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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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3 **Community paramedicine – Cost-benefit analysis and safety evaluation in**  
4 **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 PRISMA extension for scoping reviews (PRISMA-ScR). 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. Firstly, two reviewers independently screened 2309 identified articles for title and abstracts and secondly 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.

## ARTICLE SUMMARY

### Strengths and limitations of this study

- There are limited studies that investigate cost-benefit analysis or safety evaluation in rural community paramedicine.
- Through our overview, gaps in the knowledge base were identified. The broad search on published literature aimed at balancing sensitivity and precision. However, leaving out grey literature and our choice of search strategy may have caused us to miss relevant articles.
- A study of safety within a health care service is complex due to many context sensitive variables and therefore there is a need for a multidimensional approach to evaluate safety.
- To interpret the findings in a scoping review can be challenging without a quality appraisal of the included articles.

### KEYWORDS

Community paramedic

Cost-benefit analysis

Safety

Rural area

## INTRODUCTION

Community paramedicine has developed in response to changing needs and conditions for health care 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 these tasks, education and health care organisations for community paramedics, incorporate substantially more and there is wide variation between countries and even within 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, multi-agency collaboration, patient-centred prevention and establishment of education and development programmes (5).

The need for change in community health care services has evolved through a combination of health care 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 health care 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 urbanized areas (10). The definition of rural versus urban areas varies widely between nations, and the definition by the United Nations (UN) emphasizes 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 health care services towards larger communities (12). By allowing paramedics to work in expanded roles in cooperation with primary

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3 healthcare services the goal is to improve access to care in rural areas and increased use of  
4 existing resources (6).

### 7 **Study rationale**

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

20  
21 To decide on the worth of a project involving public expenditure, it is necessary to compare  
22 advantages and disadvantages. Cost-benefit analysis is a way of deciding what society prefers.  
23 Where only one option can be chosen from a series of options, the cost-benefit analyses  
24 should inform the decision maker as to which option is socially most preferred (16).

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26 By searching for all relevant studies concerning community paramedicine in rural areas for  
27 cost-benefit analysis and safety, our intention was to identify gaps in the research/knowledge  
28 base.

### 29 **Objectives**

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31 The objective of this scoping review is to identify, categorize, summarize and synthesize  
32 knowledge about cost-benefit analysis and safety evaluation for community paramedicine in  
33 rural areas and thereby, identify knowledge gaps and develop recommendations for future  
34 research surrounding community paramedicine. This review has the following research  
35 questions:

- 36 1. Are there cost-benefit analyses for community paramedicine in rural areas and if so  
37 what are their characteristics?
  - 38 2. Are there safety studies for community paramedicine in rural areas and if so what are  
39 their characteristics?
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## 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; (5) collating, summarizing 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-Analysis guidelines extension for Scoping Reviews (PRISMA-ScR); Checklist and Explanation (19).

### Search strategy

The authors, who included an experienced librarian (ML), created the search strategy (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 Olausson 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 Peter O'Meara 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:

- a) Empirical studies from rural areas
- b) Cost-benefit analysis or safety evaluation performed in the study
- c) English language

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3 Excluded were articles without an abstract, textbooks, comments, letters to the editor,  
4 guidelines, opinion and policy documents.  
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### 8 **Study selection and data extraction**

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10 All identified articles were collected and uploaded into our citation management system  
11 (Endnote X9 [Clarivate Analytics, PA, USA]). A two-part study selection process was used:  
12 (1) title and abstract review and (2) full text review. In the first stage, the first (OEE) and  
13 second (OU) author independently screened the abstracts and titles according to the inclusion  
14 and exclusion criteria using the web-based citation management system Rayyan (Qatar  
15 Computing Research Institute, Doha, Qatar). All the articles evaluated as being relevant were  
16 included in the full text-evaluation. The same two investigators independently assessed the  
17 full-text reports retrieved for potential inclusion. There were no differences in opinion  
18 between the two reviewers. All data were independently charted from the included papers by  
19 the first and second author. A standardized charting form was developed to aid in the  
20 categorisation of the data.  
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## 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 twenty-one 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 summarized results from the included studies are presented in Table 1.

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

Included studies	Community paramedicine applied in a rural community (27).	Conserving Quality of Life through Community Paramedics (28).	Cost effectiveness and outcomes of a nurse practitioner-paramedic family physician model of care: the Long and Brier Islands study (6).
Authors Year/Country	Bennett et al, 2017, USA	Ashton et al, 2017, Canada	Martin-Misener et al, 2008, Canada
Aim(s)	To explore if a community paramedicine program reduced Emergency Department visits while improving patient outcomes.	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 monetized value.	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.
Type of study	Intervention study	Randomized controlled trial	Longitudinal study
Study participants	Comparing 68 enrolled participants and 125 comparisons pre/post test	200 participants	50 participants over three years
Inclusion criteria	Community paramedicine Cost-benefit analysis. Rural	Community paramedicine Cost-benefit analysis. Both rural and urban area.	Nurses, community paramedics together with physician Cost-benefit analysis.

			Rural
What is included in the cost-benefit analysis?	Health parameters. Reduced health care utilisation.	Quality adjusted life years (QALY) measured by EQ-5D. Cost of community paramedic per patient per year.	Cost of program Reduction in costs for medication and travel to General Practitioner or hospital.
Method(s) and data used	Total cost of community paramedic service. Reduction in health care utilisation seen in local health care statistics and estimated prices for Emergency Department visits, EMS calls, hospital admissions, health care cost statistics. Thereby comparing program cost with cost avoidance.	Economic impact of community paramedic service calculated through monetizing the value of conserving quality adjusted life years (QALY) measured by EQ-5D questionnaire divided by total cost per intervention.	Cost of program over 3 years. Local health care statistics over 3 years Structured questionnaires, both individual and group interviews to map psychosocial adjustment during the program period. Compared to previous cost to medication and travel for local population.
Cost-benefit outcome	Positive	Negative/Inconclusive	Positive

*EMS: Emergency Medical Services; EQ-5D: EuroQol 5 Dimension. A standardised measure of health-related quality of life.*

### Characteristics of included studies

All three studies are from North America, with two Canadian (6, 28) and one from USA (27). 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 randomized 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, 27), while in the third study the cost for every quality adjusted life year (QALY) gained was higher than recommended by the NICE guidelines (28).

