



Review

Limited data to support improved outcomes after community paramedicine intervention: A systematic review☆



Peter S. Pang, MD^{a,b,*}, Megan Litzau, MD^a, Mark Liao, MD^a, Jennifer Herron, MLIS^c, Elizabeth Weinstein, MD^{a,b}, Christopher Weaver, MD MBA^a, Dan Daniel, MD^{a,b}, Charles Miramonti, MD^{a,b}

^a Indiana University School of Medicine, Department of Emergency Medicine, United States of America

^b Indianapolis EMS, United States of America

^c Indiana University School of Medicine, Ruth Lilly Library, United States of America

ARTICLE INFO

Article history:

Received 23 January 2019

Received in revised form 20 February 2019

Accepted 24 February 2019

ABSTRACT

Background: Community paramedicine (CP) leverages trained emergency medical services personnel outside of emergency response as an innovative model of health care delivery. Often used to bridge local gaps in healthcare delivery, the CP model has existed for decades. Recently, the number of programs has increased. However, the level of robust data to support this model is less well known.

Objective: To describe the evidence supporting community paramedicine practice.

Data sources: OVID, PubMed, SCOPUS, EMBASE, Google Scholar-WorldCat, OpenGrey.

Study appraisal and synthesis methods: Three people independently reviewed each abstract and subsequently eligible manuscript using prespecified criteria. A narrative synthesis of the findings from the included studies, structured around the type of intervention, target population characteristics, type of outcome and intervention content is presented.

Results: A total of 1098 titles/abstracts were identified. Of these 21 manuscripts met our eligibility criteria for full manuscript review. After full manuscript review, only 6 ultimately met all eligibility criteria. Given the heterogeneity of study design and outcomes, we report a description of each study. Overall, this review suggests CP is effective at reducing acute care utilization.

Limitations: The small number of available manuscripts, combined with the lack of robust study designs (only one randomized controlled trial) limits our findings.

Conclusions: Initial studies suggest benefits of the CP model; however, notable evidence gaps remain.

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1. Introduction

The community paramedicine (CP) model of healthcare delivery bridges gaps in basic care, tailored to local needs. CP leverages well trained emergency medical services (EMS) personnel outside of emergency (911) response [1,2]. These personnel commonly visit patients in their homes, usually facilitating access to care or as follow up of established care. Less commonly, CP treats patients' medical needs without the intent of transport to the hospital. By itself, the model is not new; reports over 20 years old describe the CP model [3,4]. The concept originated in rural settings, to improve access to basic health care

[4]. The model has since expanded, driven by fragmented care, challenges in accessing care, and the ever growing focus on cost-containment. CP is now widespread, certified in many states, and part of the EMS Agenda 2050, outlining the future vision of EMS [3,5].

Data supporting the CP model is sparse however. The siren call of CP is its promise of reducing costly emergency department (ED) visits and hospitalizations, by leveraging an existing infrastructure (EMS). Some have suggested community paramedics may help close the primary care gap in the US [6]. As such, the number of CP pilot studies and demonstration projects continues to proliferate throughout the United States [3]. However, the extent to which CP programs demonstrably improve outcomes is less well known [7]. Such knowledge would inform key stakeholders to the value of CP as well as build upon past work. Thus, our objective was to systematically review the literature to describe the outcomes utilized by CP programs and the extent to which CP programs improved those outcomes.

☆ Systematic review registration number: PROSPERO: CRD42016052543.

* Corresponding author at: Department of Emergency Medicine, Indiana University School of Medicine, United States of America.

E-mail address: ppang@iu.edu (P.S. Pang).

2. Methods

We have structured our manuscript per PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. This review is registered on PROSPERO: CRD42016052543.

2.1. Eligibility criteria

Using the PICOS format:

Participants: Any patient visited at home or residence by community paramedics. We excluded patients seen at home only by visiting nurses, community health workers, home health, or any other category that excluded community paramedics. We used the following broad consensus construct definition of CP for our search:

“Community paramedicine (CP) is an emerging healthcare delivery model that increases access to basic services through the use of specially trained emergency medical service (EMS) providers in an expanded role. CP providers care for patients at home or in other non-urgent settings outside of a hospital under the supervision of a physician or advanced practice provider. CP can expand the reach of primary care and public health services by using EMS personnel to perform patient assessments and procedures that are already in their skill set.” [1]

Study characteristics for inclusion:

1. Data available in a peer reviewed journal.
2. Patient had to receive a visit by community paramedic in an outpatient setting.
3. Any visit for any reason irrespective of intervention was included
4. Any outcome was included. Given the limited evidence to date [3], we avoided a specific outcome, such as ED utilization, to more broadly capture potential CP efficacy or effectiveness.

