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Community paramedicine: cost–benefit analysis and safety evaluation in paramedical emergency services in rural areas – a scoping review

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ABSTRACT

Objective To examine the current knowledge and possibly identify gaps in the knowledge base for cost–benefit analysis and safety concerning community paramedicine in rural areas.

Design Scoping review.

Data sources MEDLINE via PubMed, CINAHL, Cochrane and Embase up to December 2020.

Study selection All English studies involving community paramedicine in rural areas, which include cost–benefit analysis or safety evaluation.

Data extraction This scoping review follows the methodology developed by Arksey and O'Malley and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews. We systematically searched for all types of studies in the databases and the reference lists of key studies to identify studies for inclusion. The selection process was in two steps. First, two reviewers independently screened 2309 identified articles for title and abstracts and second performed a full-text review of 24 eligible studies for inclusion.

Results Three articles met the inclusion criteria concerning cost–benefit analysis, two from Canada and one from USA. No articles met the inclusion criteria for safety evaluation.

Conclusion There are knowledge gaps concerning safety evaluation of community paramedicine in rural areas. Three articles were included in this scoping review concerning cost–benefit analysis, two of them showing positive cost-effectiveness with community paramedicine in rural areas.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ There are limited studies that investigate cost–benefit analysis or safety evaluation in rural community paramedicine.
⇒ Gaps in the knowledge base were identified.
⇒ Leaving out grey literature and our choice of search strategy may have caused us to miss relevant articles.

INTRODUCTION

Community paramedicine has developed in response to changing needs and conditions for healthcare in several countries, for example, Australia, Canada, USA and UK.[1] The traditional tasks of paramedics were primarily to provide emergency medical response and transportation of patients to nearby medical facilities.[2] Today community paramedics have incorporated substantially more tasks than emergency medical response and transportation due to higher education and new healthcare organisation with a wide variation between countries and even within some countries.[3] Although, there is currently no common consensus on the definition, role and tasks of community paramedics, the following definition proposed by the International Roundtable on Community Paramedicine (IRCP) has been widely cited: 'Community paramedicine is a model of care whereby paramedics apply their training and skills in 'non-traditional' community-based environments, often outside the usual emergency response and transportation model'.[4] The core areas for community paramedicine can be summarised into four main areas: emergency medical response, multiagency collaboration, patient-centred prevention and establishment of education and development programmes.[5]

The need for change in community healthcare services has evolved through a combination of healthcare service gaps in under-served communities and the growing professionalisation of the workforce. This has led to new models of community paramedicine.[6–8] Established gaps in healthcare delivery can have various causes, of which two major factors are the global ageing of the population together with an increased urbanisation. The population aged 65 and above is growing faster than all other age groups.[9]

Increased urbanisation is also a worldwide phenomenon, where more than half of the global population today live in urbanised areas.[10] The definition of rural vs urban areas varies widely between nations, and the definition by the United Nations (UN) emphasises that due to distinct nationwide characteristics a single definition applicable to all countries is not amenable.[11]

The combination of an ageing population and urbanisation leaves rural health services more vulnerable, where the number of relatively fewer health workers left, has led to new models of community paramedicine. Rural parts of Norway are experiencing difficulties with recruiting skilled health personnel and the forecast predicts increased challenges due to an older population, urbanisation and centralisation of healthcare services towards larger communities.[12] By allowing paramedics to work in expanded roles in cooperation with primary healthcare services the goal is to improve access to care in rural areas and increased use of existing resources.[6]

Study rationale

Community paramedicine is a relatively new model of healthcare delivery in the interface between primary healthcare services and emergency medical services (EMSs).[1] Community paramedics work in expanded roles and increase medical access in underserved communities.[13] Rising expectations from patients and next of kin are seen in many countries with public health systems.[14] Public policy debates concerning the health service can often relate more to quantity than quality, for example more services, more general practitioners (GPs), more high-cost pharmaceuticals and more hospital-beds. It is normal to consider the quality of healthcare as one of the most fundamental expectations.[14] Safety and subsequent evaluations are regarded as one of six quality dimensions as defined by the Institute of Medicine where the safety aspect incorporates the task of avoiding injuries from healthcare services that are intended to help the patient.[15]

To decide on the worth of a project involving public expenditure, it is necessary to compare advantages and disadvantages. Cost–benefit analysis is a way of deciding what society prefers. Where only one option can be chosen from a series of options, the cost–benefit analyses should inform the decision-maker as to which option is socially most preferred.[16]

By searching for all relevant studies concerning community paramedicine in rural areas for cost–benefit analysis and safety, our intention was to collate and summarise knowledge and possibly identify gaps in the research/knowledge base. Thereby, learn more about community paramedicine in rural areas and facilitate a new model of care in rural Norway.