*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

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3 three years (6). The aim was to compare expenses for medications, transportation, GP  
4 consultations and hospital admissions before and during the study period. The cost in  
5 monetary units decreased year by year, significantly for both medication and travel expenses.  
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7 The use of both GP and Emergency Department (ED) services were reduced with more than  
8 24 % during the study period. No significant differences were found for psychosocial health,  
9 scored with the psychosocial adjustment to illness scale (PAIS) over the three years of the  
10 study (6). The PAIS is a multi-dimensional, semi-structured clinical interview designed to  
11 assess the psychological and social adjustment of medical patients (29).  
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18 *Community paramedicine applied in a rural community* by Bennet et al. enrolled 68  
19 participants in the intervention group that received a written care plan approved by the  
20 medical director, and community paramedics executed the plan through follow up visits (27).  
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22 125 persons with similar comorbidities, gender, age, race and insurance type made up a  
23 control group over 15 months. The results were compared through a 6-month chart review  
24 from the nearby hospital, Abbeville Area Medical Center and Abbeville County EMS, South  
25 Carolina, USA before study start (27). Through education and guidance, community  
26 paramedics facilitated a shift from providing assessment and care in the ED and inpatient  
27 arena, to outpatient and medical home-based care. This led to a meaningful difference in  
28 health, for example reduced blood pressure among those with hypertension and reduced  
29 fasting glucose level among those with diabetes, and reduced local health spending (27).  
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38 *Conserving Quality of Life through Community Paramedics* by Ashton et al completed an  
39 RCT study in both rural and urban area for community paramedics (28). An intervention  
40 group, receiving community paramedicine services, and a control group in both urban and  
41 rural area (urban with 120 participants and rural with 80 participants in total) for frequent  
42 users of healthcare services, were recruited in early 2015. Frequent users were visitors to the  
43 Emergency Room (ER) with three or more visits in the preceding year, and with one or more  
44 of five chronic diseases (e.g. congestive heart failure, chronic obstructive pulmonary disease,  
45 hypertension, stroke and diabetes). These participants were randomly assigned to either the  
46 intervention group (receiving community paramedicine services for 12 months) or the control  
47 group (receiving conventional treatment). There was a reduction in EuroQol 5 Dimension  
48 (EQ-5D) score for all groups, which translates into a reduced QALY score. With a lesser  
49 reduction in EQ-5D 3L in the intervention groups compared with the control groups, both in  
50 rural and urban area, the study showed a positive effect with community paramedicine for the  
51 patients. EQ-5D 3L is a validated questionnaire for measuring quality of life through five  
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3 domains (mobility, self-care, usual activities, pain/discomfort and anxiety/depression). EQ-5D  
4 3L indices range from 1 through zero to -0.6. One (1) is perfect health, zero (0) equals death  
5 and “below zero represent states worse than death” (30). The health care expenditure was  
6 higher than recommended by the NICE guidelines. However, the number of participants was  
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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 “below zero represent states worse than death” (30). The health care 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 (28).

## 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 randomized controlled trial 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 urbanized 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 health care service is complex due to many context sensitive variables, for example education, equipment, workload, funding, morbidity, mortality, numbers treated, admissions to hospital or re-contact (15). Due to the complexity and multiple variables, safety evaluations are difficult and need high numbers of patients. 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.

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 program over another measured in monetary units (32). Cost-effectiveness analysis compares cost to gains in quality

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3 of life in one program compared to the other (33). We have included both types of analysis in  
4 our scoping review. In the included studies, Ashton et al. (28) converted EQ-5D 3L, a  
5 validated tool for patient self-scoring of experienced health (30), to QALY. In the study by  
6 Martin-Misener et al.(6), PAIS was used as a validated tool for patient self-scoring, to score  
7 psychosocial health, thereby both of these made a cost-effectiveness analysis for community  
8 paramedics in a rural area (29).  
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14 With only three studies included describing the specific investigative questions within the  
15 field of community paramedicine in countries with large populations, there is a paucity of  
16 published knowledge. Therefore, we recommend new studies, for example comparing quality  
17 life-years gained with community paramedics versus regular ambulance service in  
18 comparable rural areas. Using validated scoring tools (e.g. EQ-5D) before, during and after  
19 implementations of new care models, this approach could provide a wider basis using  
20 scientific methodology for future decisions. As traditional medical research mainly focuses on  
21 the aspects of biopsychosocial processes and outcome (34), future health care research also  
22 needs to address data on treatment costs and expanded framework models of quality (15).  
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31 To study safety within a health care service is complex due to many variables. Therefore,  
32 there is a need for a multidimensional approach to evaluate safety. Safety is however of  
33 paramount importance in any health service and is incorporated in many systems as a quality  
34 indicator (15). Interpreting the findings in a scoping review can be challenging without a  
35 quality appraisal of the included articles. Another limitation is that very few articles were  
36 included in our study. This potentially may have resulted from the strict inclusion criteria  
37 applied. Another possibility is that our scoping review was only based on peer-reviewed  
38 articles searchable in the defined literature databases. Community paramedicine is a new  
39 evolving field of medicine, where academic research is scarce. This may lead to lack of peer-  
40 review publications, though safety and cost-benefit evaluations may have been published in  
41 other journals not eligible for our search.  
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## 51 **CONCLUSION**

52 There are knowledge gaps concerning safety evaluation of community paramedicine in rural  
53 areas. Three articles were included in this scoping review concerning cost-benefit analysis,  
54 two of them showing positive cost-effectiveness with community paramedicine in rural areas.  
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### **DATA AVAILABILITY STATEMENT**

Data are available upon reasonable request.

### **PUBLIC AND PATIENT INVOLVEMENT**

This study is based on a literature search without public or patient involvement according to the GRIPP2 short form (35). Dissemination of the results from our study will be published in an international peer-reviewed journal.

### **ETHICS AND DISSEMINATION**

The data used are from publicly available secondary sources, so this study does not require ethical review. The result will be disseminated through peer-reviewed publication.

### **ACKNOWLEDGEMENTS**

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### **AUTHOR CONTRIBUTIONS**

HSH conceived the idea behind 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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### **CONFLICT OF INTEREST**

The authors declare no conflict of interest.



