American Journal of Emergency Medicine 35 (2017) 1702–1705

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Brief Report

A pilot mobile integrated healthcare program for frequent utilizers of emergency department services

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ARTICLE INFO

Article history:
Received 9 March 2017
Received in revised form 25 April 2017
Accepted 26 April 2017

Keywords:
Mobile integrated healthcare
Emergency medicine
Emergency utilization

ABSTRACT

Purpose: To examine whether or not a mobile integrated health (MIH) program may improve health-related quality of life while reducing emergency department (ED) transports, ED admissions, and inpatient hospital admissions in frequent utilizers of ED services.
Methods: A small retrospective evaluation assessing pre- and post-program quality of life, ED transports, ED admissions, and inpatient hospital admissions was conducted in patients who frequently used the ED for non-emergent or emergent/primary care treatable conditions.
Results: Pre- and post-program data available on 64 program completers are reported. Of those with mobility problems (n = 42), 38% improved; those with problems performing usual activities (N = 45), 58% reported improvement; and of those experiencing moderate to extreme pain or discomfort (N = 48), 42% reported no pain or discomfort after program completion. Frequency of ED transports decreased (5.34 ± 6.0 vs. 2.08 ± 3.3; $p < 0.000$), as did ED admissions (9.66 ± 10.2 *vs.* 3.30 ± 4.6; $p < 0.000$), and inpatient hospital admissions (3.11 ± 5.5 *vs.* 1.38 ± 2.5; $p = 0.003$).
Conclusion: Results suggest that MIH participation is associated with improved quality of life, reduced ED transports, ED admissions, and inpatient hospital admissions. The MIH program may have potential to improve health outcomes in patients who are frequent ED users for non-emergent or emergent/primary care treatable conditions by teaching them how to proactively manage their health and adhere to therapeutic regimens. Programmatic reasons for these improvements may include psychosocial bonding with participants who received in-home care, health coaching, and the MIH team's 24/7 availability that provided immediate healthcare access.

1. Introduction

Interest in mobile integrated healthcare (MIH) to alleviate fractured systems of care, increase patient navigation, and improve continuity of care has grown over the past few years [1-4]. Roughly 20 states deliver some type of MIH program in their communities [1,2]. Popular press reports that over 1100 emergency department (ED) visits in Nevada were avoided with the Nurse Navigator program, 190 ED transports were avoided with the Ambulance Transport Alternative program, and hospital readmissions declined by 5% with the Community Paramedic program [5]. In North Carolina, over 300 MIH participants with acute mental health and/or addiction crises were diverted from the ED by paramedics, although approximately 25% required hospital transport shortly after the initial crisis [6].

However, empirical data of MIH-type interventions are limited. A study of chronically ill Medicare patients found one in-home visit with a paramedic was not enough to keep them out of the hospital [7]. Others found four coaching sessions provided by nurses or social workers prevented 30-day hospital readmissions [8]. A retrospective study found 90-days of weekly care coordination by multidisciplinary health professionals reduced ED use and admissions [9]. One case series reported three of four patients receiving post-discharge transitional care avoided a 30-day hospital readmission [10].

The effectiveness of MIH programs on patient health outcomes and ED use in frequent ED utilizers is an area of needed research as about 30% of patients in the United States seek ED services for non-emergent care [11] with an estimated annual cost of $750 billion [12]. Locally, Tarrant County hospitals provided care in over 368,000 ED visits with 56% of these visits for non-emergent or emergent/primary care treatable conditions [13]. Patients using ED services for non-emergent or emergent/primary care treatable conditions may divert clinicians away from seriously ill patients which potentially increases wait times

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http://dx.doi.org/10.1016/j.ajem.2017.04.061
0735-6757/

and treatment delays. The Centers for Medicare & Medicaid Services (CMS) recommends reducing inappropriate ED use by diverting care to appropriate settings [14]. Section 3025 of the Affordable Care Act augments section 1886(q) of the Social Security Act requires CMS to financially penalize hospitals with excessive 30-day readmissions [14]. Whether MIH programs have potential to improve patients' quality of life while reducing inpatient admissions or diverting non-emergent or emergent/primary care treatable patients from frequent ED use remains unclear.

To our knowledge, there are no studies examining the usefulness of emergency medical technicians (EMT) or critical care paramedics (CCP) delivering an MIH program to frequent ED users seeking non-emergent care. Here, the primary goals were to (1) identify if health-related quality of life in frequent ED utilizers may improve with MIH participation, and (2) determine if MIH program participation may reduce ED transports through the emergency medical system (EMS) provider, ED admissions via walk-in or other transport, and inpatient hospital admissions. We hypothesized MIH program participation would improve quality of life and reduce ED transports, ED admissions, and inpatient admissions.