Study objectives

The objective of this scoping review is to identify, categorise, summarise and synthesise knowledge about cost–benefit analysis and safety evaluation for community paramedicine in rural areas and thereby, identify knowledge gaps and develop recommendations for future research surrounding community paramedicine. This review has the following research questions:

1. Are there cost–benefit analyses for community paramedicine in rural areas and if so what are their characteristics?
2. Are there safety studies for community paramedicine in rural areas and if so what are their characteristics?

METHODS AND ANALYSIS

A systematic scoping review methodology was employed, based on a previously published protocol.[17] Briefly, this scoping review followed the methodology developed by Arksey and O'Malley.[18] They described the following five-stage approach: (1) identifying the research question(s); (2) identifying potentially relevant studies; (3) selecting eligible studies; (4) charting the data and (5) collating, summarising and reporting the results. In addition, a consultation exercise is an optional step that we performed. During the consultation exercise, authors of the included studies were contacted to confirm the components of their respective studies. Unfortunately, we received no replies to our request by mail. We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines extension for Scoping Reviews; Checklist and Explanation.[19]

Search strategy

The authors, who included an experienced librarian (ML), created the search strategy (online supplemental file 1). A combination of the three-step search plan previously described by Peters *et al* and search strategies for articles related to paramedic practice by Olaussen *et al* was applied to identify all relevant studies and published in the protocol.[17 20 21] Literature search strategies were developed using medical subject headings and text words related to community paramedicine, cost–benefit analysis and safety evaluation.[17] MEDLINE via PubMed, CINAHL, Cochrane and Embase were searched twice, first in September and then in December 2020. Searches were performed for articles in English without any date of publication restrictions. The databases were searched from the specific inception time of each database. We also included five articles recommended by reviewer during the submission of our scoping review protocol.[17 22–26] All reference lists of included articles were searched to identify additional studies, by which nine articles were identified.

The criteria for inclusion in this study were all articles concerning health personnel working as community paramedics regardless of model of community paramedicine studied as long as they fulfilled the following criteria:

1. Empirical studies taking place in rural areas, defined as rural by the authors.
2. Cost–benefit analysis or safety evaluation performed in the study.
3. English language.

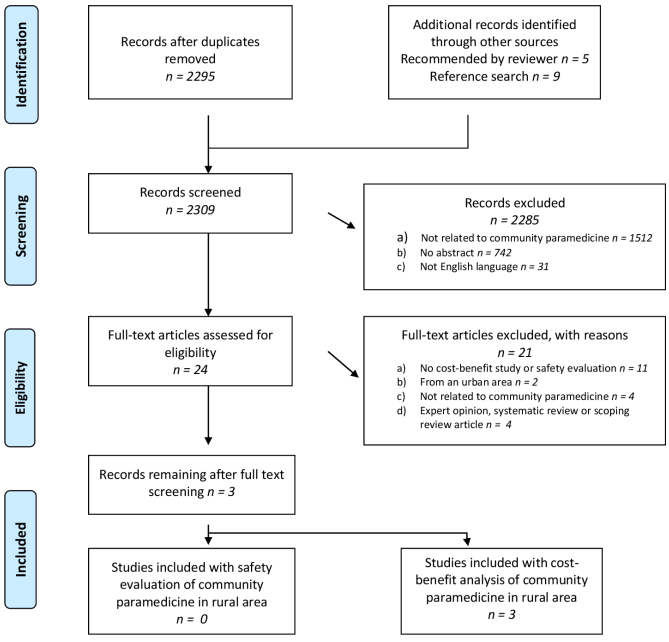

Figure 1 Study flow diagram of the literature review process this figure illustrates the inclusion and exclusion process of selected literature.