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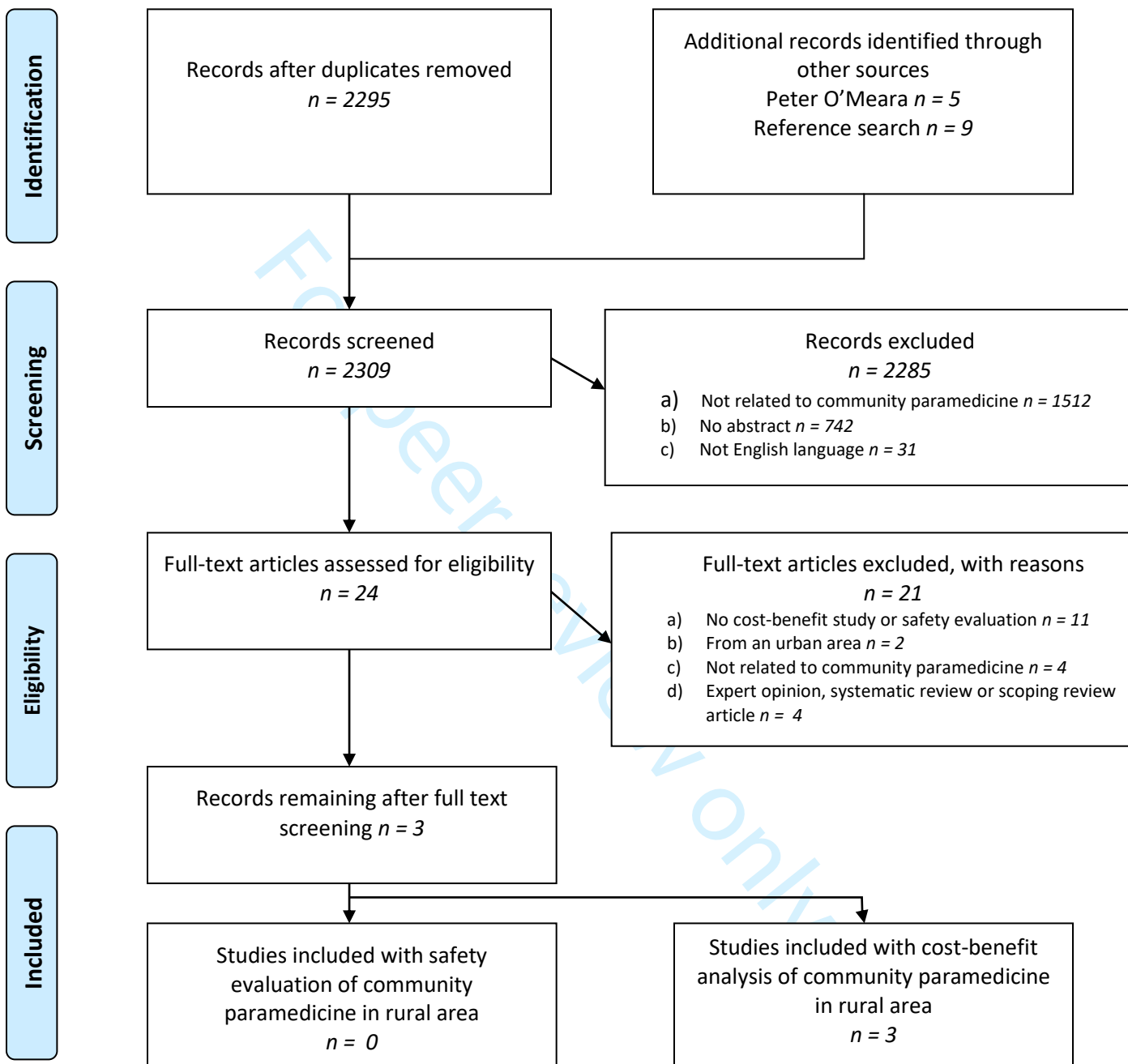
1  
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3 **LEGENDS**  
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5 **Figure 1** Study flow diagram of the literature review process  
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7 *This figure illustrates the inclusion and exclusion process of selected*  
8 *literature.*  
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11  
12 **Table 1** Data charting from included studies  
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16 **Supplemental File 1** Search strategy  
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For peer review only



## Supplemental file 1

### Search strategy for MEDLINE via PubMed, CINAHL, Cochrane, and Embase.

A preliminary search was conducted 21. of September 2020 according to the PCC-grid in table 1. This search resulted in 1273 hits.

A second search was conducted 15. of December 2020 as shown in tables 2-5. This time adding terms concerning safety and cost-benefit and removing the terms Mobile health units, Quality of life and Quadruple aim. This search resulted in 1495 hits.

The total results of both searches was 2309 hits when duplicates were removed.  
Limits: English language.

**Table 1. PCC-grid.**

	Participants	Concept	Context
Definition	Community paramedic	Cost-benefit analysis Safety	Rural area
MeSH-terms	Emergency Medical Technician Allied Health Personnel Emergency Medical Services Mobile Health Units	Analysis, cost benefit Cost-savings Health care cost Costs and cost analysis Safety Quality of Life	Rural Health Rural Health Services Rural Population
Text words in T/A	Emergency Medical Technician Emergency Medical Services Paramedic* Community Paramedicine Paramedic Practitioner	Analysis, cost benefit Cost-savings Health care cost Costs and cost analysis Safety Quadruple Aim	Rural health Rural population Rural health services

**Table 2. Search strategy in Medline via PubMed.**

Community paramedic MeSH [Medical Subject Headings]
1. Emergency Medical Technician (5737)
2. Allied Health Personnel (50177)
Community paramedic [Text words]
3. Emergency Medical Technician (379)
4. Allied Health Personnel (12015)
5. Community health workers (7640)
6. Emergency Medical Services (46758)
7. Paramedic (2624)
8. Paramedics (3917)
9. <b>or/1-8 [Community paramedic MeSH and Text words] (97,679)</b>
Cost-benefit analysis MeSH [Medical Subject Headings]
10. Costs and cost analysis (240612)
Cost-benefit analysis [Text words]
11. Cost benefit analysis (84551)
12. Cost-savings (23279)
13. Health care cost (2232)
14. Costs 52787
15. Cost comparison (1017)
16. Health expenditures (21801)
17. Cost Measures (206)
18. <b>or/10-17 [Cost-benefit analysis MeSH and Text words] (251,949)</b>
Safety MeSH [Medical Subject Headings]
19. Safety (81927)
20. Risc (1233809)
21. Medical errors (114406)
Safety [Text words]
22. Safety (587104)
23. Risk (2623006)
24. Adverse effect (31522)
25. Adverse effects (1852636)
26. Medical error (1749)
27. Medical errors (18914)
28. Patient harm (1741)
29. Patient Safety (46114)
30. <b>or/19-29 [Safety MeSH and Text words] (4,526,513)</b>
31. <b>18 or 30 [Safety or Cost-benefit MeSH and Text words] (4,723,505)</b>
Rural area MeSH [Medical Subject Headings]
32. Rural Health (23484)
33. Rural Health Services (13049)
34. Rural Population (60711)
Rural area [Text words]
35. Rural health (38996)
36. Rural population (64565)
37. Rural health services (13369)
38. Rural Communities (7359)
39. Rural Community (5241)
40. <b>or/32-39 [Rural area MeSH and Text words] (101353)</b>
41. <b>9 and 31 and 40 [Community paramedic and (Safety or Cost-benefit) and Rural area MeSH and text words] (669)</b>
42. <b>Filter: English language (653)</b>

