	289 (18.0)	42 (11.4)	110 (27.2)	<.001
Insurance status				
Medicaid primary	30 (1.9)	11 (3.0)	8 (2.0)	
Medicare primary	947 (59.1)	209 (56.6)	262 (64.9)	
Private	625 (39.0)	149 (40.4)	134 (33.2)	

Individuals in the traditional EMS group used only traditional EMS during the study period; individuals in the CP group used CP at least once during the study period.

[a]Bathing, toileting, walking, transferring, dressing, and feeding.

feedback indicated that individuals and caregivers welcomed this care model enhancement, likely because it was consistent with desires to age in place and receive meaningful clinical care given CP's unique ability to deliver advanced diagnostics and in-home medication administration on an urgent basis around the clock.

As payers push providers to assume risk for healthcare spending, it is anticipated that the opportunity for cost savings will lead to CP program expansion. Lack of reimbursement for nontransported paramedic services is an obstacle to this model's proliferation. With Medicare's average hospitalization cost of $12,200 in 2012,[16] preventing even a few admissions could offset the cost of a CP program and generate revenue in risk-based arrangements. CP pilot programs are currently being funded through grants, institutional support, and per-member-per-month fees; further research generated from these pilot programs on cost savings, satisfaction, and safety could provide evidence for reimbursement for CP services.

Data from other programs using CP to treat urgent conditions are promising. One randomized controlled trial from the United Kingdom that used CP during daytime hours to care for a limited scope of medical conditions showed a reduction in ED visits and a nonsignificant trend toward reduction in cost of care for individuals in the CP group.[17] Another used CP to treat elderly adults with minor medical conditions at home; the intervention group experienced a decrease in ED visits and hospital admissions, greater satisfaction, and no significant difference in 28-day mortality.[18] Systematic reviews concluded that this model provided value by treating adults on scene, reduced referrals to EDs, and showed promise in improving system performance and outcomes.[19,20]

There are limitations to this report, including selection bias and lack of control group; clinical judgment guided CP deployment and the decision to transport during the response. Survey return rate was relatively low, and future studies may seek a higher rate by collecting satisfaction results telephonically. In addition, this program might not be easily replicated in all locations for two reasons. First, laws governing the use of paramedics as physician extenders may be prohibitive, and second, programs may lack the institutional support that is often needed to initiate a CP program. Nonetheless, as the number of adults with

advanced illness rises, the need for a meaningful around-the-clock clinical response will only grow. This report shows the potential feasibility and benefits of a CP model in which paramedics and physicians move from risk-avoidant toward risk-tolerant care and supports the model's further evaluation.

ACKNOWLEDGMENTS

The authors would like to acknowledge and thank Kashifuddin Baqai, BS, CCEMT-P and Craig Smith, EMT-P, for CP program design and execution, and Karin Rhodes, MD, MS, for assistance with manuscript revision.

Conflict of Interest: Mr. Washko provides private consulting regarding EMS operations. With that exception, the authors have no financial or personal conflicts of interest to disclose.

Institutional support from Northwell Health; funding for video conferencing integration from Verizon Foundation.

Author Contributions: Abrashkin K. A.: study design, data interpretation, drafting of article. Washko J.: program design, study design, data acquisition. Zhang J.: data acquisition, study design. Poku A.: data acquisition, study design. Kim H.: data analysis. Smith K. L.: study design, data interpretation, critical manuscript revision.

Sponsor's Role: This project was funded by institutional support from Northwell Health. Video integration was supported through a grant from the Verizon Foundation. The Verizon Foundation did not contribute to study design, methods, data collection, or manuscript preparation.

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