Studies were excluded if:

1. Not in English
2. Not original research or a systematic review
3. Study size was less than 25 or was only a letter to the editor, a commentary, or design and rationale paper.
4. Did not answer the clinical question of interest
5. Only included patients in nursing homes or skilled nursing facilities or other established healthcare or setting
6. Published prior to 2011 or after 2017 (*a 2013 systematic review (using data up through 2011) is the reason we chose published manuscripts after this date) [8]

Interventions: Community paramedicine (CP) or mobile integrated health (MIH). Essentially, any activity related to a community paramedicine provider visiting the home. Intervention was not required. A priori, if certain subgroups or disease specific interventions were identified, these would be classified appropriately during the outline or drafting of the manuscript (i.e. interventions targeted at older patients or preventing heart failure re-admissions).

Comparisons: There were no pre-specified comparisons. Any CP study or report meeting all eligibility criteria.

Outcomes: Any reported outcome or benefit (or lack of benefit) of CP or mobile integrated health (MIH).

Information Sources: A professional librarian (JH) developed the search strategy with input from a study author (PSP). In December 2016 as well as January of 2018, a multi-term, layered search strategy was employed. Details are available as Supplemental figure 1, with one full electronic search strategy detailed below. Results from 6 databases were examined: OVID, PubMed, EMBASE, Scopus, Google Scholar – WorldCat, OpenGray. The strategy for the search used a combination of keywords and Medical Subject Headings (MeSH) relating to “community paramedicine”; “mobile health units”; “preventive medicine”; “emergency medical technicians”; and “ambulances”. Limits selected for this search included publication date (2011–2017), publication

language (English), and humans. To exclude irrelevant subjects, MeSH terms and keywords were also excluded from the results relating to “critical care”; “occupational diseases” and other health services not related to the research question. Terms were eliminated using the NOT operator and as the strategy was being developed, these were removed individually to review citations being excluded.

2.2. Search strategy

Per PRISMA, a single detailed search strategy is detailed in Table 1.

2.3. Study selection

After initial abstract generation, three people independently reviewed every abstract. Each abstract was grouped into 3 categories based on eligibility criteria (include, exclude, questionable). Any abstract with two congruent yes/no votes were either included or excluded, respectively, for full manuscript review. Any abstract with one yes vote and one questionable were also included for full manuscript review. Any abstract with two questionable and a no vote were also excluded.

A kappa statistic was calculated to show interobserver agreement, using STATA/SE 14.2, StataCorp, College Station, TX. A 3-way Kappa was also calculated. Given the high expected agreement, (and subsequent low Kappa scores) [9], percent agreement is also included.

2.4. Final manuscript selection

For every abstract that passed review, the manuscript was reviewed by the same authors. Two reviewers were asked to score only yes/no and one reviewer as yes/no/undecided. Any disagreements between the first two reviewers were settled by the third reviewer. If an ‘undecided’ vote was the final vote, the manuscript was included for review.

Further data collection: No attempts were made to contact authors for data verification or additional data.

Data items: A standardized form was used to extract relevant data during manuscript review. A narrative synthesis of the findings from the included studies, structured around the type of intervention, target

Table 1

Search strategy: MEDLINE using the OVID interface.

1. exp “Delivery of Health Care, Integrated”/
2. exp Preventive Health Services/
3. exp Community Health Services/
4. exp Mobile Health Units/
5. community paramedicine.mp.
6. out-of-hospital care.mp.
7. exp Risk Factors/
8. exp Preventive Medicine/
9. exp Early Medical Intervention/
10. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
11. exp. Ambulances/
12. exp. Emergency Medical Technicians/
13. exp. Allied Health Personnel/
14. paramed\$.mp.
15. 11 or 12 or 13 or 14
16. 10 and 15
17. exp. Occupational Diseases/
18. exp. Time Factors/
19. exp. Community Health Workers/
20. dent\$.mp.
21. nutrit\$.mp.
22. physical therap\$.mp.
23. exp Nursing/
24. exp Critical Care/
25. exp “Salaries and Fringe Benefits”/
26. exp Veterinary Medicine/
27. 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26
28. 16 not 27
29. limit 28 to (English language and humans and yr = “2011 - Current”)

population characteristics, type of outcome and intervention content is presented.