**Table 3. Search strategy in Cinahl.**

MM=major headings, AB=abstract

Community paramedic MM [Subject Headings]
1. Allied health personnel (2533)
2. Rural health personnel (395)
Community paramedic AB [Text words in abstract]
3. "Emergency Medical Technician*" (655)
4. "Allied Health Personnel*" (58)
5. "Community health workers*" (1850)
6. "Emergency Medical Service*" (4033)
7. Paramedic* (4005)
8. <b>or/1-7 [Community paramedic MM and AB] (12,304)</b>
Cost-benefit analysis MM [Subject Headings]
9. Costs and cost analysis (4067)
Cost-benefit analysis AB [Text words in abstract]
10. "Cost benefit analysis" (724)
11. Cost-savings (7613)
12. "Health care cost*" (5792)
13. Cost* (152912)
14. "Cost* comparison*" (274)
15. "Health expenditure*" (1454)
16. "Cost Measure*" (157)
17. <b>or/9-16 [Cost-benefit analysis MM and AB] (156,017)</b>
Safety MM [Subject Headings]
18. Patient Safety (30654)
19. Health Care Errors (2226)
Safety AB [Text words in abstract]
20. Safety (143288)
21. Risk (632025)
22. "Adverse effect*" (32598)
23. "Medical error*" (2251)
24. "Patient harm" (978)
25. "Patient Safety" (16310)
26. <b>or/18-25 [Safety MM and AB] (781,678)</b>
27. <b>17 or 26 [Safety or Cost-benefit MM and AB] (897,447)</b>
Rural area MM [Subject Headings]
28. Rural Health (3735)
29. Rural Health Services (4739)
30. Rural Population (4196)
Rural area AB [Text words in abstract]
31. "Rural health" (1948)
32. "Rural population" (912)
33. "Rural health services" (123)
34. "Rural Communit*" (4413)
35. <b>or/28-34 [Rural area MM and AB] (17,398)</b>
36. <b>9 and 27 and 35 [Community paramedic and (Safety or Cost-benefit) and Rural area MM and AB] (90)</b>
37. <b>Filters:</b> English language, humans, <b>Exclude:</b> medline records (17)



**Table 4. Search strategy in Cochrane.**

ti = title, ab = abstract, kw = keyword

Community paramedic MeSH [Medical Subject Headings descriptor]
1. Allied Health Personnel (1179)
2. Emergency Medical Services (3894)
3. Mobile health units (66)
Community paramedic [Text words in (ti,ab,kw)*]
4. Emergency Medical Technician (335)
5. Allied Health Personnel (372)
6. Community health workers (2951)
7. Emergency Medical Services (4288)
8. Mobile health units (1261)
9. Paramedic* (1158)
10. <b>or/1-9 [Community paramedic MeSH and Text words] (12,708)</b>
Cost-benefit analysis MeSH [Medical Subject Headings descriptor]
11. Costs and cost analysis (10573)
Cost-benefit analysis [Text words in (ti,ab,kw)*]
12. Costs and cost analysis (37726)
13. Cost benefit analysis (12223)
14. Cost-savings (2412)
15. Health care cost (20304)
16. Costs (30108)
17. Cost comparison (8554)
18. Health expenditures (804)
19. Cost Measures (9080)
20. <b>or/11-19 [Cost-benefit analysis MeSH and Text words] (57,855)</b>
Safety MeSH [Medical Subject Headings descriptor]
21. Safety (3935)
Safety [Text words in (ti,ab,kw)*]
22. Safety (235889)
23. Risk (231552)
24. Adverse effect* (253130)
25. Medical error* (3085)
26. Patient harm (1785)
27. Patient safety (73630)
28. <b>or/21-27 [Safety MeSH and Text words] (565,707)</b>
29. <b>20 or 28 [Safety or Cost-benefit MeSH and Text words] (599,070)</b>
Rural MeSH [Medical Subject Headings descriptor]
30. Rural Health (524)
31. Rural Health Services (340)
32. Rural population (1694)
Rural area [Text words in (ti,ab,kw)*]
33. Rural health (5970)
34. Rural health service* (2008)
35. Rural population (3799)
36. Rural Communit* (3554)
37. <b>or/30-36 [Rural area MeSH and Text words] (7,689)</b>
38. <b>10 and 29 and 37 [Community paramedic and (Safety or Cost-benefit) and Rural area MeSH and Text words] (434)</b>

**Table 5. Search strategy in Embase.**

mp = title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword

Community paramedic [Emtree-term]
1. Rescue personnel (3,917)
2. Paramedical personnel (6,627)
Community paramedic [Keyword .mp]
3. "Emergency Medical Technician" (511)
4. "Allied Health Personnel" (360)
5. "Community health worker*" (5,763)
6. "Emergency Medical Service*" (14,686)
7. Paramedic* (27,665)
8. <b>or/1-7 [Community paramedic Emtree-term and Keyword] (48,751)</b>
Cost-benefit analysis [Emtree-term]
9. Cost benefit analysis (11,812)
Cost-benefit analysis [Keyword .mp]
10. "Cost benefit analysis" (11812)
11. Cost-savings (7613)
12. "Health care cost*" (23332)
13. Cost* (1110639)
14. "Cost* comparison*" (2274)
15. "Health expenditure*" (5221)
16. "Cost Measure*" (662)
17. <b>or/9-16 [Cost-benefit analysis Emtree-term and Keyword] (1,111,562)</b>
Safety [Emtree-term]
18. Safety (56780)
19. Risk (61887)
20. Medical error (8021)
Safety [Keyword .mp]
21. Safety (1178221)
22. Risk (3988547)
23. "Medical error*" (22105)
24. "Adverse effect*" (253851)
25. "Patient harm" (3628)
26. "Patient Safety" (138723)
27. <b>or/18-26 [Safety Emtree-term and Keyword] (5,026,586)</b>
28. <b>20 or 28 [Safety or Cost-benefit Emtree-term and Keyword] (5,862,751)</b>
Rural [Emtree-term]
29. Rural health care/ or rural health/ or rural population/ (60048))
Rural area [Keyword .mp]
30. "Rural health" (19283)
31. "Rural population" (50269)
32. "Rural health service*" (717)
33. "Rural Communit*" (14502)
34. <b>or/29-33 [Rural area Emtree-term and Keyword] (71,212)</b>
35. <b>8 and 28 and 34 [Community paramedic and (Safety or Cost-benefit) and Rural area Emtree-term and Keyword] (391)</b>

## Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
<b>TITLE</b>			
Title	1	Identify the report as a scoping review.	Reported on page 1
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Reported on page 2
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Reported on page 5
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Reported on page 5
<b>METHODS</b>			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	Reported on page 6 Elden OE, Uleberg O, Lysne M, Haugdahl HS. Community paramedicine-cost-benefit analysis and safety with paramedical emergency services in rural areas: scoping review protocol. <i>BMJ Open</i> . 2020;10(9):e038651. <a href="http://bmjopen.bmj.com/content/10/9/e038651.full.pdf">e038651.full.pdf (bmj.com)</a>
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Reported on page 6
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Reported on page 6
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Please see "Supplemental File 1 Search strategy"



SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Reported on page 6
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Reported on page 7
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	Please see table 1: Study information of included studies (N=3) on page 8 and 9.
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	Reported on page 3 and 12
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	Reported on page 7
<b>RESULTS</b>			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	Reported on page 8 and please see: <b>Figure 1</b> Study flow diagram of the literature review process
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	Reported on page 9
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	Reported on page 3 and 12
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Reported on page 8 and 9 Please see: Table 1: Study information of included studies (N=3).
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	Reported on page 9, 10 and 11
<b>DISCUSSION</b>			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	Reported on page 11 and 12
Limitations	20	Discuss the limitations of the scoping review process.	Reported on page 3 and 12



SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	Reported on page 12
<b>FUNDING</b>			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	Reported on page 13

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

\* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med.* 2018;169:467–473. doi: [10.7326/M18-0850](https://doi.org/10.7326/M18-0850).