Excluded were articles without an abstract, textbooks, comments, letters to the editor, guidelines, opinion and policy documents.

Study selection and data extraction

All identified articles were collected and uploaded into our citation management system (Endnote V.X9 (Clarivate Analytics, Pennsylvania, USA)). A two-part study selection process was used: (1) title and abstract review and (2) full-text review. In the first stage, the first (OEE) and second (OU) author independently screened the abstracts and titles according to the inclusion and exclusion criteria using the web-based citation management system Rayyan (Qatar Computing Research Institute, Doha, Qatar). All the articles evaluated as being relevant were included in the full-text evaluation. The same two investigators independently assessed the full-text reports retrieved for potential inclusion. There were no differences in opinion between the two reviewers. All data were independently charted from the included papers by the first and second author. A standardised charting form was developed to aid in the categorisation of the data.

RESULTS

A total of 2309 articles were screened after the literature search (figure 1). Twenty-four potentially eligible articles remained after initial screening and were assessed in full text, of which 21 were excluded based on the inclusion and exclusion criteria. This resulted in three included studies concerning cost–benefit analysis of community paramedicine in rural areas. No articles concerning safety evaluation of community paramedicine in rural areas were eligible for inclusion. The summarised results from the included studies are presented in tables 1 and 2.

Characteristics of included studies

All three studies are from North America, with two Canadian[6 27] and one from USA.[28] The studies were conducted between 2008 and 2017. Sample size for participants included ranged from 50 to 200. The study designs of included articles were one randomised controlled trial (RCT) study, one intervention study and one longitudinal study.

Cost–benefit with community paramedics in rural areas (outcome and effect)

Two of the studies showed a positive cost–benefit outcome with community paramedics in rural settings,[6 28] while in

Table 1 Study information of included studies (N=3)

Included studies	Authors year/country	Aim(s)	Type of study	Study participants
Community paramedicine applied in a rural community.	Bennett *et al*, 2017, USA[28]	To explore if a community paramedicine programme reduced emergency department (ED) visits while improving patient outcomes.	Intervention study	Comparing 68 enrolled participants and 125 comparisons pre/post test. High users of ED with one or more chronic disease.
Conserving Quality of Life through Community Paramedics.	Ashton *et al*, 2017, Canada[27]	To determine whether community paramedicine services (the intervention through home visits) would have a positive economic impact through influencing self-perceived quality of life and determining a monetised value.	Randomised controlled trial	200 participants. High users of healthcare services with one or more of five chronic diseases.
Cost-effectiveness and outcomes of a nurse practitioner-paramedic family physician model of care: the Long and Brier Islands study.	Martin-Misener *et al*, 2008, Canada[6]	To describe and evaluate the cost-effectiveness and outcomes of a nurse practitioner-paramedic-family physician model of care for adults living in a rural community.	Longitudinal study	50 participants over 3 years. Adult residents with more than one chronic disease, able to give informed written consent.

Table 2 Study information of included studies (N=3)

Included studies	Inclusion criteria	What is included in the cost–benefit analysis?	Method(s) and data used	Cost–benefit outcome
Community paramedicine applied in a rural community.[28]	Community paramedicine Cost–benefit analysis Rural	Health parameters Reduced healthcare utilisation	Total cost of community paramedic service Reduction in healthcare utilisation seen in local healthcare statistics and estimated prices for Emergency Department visits, EMS calls, hospital admissions, healthcare cost statistics Thereby comparing programme cost with cost avoidance	Positive
Conserving Quality of Life through Community Paramedics.[27]	Community paramedicine Cost–benefit analysis Both rural and urban area	Quality-adjusted life-years (QALYs) measured by EQ-5D Cost of community paramedic per patient per year	Economic impact of community paramedic service calculated through monetising the value of conserving QALYs measured by EQ-5D questionnaire divided by total cost per intervention	Negative or inconclusive
Cost-effectiveness and outcomes of a nurse practitioner-paramedic family physician model of care: the Long and Brier Islands study.[6]	Nurses, community paramedics together with physician Cost–benefit analysis Rural	Cost of programme Reduction in costs for medication and travel to General Practitioner or hospital.	Cost of programme over 3 years. Local healthcare statistics over 3 years Structured questionnaires, both individual and group interviews to map psychosocial adjustment during the programme period. Compared with previous cost to medication and travel for local population.	Positive