Risk of bias & quality of study: We used a previously described 5-level modified instrument that has been applied to clinical trials, descriptive studies, and surveys (Hawker risk of bias) [10–12]. To grade the quality of the study, quality level 1 consisted of prospective studies that studied a clearly defined outcome measure with a random or consecutive sample, large enough to have narrow confidence intervals (CIs) as well as heterogeneous enough to have good generalizability. Quality level 2 was similar to level 1, but was more limited with respect to sample sizes or generalizability. Quality level 3 included retrospective studies that would have otherwise qualified as level 1 or 2. Quality level 4 were studies that used convenience sampling or other techniques prone to bias. Quality level 5 included studies lacking a clearly defined or validated outcome measure. We further assessed for study quality using the Hawker et al. 9 domains, averaging each domain score into a final risk of bias score [12].

3. Results

A total of 1098 titles/abstracts were reviewed. Table 2a shows excellent agreement between reviewers; however, Kappa scores were low, due to the high level of expected agreement [13]. Of these, 21 titles/abstracts were selected for further manuscript review (Table 2b).

After review of each manuscript, 6 manuscripts made the final list. (Table 3) Overall, the quality of studies was poor and thus the risk for bias high. Given the varying patient populations and outcomes for each study, each manuscript is described in further detail below.

Hoyle et al. [14]. tested a model of care termed “extended care paramedic” or ECP. These paramedics received additional training and protocols. The authors retrospectively examined the first 1000 patients seen by ECP and compared them to ‘standard’ paramedics over the same time period. Their goals were: 1) determine treatment rates in the community and 2) hospitalization rates within 7 days. The ECP was considered an extra resource, available to respond to any incoming requests, similar to a standard crew responding to an emergency. The dispatcher could choose which crew to send to the scene; if the dispatcher felt transport to the ED might be avoided with ‘treatment in the community.’ The authors noted the potential risk for bias. Ultimately, they found ECP’s transported only 40% of patients compared to 74% by standard paramedics.

Agrawal et al. [15]. conducted a pilot feasibility study involving 79 unique patients for a total of 1365 visits. Their goal was to test the feasibility of community paramedicine model for older adults living in subsidized housing, termed CHAP-EMS (Community Health Assessment Program through EMS). This program was based on the CHAP program (Cardiovascular Health Awareness Program), a screening and prevention program promoting cardiovascular health. For this pilot, community paramedics performed CV risk assessment, blood pressure monitoring, health education, diabetes and falls screening. Importantly, a key goal was to connect patients to primary care providers. Their ultimate outcome is to reduce EMS and ED utilization; however, this process focused primarily on process measures for feasibility. Rather than go to patients’ home, the CHAP-EMS conducted weekly sessions at a single subsidized housing building for 1 year. Ultimately, 34.8% of the 234 residents participated in the program, with successful linkages of

Table 2b
Manuscript Review - Degree of Agreement.

	Agreement	Expected agreement	Kappa	Std. error	p-Value
Reviewer 1 & 2	81.8%	46.3%	0.66	0.26	0.01
Reviewer 1 & 3	81.8%	46.3%	0.66	0.26	0.01
Reviewer 2 & 3	81.8%	50.4%	0.63	0.30	0.02
Three way analysis			0.65		0.00

residents not only to primary care but also to other health and wellness resources.

In their follow up study published 2 years later (2017), Agrawal et al. [16]. report their follow up data on the same number of patients. Compared to the 2 years prior to their intervention, the average number of calls from the same setting decreased by 7.1% at 6 months, and 25% by 1 year. Both systolic and diastolic blood pressures decreased significantly as well. Although not statistically significant, patients’ risk for diabetes assessed by the CANRISK score (Canadian Diabetes Risk) also decreased from high to moderate or moderate to low. Finally, a post-hoc analysis of costs suggested a decrease in acute care utilization, primarily by the decrease in 911 utilization and subsequent ER visits.

Abrashkin et al. [17]. utilized community paramedics within a disease management program for older adults, comprised of 1602 patients. Patients within this program, where the majority were older than 70, had access to a call center 24/7. A nurse would then triage the call per an algorithm. In this observational, prospective study, they found only 22% of patients required hospital transport when seen by CP. It is assumed that all patients seen by EMS were transported, but this was not explicitly reported. However, if transported, more CP patients were likely to be admitted than by traditional EMS. These intriguing findings support the need for a prospective study as the lack of a control group and selection bias limit the strength and generalizability of their findings.