# BMJ Open

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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-057752.R1
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Complete List of Authors:	Elden, Odd Eirik; Nord-Trøndelag Hospital Trust, Department of Pre-Hospital Services; St Olavs Hospital Trondheim University Hospital, Department of Emergency Medicine and Pre-Hospital Services Uleberg, Oddvar; St Olavs Hospital Trondheim University Hospital, Department of Emergency Medicine and Pre-Hospital Services; Norwegian Air Ambulance Foundation, Department of Research and Development Lysne, Marianne; Nord-Trøndelag Hospital Trust, Department of Research Haugdahl, Hege; Nord-Trøndelag Hospital Trust, Department of Research; Norwegian University of Science and Technology, Department of Public Health and Nursing
<b>Primary Subject Heading</b>:	Emergency medicine
Secondary Subject Heading:	Health services research, Health economics, Medical management, Public health
Keywords:	HEALTH ECONOMICS, HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Health & safety < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Health economics < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PUBLIC HEALTH

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3 **Community paramedicine – Cost-benefit analysis and safety evaluation in**  
4 **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 PRISMA extension for scoping reviews (PRISMA-ScR). 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. Firstly, two reviewers independently screened 2309 identified articles for title and abstracts and secondly 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.

## ARTICLE SUMMARY

### 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.

### KEYWORDS

Community paramedic

Cost-benefit analysis

Safety

Rural area

## INTRODUCTION

Community paramedicine has developed in response to changing needs and conditions for health care 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 health care organization 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, multi-agency collaboration, patient-centred prevention and establishment of education and development programmes (5).

The need for change in community health care services has evolved through a combination of health care 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 health care 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 urbanized areas (10). The definition of rural versus urban areas varies widely between nations, and the definition by the United Nations (UN) emphasizes 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 health care services towards larger communities (12). By allowing paramedics to work in expanded roles in cooperation with primary

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3 healthcare services the goal is to improve access to care in rural areas and increased use of  
4 existing resources (6).

### 7 **Study rationale**

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

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

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

### 47 **Study objectives**

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54 The objective of this scoping review is to identify, categorize, summarize and synthesize  
55 knowledge about cost-benefit analysis and safety evaluation for community paramedicine in  
56 rural areas and thereby, identify knowledge gaps and develop recommendations for future  
57 research surrounding community paramedicine. This review has the following research  
58 questions:

- 59 1. Are there cost-benefit analyses for community paramedicine in rural areas and if so  
60 what are their characteristics?

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3 2. Are there safety studies for community paramedicine in rural areas and if so what are  
4 their characteristics?  
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## 7 **METHODS AND ANALYSIS**

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

30 The authors, who included an experienced librarian (ML), created the search strategy  
31 (Supplemental File 1). A combination of the three-step search plan previously described by  
32 Peters et al. and search strategies for articles related to paramedic practice by Olausson et al.  
33 was applied to identify all relevant studies and published in the protocol (17, 20, 21).  
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38 Literature search strategies were developed using medical subject headings and text words  
39 related to community paramedicine, cost-benefit analysis and safety evaluation (17).  
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41 MEDLINE via PubMed, CINAHL, Cochrane, and Embase were searched twice, first in  
42 September and then in December 2020. Searches were performed for articles in English  
43 without any date of publication restrictions. The databases were searched from the specific  
44 inception time of each database. We also included five articles recommended by reviewer  
45 during the submission of our scoping review protocol (17, 22-26). All reference lists of  
46 included articles were searched to identify additional studies, by which nine articles were  
47 identified.  
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53 The criteria for inclusion in this study were all articles concerning health personnel working  
54 as community paramedics regardless of model of community paramedicine studied as long as  
55 they fulfilled the following criteria:  
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- 58 a) Empirical studies taking place in rural areas, defined as rural by the authors.  
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3 b) Cost-benefit analysis or safety evaluation performed in the study  
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5 c) English language

6 Excluded were articles without an abstract, textbooks, comments, letters to the editor,  
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8 guidelines, opinion and policy documents.  
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### 10 **Study selection and data extraction**

11 All identified articles were collected and uploaded into our citation management system  
12 (Endnote X9 [Clarivate Analytics, PA, USA]). A two-part study selection process was used:  
13 (1) title and abstract review and (2) full text review. In the first stage, the first (OEE) and  
14 second (OU) author independently screened the abstracts and titles according to the inclusion  
15 and exclusion criteria using the web-based citation management system Rayyan (Qatar  
16 Computing Research Institute, Doha, Qatar). All the articles evaluated as being relevant were  
17 included in the full text-evaluation. The same two investigators independently assessed the  
18 full-text reports retrieved for potential inclusion. There were no differences in opinion  
19 between the two reviewers. All data were independently charted from the included papers by  
20 the first and second author. A standardized charting form was developed to aid in the  
21 categorisation of the data.  
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## 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 twenty-one 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 summarized results from the included studies are presented in Table 1 and 2.

**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 (27).	Bennett et al, 2017, USA	To explore if a community paramedicine program reduced emergency department (ED) visits while improving patient outcomes.	Intervention study	Comparing 68 enrolled participants and 125 comparisons pre/post test. High users of emergency department (ED) with one or more chronic disease.
Conserving Quality of Life through Community Paramedics (28).	Ashton et al, 2017, Canada	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 monetized value.	Randomized 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	Martin-Misener et al, 2008, Canada	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 three years. Adult residents with more than one chronic disease, able to give informed written consent.

Brier Islands study (6).				
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**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 (27).	Community paramedicine Cost-benefit analysis. Rural	Health parameters. Reduced health care utilisation.	Total cost of community paramedic service. Reduction in health care utilisation seen in local health care statistics and estimated prices for Emergency Department visits, EMS calls, hospital admissions, health care cost statistics. Thereby comparing program cost with cost avoidance.	Positive
Conserving Quality of Life through Community Paramedics (28).	Community paramedicine Cost-benefit analysis. Both rural and urban area.	Quality adjusted life years (QALY) measured by EQ-5D. Cost of community paramedic per patient per year.	Economic impact of community paramedic service calculated through monetizing the value of conserving quality adjusted life years (QALY) 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 program Reduction in costs for medication and travel to General Practitioner or hospital.	Cost of program over 3 years. Local health care statistics over 3 years Structured questionnaires, both individual and group interviews to map psychosocial	Positive



			adjustment during the program period. Compared to previous cost to medication and travel for local population.	
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*EMS: Emergency Medical Services; EQ-5D: EuroQol 5 Dimension. A standardised measure of health-related quality of life.*

### **Characteristics of included studies**

All three studies are from North America, with two Canadian (6, 28) and one from USA (27). 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 randomized 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, 27), while in the third study the cost for every quality adjusted life year (QALY) gained was higher than recommended by the NICE guidelines (28). 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, 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 three 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 Emergency Department (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 three years of the