A standardised measure of health-related quality of life.
EMS, Emergency Medical Services.

the third study the cost for every quality-adjusted life-year (QALY) gained was higher than recommended by the National Institute for Health and Care Excellence (NICE) guidelines.[27] The studies measured different health variables. Importantly, all three studies showed a health benefit for the patients treated or followed up by community paramedics. The health benefits were shown through reduced blood pressure, reduced glucose fasting level, lesser fall in QALY with community paramedicine and indirectly with reduced expenses for medication, transportation and health consultations (GP, emergency department (ED) or less intensive care). The cost was measured in monetary units in all of the three studies, either Canadian or US dollars.

Cost-effectiveness and outcomes of a nurse practitioner–paramedic family physician model of care: the Long and Brier Islands study by Martin-Misener et al followed 50 participants over 3 years.[6] The aim was to compare expenses for medications, transportation, GP consultations and hospital admissions before and during the study period. The cost in monetary units decreased year by year, significantly for both medication and travel expenses. The use of both GP and ED services were reduced with more than 24% during the study period. No significant differences were found for psychosocial health, scored with the Psychosocial Adjustment to Illness Scale (PAIS) over the 3 years of the study.[6] The PAIS is a multidimensional, semistructured clinical interview designed to assess the psychological and social adjustment of medical patients.[29]

Community paramedicine applied in a rural community by Bennet *et al* enrolled 68 participants in the intervention group that received a written care plan approved by the medical director, and community paramedics executed the plan through follow-up visits. A total of 125 persons with similar comorbidities, gender, age, race and insurance type made up a control group over 15 months. The results were compared through a 6-month chart

review from the nearby hospital, Abbeville Area Medical Center and Abbeville County EMS, South Carolina, USA before study start.[28] Through education and guidance, community paramedics facilitated a shift from providing assessment and care in the ED and inpatient arena, to outpatient and medical home-based care. This led to a meaningful difference in health, for example reduced blood pressure among those with hypertension and reduced fasting glucose level among those with diabetes, and reduced local health spending.[28]

Conserving Quality of Life through Community Paramedics by Ashton *et al* completed an RCT study in both rural and urban area for community paramedics.[27] An intervention group, receiving community paramedicine services, and a control group in both urban and rural area (urban with 120 participants and rural with 80 participants in total) for frequent users of healthcare services, were recruited in early 2015. Frequent users were visitors to the emergency room (ER) with three or more visits in the preceding year, and with one or more of five chronic diseases (eg, congestive heart failure, chronic obstructive pulmonary disease, hypertension, stroke and diabetes). These participants were randomly assigned to either the intervention group (receiving community paramedicine services for 12 months) or the control group (receiving conventional treatment). There was a reduction in EQ-5D 3L score (a standardised measure of health-related quality of life) for all groups, which translates into a reduced QALY score. With a lesser reduction in EQ-5D 3L in the intervention groups compared with the control groups, both in rural and urban area, the study showed a positive effect with community paramedicine for the patients. EQ-5D 3L is a validated questionnaire for measuring quality of life through five domains (mobility, self-care, usual activities, pain/discomfort and anxiety/depression). EQ-5D 3L indices range from 1 through zero to −0.6. One[1] is perfect health, zero (0) equals death and 'elow zero represent states worse than death'.[30] The healthcare expenditure was higher than recommended by the NICE guidelines. However, the number of participants was small for a relatively short period of 12 months; a larger group for a longer time period could have reduced the cost per QALY.[27]

DISCUSSION

To our knowledge, this is the first scoping review article concerning safety or cost–benefit evaluations in community paramedicine in rural areas. The search strategy was wide, but we only located three studies with regards to cost–benefit analysis. No articles concerning safety evaluation with community paramedics in rural areas were identified.