2. Methods

2.1. Program design

A North Texas metroplex community EMS provider used their patient call records, billing, and collection data from 2009 to 2012 to conduct an internal examination of patients frequently calling 911. Diagnosis, chief complaints, and reasons for calling 911 were reviewed and the level of illness/injury severity was categorized using the New York University algorithm [15]. Patients using ED services for non-emergent care or emergent needs/primary care treatable were identified. A Critical Care Group (e.g. EMT, CCP, physician medical director, clinical program manager) designed an MIH intervention for these patients meeting National Committee for Quality Assurance (NCQA) accreditation criteria and metrics. The guiding philosophy was to provide patients with in-home, coordinated care to prevent illness exacerbation. The EMS provider implemented, delivered a small pilot MIH program, and collected participant data from 2013 to 2015. The evaluation team received university Institutional Review Board approval to conduct a retrospective program evaluation using data collected by the EMS provider.

2.2. Participants

The sample of participants were those residing in a metroplex community who were urban city residents. Eligible participants were required to have: (1) been transported to the ED ≥4 times within a 1-year period during 2013–2015 seeking treatment for a non-emergent or emergent/primary care treatable condition, (2) the mental capacity to follow medical advice, (3) the willingness to engage in navigational assistance, and (4) the ability to proactively seek health resources outside the ED. Participants were excluded if they were: (1) pregnant, (2) receiving chemotherapy or radiation for active malignancies, (3) younger than 18-years old, (4) homeless without shelter, (5) lacking mental capacity to understand disease management, (6) unwilling to allow MIH team members to enter their home, (7) unwilling to be linked to a medical home physician or clinic, (8) actively abusing substances with no intent to abstain, and (9) deemed ineligible by the EMS agency medical director. Patients meeting eligibility criteria were invited to participate.

2.3. Intervention

The program delivered twice weekly in-home visits, provided health education coaching, performed routine health screenings, vital signs, phlebotomy, electrocardiograms, injections, wellness check-ups, medication management, and assessed home safety issues. Participants were encouraged to set personal health goals and see their primary care physician (PCP) for wellness examinations and follow-up care. Those without a PCP were referred to physicians and offered transportation to their appointment. Referrals to psychologists and social workers were provided as-needed. Participants received a 10-digit access number available 24/7 to request a MIH visit, and those calling 911 were identified by EMS dispatchers who notified the MIH team to provide 'on-demand' services.

2.4. Outcomes

Based on the Agency for Healthcare Research and Quality use of the EuroQol-5D-3L Health Questionnaire (EQ-5D-3L) [16], the EMS provider's Critical Care Group chose this instrument to measure quality of life before and after participants completed the MIH program. The EQ-5D-3L is a two-part self-rating tool measuring activities of daily living (i.e. mobility, self-care, usual activities), somatic (i.e. pain & discomfort), psychological functioning (i.e. anxiety & depression), and overall health. Part one of the EQ-5D-3L utilizes qualitative self-report ratings rather than numeric scores. Part two of the EQ-5D-3L tool is a visual analogue scale (VAS) from 0 to 100 (i.e. 0 = worst health, 100 = the best health you can imagine) that participants rated their overall health.

The definition of 'ED transport' were patients transported to the ED only by the EMS provider. An 'ED admission' were all those who entered the ED through any means other than EMS such as walk-in, taxi, etc. An 'inpatient hospital admission' were those patients who were admitted as an inpatient to the county-funded hospital regardless of whether they were transferred from the ED or were a direct admission from any other source. The total number of ED transports, ED admissions and inpatient hospital admissions before and after MIH program completion were used to determine if participation was associated with reductions in these variables. These outcomes were tabulated using the MIH patient data available in the EMS provider agency's electronic database that included shared data sent to them by the local, county-funded hospital.

2.5. Statistical analyses

Pre- and post-program EQ-5S-3L data were collected at intake and at the last visit, respectively. Pre- and post-program ED transports, ED admissions, and inpatient hospital admissions were aggregated for the 12-months just prior to program enrollment and up to 9-months after program completion. Nonparametric tests were used due to a small sample size yielding data that were not normally distributed. Demographics were analyzed with descriptive statistics and frequency distributions as appropriate. Quality of life ratings were analyzed using response frequencies, McNemar test, odds ratios (OR) and corresponding 95% CI. EQ-5D-3L visual analogue scale (VAS) ratings, the number of ED transports, admissions, and inpatient admissions were analyzed with means, medians, and Wilcoxon Signed-ranks tests as appropriate. Statistical significance was determined with 95% distribution free confidence intervals (CI) using the Statistical Package for the Social Sciences (SPSS, IBM, version 21) and Statistical Analysis Software (SAS, version 9.4; Cary, NC).

3. Results

3.1. Sample characteristics

Table 1 shows sample characteristics. Paired pre- and post-program data were collected on 64 participants. The evaluation team received no information on the total number of participants who were eligible versus the number of those who enrolled. Typical program length was 61 to

Table 1
Sample characteristics ($N = 64$).