Ashton et al. [18]. performed a randomized controlled trial in two settings, urban and rural, to determine whether CP interventions improved quality of life, as measured by the EQ-5D. They focused on patients who had previously visited the ER at least 3 times and had a history of at list one chronic medical condition. The skill set and training of their CPs was quite broad, allowing for both comprehensive assessment and intervention. Several findings are noteworthy. First, when compared to historical acute care utilization, patients in the CP arm had a numerical drop in ambulance utilization. Second, both groups had a reduction in quality of life (QoL), though the intervention arm had less of a reduction. Finally, this resulted in a quality adjusted life year (QALY) of \$67,000 to \$76,000 for the CP intervention; a number higher than traditionally ‘acceptable’ to be considered of value. The strengths of this study are its design and two locations. Unfortunately, over half the patients in the rural group and over a quarter of the urban group were unable to complete the study, limiting the study findings. Overall, this study would suggest CP limits reductions in QoL, but at substantial cost.

Bennett et al. [19]. conducted a pre/post test evaluation of a community paramedicine program in rural South Carolina ($n = 68$) that included a partially matched, non-randomized control arm ($n = 125$). Their primary goal was to decrease acute care utilization (i.e. hospital and ED visits). Their secondary goals included better blood pressure and blood glucose management. Importantly, Bennett et al. also describe in robust detail their program as well as program assessment, that included patient satisfaction and cost-effectiveness. Overall, their program was successful, decreasing ED visits by 59% and hospitalizations by 69% when compared to the comparison group, which saw increases in ED visits by 4% and hospitalizations by 188%. For nearly every other metric, Bennett et al. either demonstrated statistical significance or a numerical trend favoring CP, including costs. Importantly, they describe both the barriers and facilitators of success, including

Table 2a
Abstract Review - Degree of Agreement.

	Agreement	Expected agreement	Kappa	Std. error	p-value
Reviewer 1 & 2	92.5%	90.0%	0.25	0.018	0.00
Reviewer 1 & 3	93.8%	91.2%	0.29	0.018	0.00
Reviewer 2 & 3	94.5%	87.6%	0.56	0.021	0.00
Three way analysis ^a			0.381		

^a Not all 3 reviewed every abstract – thus further statistics were not possible.

Table 3
Description of manuscripts reviewed.

Author (year)	Study type	Study quality	Hawker risk of bias	Patient <i>n</i>	Intervention	Primary outcomes
Hoyle S, et al. (2012)	Retrospective, cohort study	3	3.1	797	Use of extended care paramedics (ECP) in New Zealand	For the first 1000 clinical presentations seen by ECP, determine the proportion transported to the ED vs. treated in the community. This was compared to patients seen by standard paramedics
Agrawal G. et al. (2015)	Pilot feasibility study targeting residents of a single subsidized seniors' building	4	3.4	79	Two paramedics visiting older adults once a week for 1 year. 1) BP and DM risk assessment 2) Falls risk assessment (CANRISK and TUG test) 3) health education/promotion and referral to community resources 4) ID and referral of high risk patients 5) referral of health information to their regular physician	Feasibility process measures. 1) attendance rates 2) risk assessment results 3) referrals to community resources 4) report of challenges during implementation
Abrashkin et al. (2016)	Prospective, observational cohort study comparing patients who received CP intervention vs. usual EMS within a disease management program for older adults.	3	3.33	1602	Trained CP in geriatric assessment and emergencies. Range of medication interventions from normal saline, breathing treatments, anti-emetics, IV loop diuretics, and steroids. All within a geriatric disease management program. Patients who called were originally screened by a trained RN as part of the disease management program. (this is the limitation – if things were more emergent, 911 was probably called)	Comparison of ED transport by CP responders vs. EMS as well as subsequent hospitalization.
Agrawal et al. (2017)	Completed study targeting residents of a single subsidized seniors building	4	3.7	79	Same as above	Pre-post evaluation (2 years prior prior compared to year of intervention) of number of 911 calls 2) mean blood pressure 3) diabetes risk profile, all at 1 year of implementation
Ashton et al. (2017)	Randomized controlled trial of CP intervention in both rural and urban settings	2	2.7	200	Broad range of interventions by trained CP targeting patients with 3 or more ER visits in the past year and at least one of five chronic conditions: COPD, HF, DM, HTN, or stroke.	Quality of life as measured by EQ-5D. Secondary outcome was cost-effectiveness.
Bennett et al. (2018)	Before/After study design with a non-randomized, partially matched comparison group	4	3.4	68 patients, 125 comparisons	CP targeted frequent ED utilizers with one of five chronic conditions (hypertension, diabetes, heart failure, asthma, COPD.)	Primary outcome was acute care utilization (Hospital and ED use). Secondary goals included better hypertension and blood glucose monitoring. Robust program evaluation also occurred, including cost-effectiveness and patient satisfaction