Safety is an important aspect when evaluating quality of care. As part of a multidimensional framework, focus on increased safety and risk reduction is imperative when implementing new models of care.[15] Safety evaluation in urban areas with community paramedics, has previously been described by Mason *et al*.[31] Based on their cluster RCT where 3018 patients aged over 60 years who called the EMS were either given paramedic practitioners or standard EMS. Here they concluded that community paramedicine in urban areas is safe.[31] However, the clinical setting was a highly urbanised area (Sheffield, England) and is therefore not directly comparable to a rural setting.[31] In our opinion there seem to be a knowledge gap concerning safety evaluation in rural areas for community paramedicine, as no eligible studies could be included in our search. Studying safety within a healthcare service is complex due to many context sensitive variables, for example education, equipment, workload, funding, morbidity, mortality, numbers treated, admissions to hospital or recontact.[15] Due to the complexity and multiple variables, safety evaluations are difficult and will need high larger study cohorts. When establishing and implementing new models of care, follow-up research should be incorporated as a natural part of any project, to provide further knowledge and optimisation of care models. As community paramedicine has been an evolving new model of care during the last two decades, this research article show a lack of follow-up research concerning safety with community paramedicine in rural areas.

Cost–benefit analysis has two distinctive tasks: (1) to compare costs and consequences, and (2) to compare two or more alternative treatment options.[32] In a cost–benefit analysis consequences are measured as the net costs/benefits of applying one programme over another measured in monetary units.[32] Cost-effectiveness analysis compares cost to gains in quality of life in one programme compared with the other.[33] We have included both types of analysis in our scoping review. In the included studies, Ashton *et al*[27] converted EQ-5D 3L, a validated tool for patient self-scoring of experienced health,[30] to QALY. In the study by Martin-Misener *et al*,[6] PAIS was used as a validated tool for patient self-scoring, to score psychosocial health, thereby both of these made a cost-effectiveness analysis for community paramedics in a rural area.[29]

With only three studies included describing the specific investigative questions within the field of community paramedicine in countries with large populations, there is a paucity of published knowledge. Therefore, we recommend new studies, for example comparing quality life-years gained with community paramedics versus regular ambulance service in comparable rural areas. Using validated scoring tools (eg, EQ-5D) before, during and after implementations of new care models, this approach could provide a wider basis using scientific methodology for future decisions. As traditional medical research mainly focuses on the aspects of biopsychosocial processes and outcome,[34] future healthcare research also needs to address data on treatment costs and expanded framework models of quality.[15]

To study safety within a healthcare service is complex due to many variables. Therefore, there is a need for a multidimensional approach to evaluate safety. Safety is

however of paramount importance in any health service and is incorporated in many systems as a quality indicator.[15] Interpreting the findings in a scoping review can be challenging without a quality appraisal of the included articles. In the Long and Brier Island study by Martin-Misener *et al*,[6] there were no differentiation between nurses and paramedics in the evaluation of the model used. This potentially limit the value of the Long and Brier Island study in our scoping review, even though the paramedics in the study worked according to the definition outlined by the IRCP. Another limitation is that very few articles were included in our study. This potentially may have resulted from the strict inclusion criteria applied. Another possibility is that our scoping review was only based on peer-reviewed articles searchable in the defined literature databases. Community paramedicine is a new evolving field of medicine, where academic research is scarce. This may lead to lack of peer-review publications, though safety and cost–benefit evaluations may have been published in other journals not eligible for our search. In the initial phase of this article, we; therefore, decided not to include non-peer review publications (ie, grey literature) due to inconsistencies in search results with electronic databases and due to the methodological challenges such as lack of transparency and replicability.

CONCLUSION

There are knowledge gaps concerning safety evaluation of community paramedicine in rural areas. Three articles were included in this scoping review concerning cost–benefit analysis, two of them showing positive cost-effectiveness with community paramedicine in rural areas.

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Contributors HSH conceived the idea behind and is guarantor for this study. OEE, ML and HSH jointly developed the research questions. ML conducted the search. ML constructed the search map in the supplemental file. OEE and OU screened the records and full-text articles. OEE and OU outlined and wrote the article. All authors further revised the paper and approved the final text.

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