Age (mean, SD)	49.7 (13.5)
Gender (frequency)	
Men	30
Women	34
Race/ethnicity (frequency)	
Black/African American	27
Hispanic/Latino	7
Non-Hispanic Caucasian	22
Other	1
Missing	7
Health care coverage (frequency)	
JPS* connection	21
Medicaid only	17
Medicare only	3
Medicaid + medicare	7
Medicare + private insurance	4
Private insurance	6
Self-pay	6
Primary care physician (frequency)	
Yes	47
No	13
Missing	4
Home hospital at enrollment (frequency)	
Baylor Health Care System	1
Texas Health Resources	3
Plaza Medical Center	2
John Peter Smith (JPS) Health Network	56
No designated home hospital	2
Chief medical complaint (frequency)	
Respiratory	19
Cardiovascular	19
Endocrine	7
Neurological	3
Nephrological	2
Pain	9
Psychiatric	2
Missing	3
Length of MIH participation (frequency)	
<30-days	2
30 to 60-days	10
61 to 90-days	28
>90-days	24

Note: *John Peter Smith (JPS) Health Network insurance with co-pays based on a sliding scale fee using all source annual household income.

90-days. Roughly one-third of the sample participated longer than 90-days to help them meet their health goals.

3.2. EQ-5D-3L quality of life

As shown in Table 2, 16 out of 42 participants (38%) had improved mobility, 14 out of 20 (70%) had improved self-care, 26 out of 45 (57%) performed usual activities better than before the program, and 20 out of 48 participants (42%) with moderate to extreme pain or discomfort before the MIH program reported no pain or discomfort after program completion. Forty percent of participants (17 out of 43) reporting pre-program moderate to extreme anxiety or depression improved, while 60% (26 out of 43) experienced no change. The VAS self-ratings showed 9.38% of the participants ($n = 6$) believed their overall health declined, 17.19% ($n = 11$) rated their health stayed the same, and 73.44% ($n = 47$) rated their health improved 31.5% from pre- to post-program (*Medians 50 to 70; CI, 10 to 20; $Z = -5.26$, $p < 0.001$, $r = 0.66$*).

3.3. ED transports, ED admissions, inpatient hospital admissions

Post-program ED transports were significantly lower than at pre-program ($Z = -5.29$, $p < 0.000$), as were ED admissions ($Z = -6.28$, $p < 0.000$), and inpatient hospital admissions ($Z = -2.94$, $p = 0.003$). Using pre- and post-program means, participants had 61% fewer ED transports (5.34 ± 6.0 vs. 2.08 ± 3.3), 66% had fewer ED admissions (9.66 ± 10.2 vs. 3.30 ± 4.6), and 56% had fewer inpatient hospital admissions (3.11 ± 5.5 vs. 1.38 ± 2.5) at program completion. As these results were statistically significant in this small sample, we used Hotelling's Trace multivariate analyses to examine potential influencing variables. We found ED transports, ED admissions, and inpatient hospital admissions were not significantly associated with gender/sex ($F_{(6,44)} = 1.11$, $p = 0.370$), race/ethnicity ($F_{(6,44)} = 1.64$, $p = 0.160$), primary complaint ($F_{(6,44)} = 1.52$, $p = 0.193$), or length of MIH participation ($F_{(6,44)} = 1.31$, $p = 0.273$).

Table 2
Quality of life response frequencies before program enrollment and after completion.

Pre-program	Post-program responses		Statistic	
Domains	*n*			
Mobility - walking about	*Some problems*	*No problems*	*OR*	*95% CI*
Some problems (n = 42)	26	16	8	1.83, 34.79
No problems (n = 22)	2	20		
Self-care-washing/dressing	*Some problems*	*No problems*		
Some problems (n = 20)	6	14	2.33	0.8966, 6.07
No problems (n = 44)	6	38		
Performing usual activities	*Some problems*	*No problems*		
Some problems (n = 45)	19	26	6.5	2.26, 18.62
No problems (n = 19)	4	15		
Pain/discomfort	*Moderate/extreme*	*None*	*OR*	*95% CI*
Moderate/extreme (n = 48)	28	20	10	2.33, 42.78
None (n = 16)	2	14		
Anxiety/depression	*Moderate/extreme*	*None*		
Moderate/extreme (n = 43)	26	17	5.66	1.66, 19.33
None (n = 21)	3	18		

4. Discussion

These data suggest that MIH program participation may be associated with improved health-related quality of life self-ratings, reduced ED service utilization and fewer inpatient hospital admissions. Participants were middle-aged with county- or government-funded healthcare coverage, most had a designated home hospital, and over half had a primary care physician. Yet prior to the MIH program, they routinely used the local county-funded hospital ED for non-emergent or emergent/primary care treatable conditions. After program completion, most participants reported experiencing significant increases in mobility, self-care, performing usual activities, and reductions in pain and discomfort.