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3 study (6). The PAIS is a multi-dimensional, semi-structured clinical interview designed to  
4 assess the psychological and social adjustment of medical patients (29).  
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7 *Community paramedicine applied in a rural community* by Bennet et al. enrolled 68  
8 participants in the intervention group that received a written care plan approved by the  
9 medical director, and community paramedics executed the plan through follow up visits. 125  
10 persons with similar comorbidities, gender, age, race and insurance type made up a control  
11 group over 15 months. The results were compared through a 6-month chart review from the  
12 nearby hospital, Abbeville Area Medical Center and Abbeville County EMS, South Carolina,  
13 USA before study start (27). Through education and guidance, community paramedics  
14 facilitated a shift from providing assessment and care in the ED and inpatient arena, to  
15 outpatient and medical home-based care. This led to a meaningful difference in health, for  
16 example reduced blood pressure among those with hypertension and reduced fasting glucose  
17 level among those with diabetes, and reduced local health spending (27).  
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27 *Conserving Quality of Life through Community Paramedics* by Ashton et al completed an  
28 RCT study in both rural and urban area for community paramedics (28). An intervention  
29 group, receiving community paramedicine services, and a control group in both urban and  
30 rural area (urban with 120 participants and rural with 80 participants in total) for frequent  
31 users of healthcare services, were recruited in early 2015. Frequent users were visitors to the  
32 Emergency Room (ER) with three or more visits in the preceding year, and with one or more  
33 of five chronic diseases (e.g. congestive heart failure, chronic obstructive pulmonary disease,  
34 hypertension, stroke and diabetes). These participants were randomly assigned to either the  
35 intervention group (receiving community paramedicine services for 12 months) or the control  
36 group (receiving conventional treatment). There was a reduction in EQ-5D 3L score for all  
37 groups, which translates into a reduced QALY score. With a lesser reduction in EQ-5D 3L in  
38 the intervention groups compared with the control groups, both in rural and urban area, the  
39 study showed a positive effect with community paramedicine for the patients. EQ-5D 3L is a  
40 validated questionnaire for measuring quality of life through five domains (mobility, self-care,  
41 usual activities, pain/discomfort and anxiety/depression). EQ-5D 3L indices range from 1  
42 through zero to -0.6. One (1) is perfect health, zero (0) equals death and “below zero  
43 represent states worse than death” (30). The health care expenditure was higher than  
44 recommended by the NICE guidelines. However, the number of participants was small for a  
45 relatively short period of 12 months; a larger group for a longer time period could have  
46 reduced the cost per QALY (28).  
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## 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 randomized controlled trial 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 urbanized 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 health care service is complex due to many context sensitive variables, for example education, equipment, workload, funding, morbidity, mortality, numbers treated, admissions to hospital or re-contact (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 program over another measured in monetary units (32). Cost-effectiveness analysis compares cost to gains in quality of life in one program compared to the other (33). We have included both types of analysis in our scoping review. In the included studies, Ashton et al. (28) 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

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3 psychosocial health, thereby both of these made a cost-effectiveness analysis for community  
4 paramedics in a rural area (29).  
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7 With only three studies included describing the specific investigative questions within the  
8 field of community paramedicine in countries with large populations, there is a paucity of  
9 published knowledge. Therefore, we recommend new studies, for example comparing quality  
10 life-years gained with community paramedics versus regular ambulance service in  
11 comparable rural areas. Using validated scoring tools (e.g. EQ-5D) before, during and after  
12 implementations of new care models, this approach could provide a wider basis using  
13 scientific methodology for future decisions. As traditional medical research mainly focuses on  
14 the aspects of biopsychosocial processes and outcome (34), future health care research also  
15 needs to address data on treatment costs and expanded framework models of quality (15).  
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23 To study safety within a health care service is complex due to many variables. Therefore,  
24 there is a need for a multidimensional approach to evaluate safety. Safety is however of  
25 paramount importance in any health service and is incorporated in many systems as a quality  
26 indicator (15). Interpreting the findings in a scoping review can be challenging without a  
27 quality appraisal of the included articles. In the Long and Brier Island study by Martin-  
28 Misener et al (6), there were no differentiation between nurses and paramedics in the  
29 evaluation of the model used. This potentially limit the value of the Long and Brier Island  
30 study in our scoping review, even though the paramedics in the study worked according to the  
31 definition outlined by the International Roundtable on Community Paramedicine. Another  
32 limitation is that very few articles were included in our study. This potentially may have  
33 resulted from the strict inclusion criteria applied. Another possibility is that our scoping  
34 review was only based on peer-reviewed articles searchable in the defined literature  
35 databases. Community paramedicine is a new evolving field of medicine, where academic  
36 research is scarce. This may lead to lack of peer-review publications, though safety and cost-  
37 benefit evaluations may have been published in other journals not eligible for our search. In  
38 the initial phase of this article, we therefore decided not to include non-peer review  
39 publications (i.e. grey literature) due to inconsistencies in search results with electronic  
40 databases and due to the methodological challenges such as lack of transparency and  
41 replicability.  
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**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.

For peer review only

### **DATA AVAILABILITY STATEMENT**

Data are available upon reasonable request.

### **PUBLIC AND PATIENT INVOLVEMENT**

This study is based on a literature search without public or patient involvement according to the GRIPP2 short form (35). Dissemination of the results from our study will be published in an international peer-reviewed journal.

### **ETHICS AND DISSEMINATION**

The data used are from publicly available secondary sources, so this study does not require ethical review. The result will be disseminated through peer-reviewed publication.

### **ACKNOWLEDGEMENTS**

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### **CONTRIBUTORS**

HSH conceived the idea behind 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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### **CONFLICT OF INTEREST**

The authors declare no conflict of interest.