the challenges of operationalizing a CP program within an existing EMS service (as opposed to a completely separate group). Based on the authors' description, broad community support and buy-in was critical to their success; at the same time, 100% of patient respondents categorized their satisfaction with the program as 4 or 5, the highest possible scores.

4. Discussion

Based on our systematic review, the data suggest community paramedicine reduces acute care utilization. However, despite a large number of news articles seen on our review, there is little peer-reviewed, published data. This suggests work is ongoing and we hope points towards more peer-reviewed literature.

The concept of re-aligning a highly skilled, large work-force towards bridging gaps to improve healthcare quality and reduce costs is the allure of community paramedicine. A recent manuscript describing the potential of community paramedicine used the term 'primary care technicians,' suggesting trained paramedics might act outside of their traditional roles to help close the primary care gap, particularly in resource deprived environments in the United States [6]. Importantly, the authors emphasize 'primary care technicians' would not replace physicians, advance practice providers, or community health workers. Furthermore, close collaboration and integration with existing models of care would be critical for sustainability. CP programs have been

shaped and developed to address the needs of their individual communities [1,3]. As such, they have employed vastly different models (multi-visit versus single visit, inclusion of additional allied health professionals in the response team, transporting versus not.) Given limited data, it is not clear if any one model is superior to another, or if any model is superior to usual care.

Ultimately, more data is needed to help overcome the numerous hurdles of fully leveraging the community paramedicine model. First and foremost, which models are safe and effective? Second, paramedics practicing outside of usual emergency response will require legislation in most states to allow for a change in scope of practice. This then begs the question of standards in terms of training. Finally, financial sustainability will be key. By itself, it is doubtful today's reimbursement models of community paramedicine will be self-sustaining. Rather, savings generated by community paramedicine will need to be re-invested; an option most likely to be found in capitated models.

4.1. Bar-bell approach

Initially, we argue the greatest benefits of community paramedicine will fall in two large buckets. First, reducing acute care utilization (i.e. ED visits, hospitalizations) especially post-discharge. Second, and arguably the greatest value will be 'health' or primary prevention. Given the relatively longer time line and sample size of outcome benefits resulting from prevention (i.e. smoking cessation, blood pressure management,

blood sugar control), reducing acute care utilization will be the initial target for most programs; as evidenced by our own review, though with little peer-reviewed data. However, as blood pressure management and blood sugar or hemoglobin A1C measurements are so well established, outcome trials may not be necessary.

Importantly, robust evidence will require rigorous trial design. Using before/after comparisons are important but provide only a signal. Ideally, establishing data standards will enable comparisons across systems. This does not exclude local metrics to address local healthcare needs.

4.2. Limitations

The limited number of manuscripts meeting our relatively broad search criteria voids any strong conclusions about the safety, efficacy, or cost-savings of community paramedicine. Although we may have missed alternative articles in sources outside the ones queried, this is doubtful. Non-peer reviewed articles have suggested robust benefits of community paramedicine [20], however, these were excluded from our search strategy.

5. Conclusion

Based on our systematic review, there is limited robust evidence to support the community paramedicine model. More data is urgently needed before robust recommendations can be made regarding safety, efficacy, generalizability and cost-effectiveness.

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ajem.2019.02.036>.

Disclosures

PSP is or has been in the last 3 years a Consultant for: BMS, Janssen, Medtronic, Novartis, scPharmaceuticals, Trevena, Roche Diagnostics, and has received research support in the past 1 year from: Roche, USA, Novartis, PCORI, AHA, NHLBI, AHRQ.

PSP, EW, DOD, and CM all receive salary support from Indianapolis EMS.

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