Programmatic reasons for these improvements may include an element of psychosocial bonding participants received with in-home care and the MIH team's 24/7 availability that provided them with immediate healthcare access. These program attributes may be extremely important considering the sample's demographics described above. The health coaching educated participants how to recognize early warning signs to prevent illness decompensation, encouraged participants to practice proactive health behaviors and adhere to therapeutic regimens – something not typically reinforced in short outpatient appointments. Thus, the MIH team may have empowered participants to better manage their health and well-being. These results are similar to patient engagement studies [17] reporting health coaching and education improves health outcomes and reduces hospitalizations in type II diabetes patients.

Only two participants had a chief complaint of psychiatric problems at intake. Yet, over half of the sample reported pre-program moderate to extreme anxiety or depression and did not improve with program completion. Thus, future MIH programs should not simply offer referrals to psychologists and social workers; rather, adding a behavioral health

specialist to the MIH team to provide in-home behavioral health should benefit the patient and improve continuity-of-care.

Our results may not be comparable to the few empirical data available in the scientific literature as some mobile health programs provide less in-home patient contact than ours [7,8], one is a case series [10], others have little or no data describing pre- and post-program ED transport, ED admission, and inpatient admission outcomes [6,7] or they utilize a multidisciplinary team of healthcare professionals rather than rely on EMTs or CCPs to deliver the program [7]. However, we found greater post-program reductions of inpatient hospital admissions than the 5% reduction reported with Nevada's MIH programs [5]. The ED transport and ED admission reductions we found are also greater than the 19% decrease in ED transports, the 21% reduction in ED admissions, and the 40% decrease of inpatient admissions reported with Florida's MIH Care Coordination program delivered to chronically ill elderly patients [9]. In contrast to our results, none of the available programs (to our knowledge) measured pre- and post-program quality of life.

The data indicate that having county- or government-funded healthcare coverage, a designated home hospital and an assigned primary care physician may not be enough to mitigate frequent ED use for non-emergency reasons. Instead, our participants seemed to need consistent health coaching and weekly wellness monitoring. Our findings should help guide future MIH program design, and may support expanding the EMS role as a community-based ambulatory care provider to augment primary care. Future research into the costs and benefits of the MIH program to prevent frequent ED use for non-emergent or emergent/primary care treatable conditions may be especially valuable considering the rising costs of EMS and ED services compared to outpatient primary care visits.

While these data are encouraging, there are some limitations. We suspect that our MIH participants are not particularly different than any other low income, urban community patients who frequently use the ED for non-emergent reasons. However, our data were obtained from a small convenience sample of eligible participants who utilized EMS provider services and the local, county-funded hospital which may have introduced selection and sampling bias. As a small pilot program, we lacked in-depth population data necessary to create a consort diagram. In contrast to prospective research to test a theory or make between-group comparisons (which requires sample size and power calculations), we performed a retrospective program evaluation. While the retrospective design may prevent us from establishing causation and we are unable to generalize the results to broader patient populations, the results inform programmatic improvement and help answer the fundamental question, “Did it help the participants in any way?”

Although we examined gender/sex, race/ethnicity, chief medical complaint, and length of MIH participation as influencing variables and found no association, there could have been other modifying factors. The quality of life instrument may have introduced self-report bias and the qualitative nature of response frequency data prevented us from correlating quality of life outcomes with reductions in ED transports, admissions, or inpatient admissions. Nonparametric paired pre- and post-program analyses allowed each participant to serve as their own control which eliminated the need to perform multiple risk adjustments. Nevertheless, these preliminary data should be viewed with caution as prospective, well-controlled studies with a larger sample size are needed.

5. Conclusions

The results from this small retrospective program evaluation suggest that MIH participation was associated with improved quality of life, fewer ED transports, fewer ED admissions, and reduced inpatient admissions. The MIH program may have potential to improve health outcomes in patients who are frequent ED users for non-emergent or emergent/primary care treatable conditions by teaching them how to proactively manage their health and adhere to therapeutic regimens. Programmatic reasons for these improvements may also include psychosocial bonding with participants who received in-home care, health coaching, and the MIH team's 24/7 availability that provided them with immediate healthcare access.

Funding

This work was funded by a grant (RP0209) awarded to Nejtek by MedStar Mobile Integrated Health. No other authors report any conflicts of interest.

Presentation

This work was presented, in part, at Research Appreciation Day held April 18, 2016 at the University of North Texas Health Science Center in Fort Worth, Texas.

Acknowledgments

We sincerely thank Desiree Partain, CCP-C and Daniel Ebbett, CCP-C with MedStar Mobile Integrated Health for providing the evaluation team with MIH program information and data collection.

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