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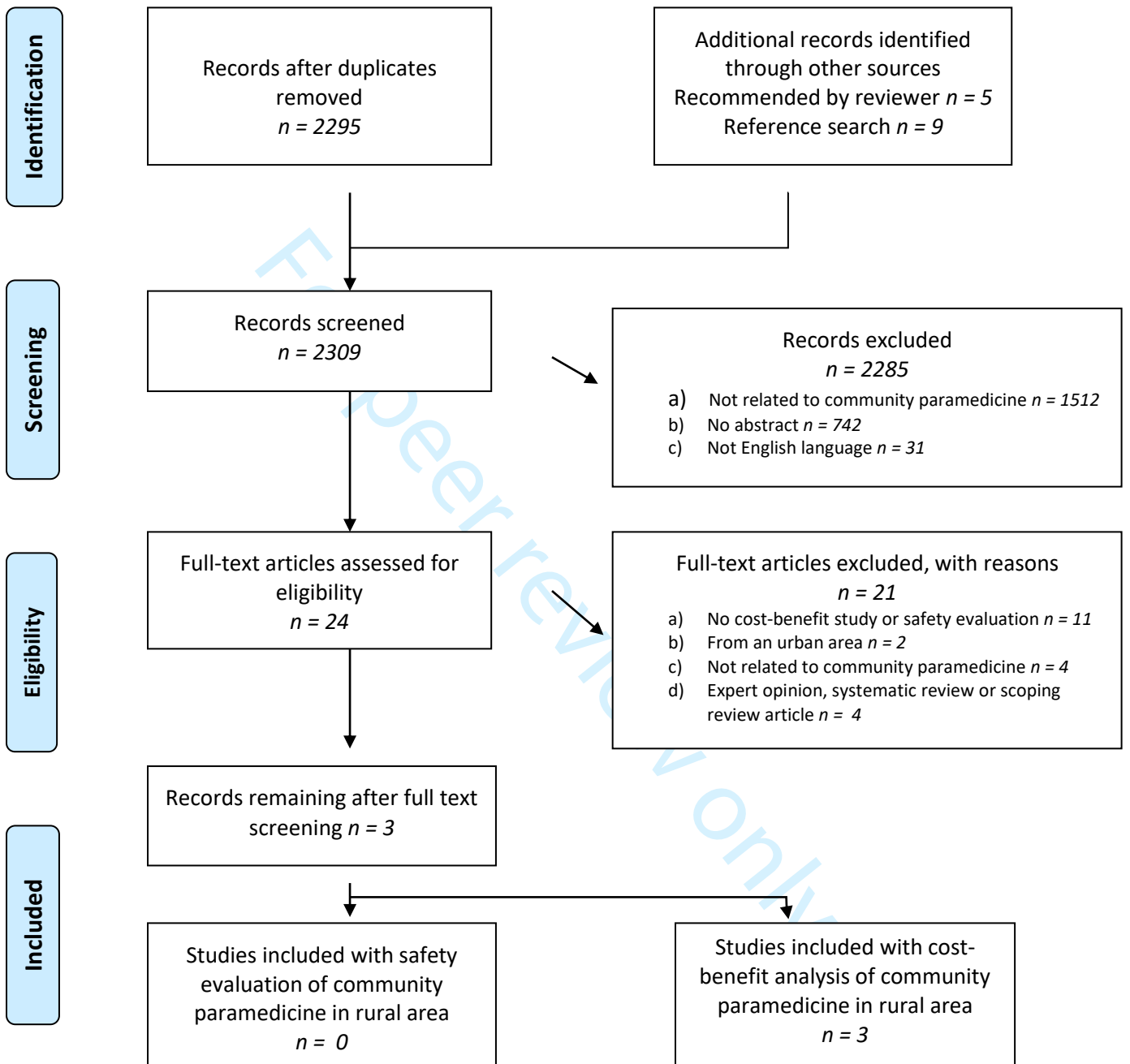
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3 **LEGENDS**  
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5 **Figure 1** Study flow diagram of the literature review process  
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7 *This figure illustrates the inclusion and exclusion process of selected*  
8 *literature.*  
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11  
12 **Table 1 and 2** Data from our three included studies, presented and discussed  
13 concerning cost-benefit analysis of community paramedicine in rural  
14 areas.  
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19 **Supplemental File 1** Search strategy  
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For peer review only



## Supplemental file 1

### Search strategy for MEDLINE via PubMed, CINAHL, Cochrane, and Embase.

A preliminary search was conducted 21. of September 2020 according to the PCC-grid in table 1. This search resulted in 1273 hits.

A second search was conducted 15. of December 2020 as shown in tables 2-5. This time adding terms concerning safety and cost-benefit and removing the terms Mobile health units, Quality of life and Quadruple aim. This search resulted in 1495 hits.

The total results of both searches was 2309 hits when duplicates were removed.  
Limits: English language.

Table 1. PCC-grid.

	Participants	Concept	Context
Definition	Community paramedic	Cost-benefit analysis Safety	Rural area
MeSH-terms	Emergency Medical Technician Allied Health Personnel Emergency Medical Services Mobile Health Units	Analysis, cost benefit Cost-savings Health care cost Costs and cost analysis Safety Quality of Life	Rural Health Rural Health Services Rural Population
Text words in T/A	Emergency Medical Technician Emergency Medical Services Paramedic* Community Paramedicine Paramedic Practitioner	Analysis, cost benefit Cost-savings Health care cost Costs and cost analysis Safety Quadruple Aim	Rural health Rural population Rural health services

**Table 2. Search strategy in Medline via PubMed.**

Community paramedic MeSH [Medical Subject Headings]
1. Emergency Medical Technician (5737)
2. Allied Health Personnel (50177)
Community paramedic [Text words]
3. Emergency Medical Technician (379)
4. Allied Health Personnel (12015)
5. Community health workers (7640)
6. Emergency Medical Services (46758)
7. Paramedic (2624)
8. Paramedics (3917)
9. <b>or/1-8 [Community paramedic MeSH and Text words] (97,679)</b>
Cost-benefit analysis MeSH [Medical Subject Headings]
10. Costs and cost analysis (240612)
Cost-benefit analysis [Text words]
11. Cost benefit analysis (84551)
12. Cost-savings (23279)
13. Health care cost (2232)
14. Costs 52787
15. Cost comparison (1017)
16. Health expenditures (21801)
17. Cost Measures (206)
18. <b>or/10-17 [Cost-benefit analysis MeSH and Text words] (251,949)</b>
Safety MeSH [Medical Subject Headings]
19. Safety (81927)
20. Risc (1233809)
21. Medical errors (114406)
Safety [Text words]
22. Safety (587104)
23. Risk (2623006)
24. Adverse effect (31522)
25. Adverse effects (1852636)
26. Medical error (1749)
27. Medical errors (18914)
28. Patient harm (1741)
29. Patient Safety (46114)
30. <b>or/19-29 [Safety MeSH and Text words] (4,526,513)</b>
31. <b>18 or 30 [Safety or Cost-benefit MeSH and Text words] (4,723,505)</b>
Rural area MeSH [Medical Subject Headings]
32. Rural Health (23484)
33. Rural Health Services (13049)
34. Rural Population (60711)
Rural area [Text words]
35. Rural health (38996)
36. Rural population (64565)
37. Rural health services (13369)
38. Rural Communities (7359)
39. Rural Community (5241)
40. <b>or/32-39 [Rural area MeSH and Text words] (101353)</b>
41. <b>9 and 31 and 40 [Community paramedic and (Safety or Cost-benefit) and Rural area MeSH and text words] (669)</b>
42. <b>Filter: English language (653)</b>

**Table 3. Search strategy in Cinahl.**

MM=major headings, AB=abstract

Community paramedic MM [Subject Headings]
1. Allied health personnel (2533)
2. Rural health personnel (395)
Community paramedic AB [Text words in abstract]
3. "Emergency Medical Technician*" (655)
4. "Allied Health Personnel*" (58)
5. "Community health workers*" (1850)
6. "Emergency Medical Service*" (4033)
7. Paramedic* (4005)
8. <b>or/1-7 [Community paramedic MM and AB] (12,304)</b>
Cost-benefit analysis MM [Subject Headings]
9. Costs and cost analysis (4067)
Cost-benefit analysis AB [Text words in abstract]
10. "Cost benefit analysis" (724)
11. Cost-savings (7613)
12. "Health care cost*" (5792)
13. Cost* (152912)
14. "Cost* comparison*" (274)
15. "Health expenditure*" (1454)
16. "Cost Measure*" (157)
17. <b>or/9-16 [Cost-benefit analysis MM and AB] (156,017)</b>
Safety MM [Subject Headings]
18. Patient Safety (30654)
19. Health Care Errors (2226)
Safety AB [Text words in abstract]
20. Safety (143288)
21. Risk (632025)
22. "Adverse effect*" (32598)
23. "Medical error*" (2251)
24. "Patient harm" (978)
25. "Patient Safety" (16310)
26. <b>or/18-25 [Safety MM and AB] (781,678)</b>
27. <b>17 or 26 [Safety or Cost-benefit MM and AB] (897,447)</b>
Rural area MM [Subject Headings]
28. Rural Health (3735)
29. Rural Health Services (4739)
30. Rural Population (4196)
Rural area AB [Text words in abstract]
31. "Rural health" (1948)
32. "Rural population" (912)
33. "Rural health services" (123)
34. "Rural Communit*" (4413)
35. <b>or/28-34 [Rural area MM and AB] (17,398)</b>
36. <b>9 and 27 and 35 [Community paramedic and (Safety or Cost-benefit) and Rural area MM and AB] (90)</b>
37. <b>Filters:</b> English language, humans, <b>Exclude:</b> medline records (17)

**Table 4. Search strategy in Cochrane.**

ti = title, ab = abstract, kw = keyword

Community paramedic MeSH [Medical Subject Headings descriptor]
1. Allied Health Personnel (1179)
2. Emergency Medical Services (3894)
3. Mobile health units (66)
Community paramedic [Text words in (ti,ab,kw)*]
4. Emergency Medical Technician (335)
5. Allied Health Personnel (372)
6. Community health workers (2951)
7. Emergency Medical Services (4288)
8. Mobile health units (1261)
9. Paramedic* (1158)
10. <b>or/1-9 [Community paramedic MeSH and Text words] (12,708)</b>
Cost-benefit analysis MeSH [Medical Subject Headings descriptor]
11. Costs and cost analysis (10573)
Cost-benefit analysis [Text words in (ti,ab,kw)*]
12. Costs and cost analysis (37726)
13. Cost benefit analysis (12223)
14. Cost-savings (2412)
15. Health care cost (20304)
16. Costs (30108)
17. Cost comparison (8554)
18. Health expenditures (804)
19. Cost Measures (9080)
20. <b>or/11-19 [Cost-benefit analysis MeSH and Text words] (57,855)</b>
Safety MeSH [Medical Subject Headings descriptor]
21. Safety (3935)
Safety [Text words in (ti,ab,kw)*]
22. Safety (235889)
23. Risk (231552)
24. Adverse effect* (253130)
25. Medical error* (3085)
26. Patient harm (1785)
27. Patient safety (73630)
28. <b>or/21-27 [Safety MeSH and Text words] (565,707)</b>
29. <b>20 or 28 [Safety or Cost-benefit MeSH and Text words] (599,070)</b>
Rural MeSH [Medical Subject Headings descriptor]
30. Rural Health (524)
31. Rural Health Services (340)
32. Rural population (1694)
Rural area [Text words in (ti,ab,kw)*]
33. Rural health (5970)
34. Rural health service* (2008)
35. Rural population (3799)
36. Rural Communit* (3554)
37. <b>or/30-36 [Rural area MeSH and Text words] (7,689)</b>
38. <b>10 and 29 and 37 [Community paramedic and (Safety or Cost-benefit) and Rural area MeSH and Text words] (434)</b>

**Table 5. Search strategy in Embase.**

mp = title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword

Community paramedic [Emtree-term]
1. Rescue personnel (3,917)
2. Paramedical personnel (6,627)
Community paramedic [Keyword .mp]
3. "Emergency Medical Technician" (511)
4. "Allied Health Personnel" (360)
5. "Community health worker*" (5,763)
6. "Emergency Medical Service*" (14,686)
7. Paramedic* (27,665)
8. <b>or/1-7 [Community paramedic Emtree-term and Keyword] (48,751)</b>
Cost-benefit analysis [Emtree-term]
9. Cost benefit analysis (11,812)
Cost-benefit analysis [Keyword .mp]
10. "Cost benefit analysis" (11812)
11. Cost-savings (7613)
12. "Health care cost*" (23332)
13. Cost* (1110639)
14. "Cost* comparison*" (2274)
15. "Health expenditure*" (5221)
16. "Cost Measure*" (662)
17. <b>or/9-16 [Cost-benefit analysis Emtree-term and Keyword] (1,111,562)</b>
Safety [Emtree-term]
18. Safety (56780)
19. Risk (61887)
20. Medical error (8021)
Safety [Keyword .mp]
21. Safety (1178221)
22. Risk (3988547)
23. "Medical error*" (22105)
24. "Adverse effect*" (253851)
25. "Patient harm" (3628)
26. "Patient Safety" (138723)
27. <b>or/18-26 [Safety Emtree-term and Keyword] (5,026,586)</b>
28. <b>20 or 28 [Safety or Cost-benefit Emtree-term and Keyword] (5,862,751)</b>
Rural [Emtree-term]
29. Rural health care/ or rural health/ or rural population/ (60048))
Rural area [Keyword .mp]
30. "Rural health" (19283)
31. "Rural population" (50269)
32. "Rural health service*" (717)
33. "Rural Communit*" (14502)
34. <b>or/29-33 [Rural area Emtree-term and Keyword] (71,212)</b>
35. <b>8 and 28 and 34 [Community paramedic and (Safety or Cost-benefit) and Rural area Emtree-term and Keyword] (391)</b>



## Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
<b>TITLE</b>			
Title	1	Identify the report as a scoping review.	Reported on page 1
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Reported on page 2
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Reported on page 5
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Reported on page 5
<b>METHODS</b>			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	Reported on page 6 Elden OE, Uleberg O, Lysne M, Haugdahl HS. Community paramedicine-cost-benefit analysis and safety with paramedical emergency services in rural areas: scoping review protocol. <i>BMJ Open</i> . 2020;10(9):e038651. <a href="http://bmjopen.bmj.com/content/10/9/e038651.full.pdf">e038651.full.pdf (bmj.com)</a>
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Reported on page 6
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Reported on page 6
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Please see "Supplemental File 1 Search strategy"



SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Reported on page 6
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Reported on page 7
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	Please see table 1: Study information of included studies (N=3) on page 8 and 9.
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	Reported on page 3 and 12
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	Reported on page 7
<b>RESULTS</b>			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	Reported on page 8 and please see: <b>Figure 1</b> Study flow diagram of the literature review process
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	Reported on page 9
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	Reported on page 3 and 12
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Reported on page 8 and 9 Please see: Table 1: Study information of included studies (N=3).
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	Reported on page 9, 10 and 11
<b>DISCUSSION</b>			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	Reported on page 11 and 12
Limitations	20	Discuss the limitations of the scoping review process.	Reported on page 3 and 12



SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	Reported on page 12
<b>FUNDING</b>			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	Reported on page 13

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

\* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med.* 2018;169:467–473. doi: [10.7326/M18-0850](https://doi.org/10.7326/M18-0850).

