Physician Assistants in Rural Emergency Medicine: A Literature Review

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ABSTRACT

Introduction: Physician assistants (PAs) work as extensions of the supervising physician(s) to make decisions regarding the designation of tasks and encounters. They commonly see the same patient acuity mixture as the physician and work across different medical disciplines, notably the emergency department. No current review explores the collection of research on PAs working in rural emergency departments (EDs) within North America.

Objective: This review will examine the role of PAs in rural EDs within North America. With this, decisions surrounding the expansion of the PA profession can be evidence-based and consistent with best practices. This paper will determine the areas of research surrounding the role of PAs in rural EDs that have been concentrated on and identify gaps in the research, as well as identify outcomes resulting from PA practice in this setting.

Methods: A literature search using Embase and Ovid-MEDLINE databases was performed using key terms pertaining to physician assistants working in rural emergency departments. Nine articles were found to meet the inclusion criteria and were analyzed for this review.

Results: Nine studies explored different aspects of PA roles and practice in rural EDs across North America. Three themes around PA roles, level of autonomy and outcomes are used to describe the nature of PA practice in rural EDs. The findings suggest that rural ED PAs provide care to a wide variety of patient presentations with varying levels of autonomy. Although the PA role appears to largely be accepted and commonly has positive effects on the ED, more research needs to be done in this area.

Conclusions: These findings suggest key factors that require future research in both Canada and the United States. For this relatively novel profession in Canada to grow into a staple in the current health system, primary research on PAs working in settings such as rural emergency departments should be prioritized.

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INTRODUCTION

Physician assistants (PA) are trained as generalists, performing various medical and surgical interventions in most medical specialties, such as the emergency department. The PA works as an extension of the supervising physician(s) to make decisions regarding the designation of tasks and encounters, PAs commonly see the same patient acuity mixture as the physician (1). The PA profession in Canada is relatively new but has quickly expanded across the country and throughout different medical disciplines. No current review explores the collection of research on PAs working in rural emergency departments (ED) within North America. Without a review like this, determining the next steps for research in this area is challenging. Additionally, supplementary guidance on further progressing the profession in Canada will not be as easily obtained without a review of PA practice activities, autonomy, and outcomes. Therefore, in the absence of a review of the current body of research on PAs in rural EDs in North America, PAs may be underutilized in rural Canadian EDs.

History of PAs

PAs were introduced into the United States for-profit healthcare system in the 1960s in response to a shortage and uneven geographical distribution of doctors (2–4). As of 2022, there was a total of 168,318 certified PAs registered across the country (5). 11.2% of the certified PAs were employed in emergency medicine as their principal clinical position, with another almost 3% holding a secondary position in emergency medicine (5). Of the US-certified PAs in 2022, 93% were employed in urban settings, while the remaining 7% worked in rural settings (defined as a population of less than 49,999) (5). In a study conducted in 2014, there were 581 PAs

employed in rural emergency medicine positions, highlighting the small but essential role of PAs working in rural emergency centers (6).

PAs were introduced to the Canadian Armed Forces in the 1950s but did not enter the semi-socialist public health system until 1999 in Manitoba (3,7). Manitoba was the only province to employ PAs up until 2007, when Ontario's health system began employing PAs (7). After the expansion to Ontario, the PA profession began growing quickly, with two civilian PA education programs beginning in 2008 in Ontario and Manitoba (7). Currently, there are PAs working in all Canadian provinces except for the northern territories; approximately 1000 certified PAs are practicing in Canada (7). As of 2019, 14% of Canadian certified PAs worked in emergency medicine or urgent care (8). PAs are used in the ED in both urban and rural settings in various ways. Indeed, from providing patient care at a Level 1 Trauma Center to being the lone provider in a rural ED (1).

Rural EDs across North America

Population density has an impact on social determinants of health. The population can be split broadly into urban and rural classifications. According to Statistics Canada, rural areas do not meet the requirements of Census Metropolitan Areas and Census Agglomerations, which are defined as having a minimum population of 100,000 people, of which at least 50,000 must live in the core and a core population of at least 10,000, respectively (9). By this definition, 16.1% of Canadians live in a rural setting (10). However, in the USA, a rural area is defined as 5000 people in an area or at least 2000 housing units (11). According to this definition, 20% of the USA's population lives in rural settings (12). Regardless of the difference between the percentages of those who live in rural areas, Canada and the United States face similar challenges regarding health behaviours (13). Rural populations have higher rates of smoking,

heavy drinking, obesity, accidents, suicides in men, and physical inactivity than those in the urban populations (13). However, access to healthcare services is not the same as in urban areas, especially for emergency services (13,14).

Rural emergency departments in the US and Canada face constant challenges. One of the main challenges in rural areas is the need for more resources, such as diagnostic imaging tools and specialist services (13,14). Furthermore, recruitment and retention for regular positions have historically been an issue in this setting. Canada has more recently introduced PAs into rural settings, which may be one way to help counteract inadequate access to care.

Canadian PAs in Rural Medicine

As of 2022, only 8% of practicing physicians in Canada worked in rural areas, while in 2021, 16.1% of Canada's population lived in rural areas (10). Conversely, according to the January 2024 survey of current members of the Canadian Association of Physician Assistants (CAPA), 24.5% of members work in rural settings (population of <50 001) (15). This would suggest that there is great potential for PAs to increase access to care in rural EDs, particularly considering the needs of rural communities and the shortage of physicians working in these settings.

According to Mac Lean et al. (2020), the three main factors that motivate PAs to work remotely are the level of autonomy, the type of practice, and the increased scope of practice (16). Current Canadian research has explored PAs in rural medicine and emergency departments, but more needs to be done on PAs working in rural emergency medicine.

One study by Shute et al. (2019) explored the acuity level of patients treated by PAs in two rural Manitoba emergency departments (17). They found that these PAs most frequently treated patients triaged as Canadian Triage and Acuity Scale (CTAS) level 3, meaning those

requiring urgent care (15). It was noted that CTAS level 3 patients made up the most significant proportion of patients presenting to the EDs in the nearest urban center to their study location, acknowledging that PAs may play a vital role in the future of EDs in Manitoba (17). De La Roche et al. (2017) looked at the effect of a PA on overall ED performance at a mid-sized urban community hospital in Ontario with a catchment area of 125,000 people (18). They compared patients who were seen while the PA was working and patients who were seen on any day the PA did not work (18). They found that for the days that the PA was present, there were lower average daily left without-being-seen rates, lower provider initial assessment times, and a lower average length of stay, demonstrating that a PA had a significant positive effect on the overall performance of the ED (16). These studies set a strong foundation for research into Canadian rural emergency PAs; however, there is much more to explore within this context.

There are still many complexities involved in capturing or researching PAs in clinical practice in a rural setting. PAs employed in the United States carry insurance, have prescribing numbers, and can bill, which makes them easier to monitor in research (19–21). While Canadian PAs also carry insurance, they cannot bill nor have their own prescribing numbers, thus creating a barrier to gathering and assessing PA contributions to the Canadian Healthcare system. Due to the subsequent ease of monitoring and the close to 75 years of professional existence in the United States, the body of research on PAs is much broader than in Canada. Hence, exploring the existing body of research on rural emergency medicine throughout North America is important to expand the same within the Canadian context.

OBJECTIVE

This is a literature review that will examine the contributions of physician assistants in rural emergency departments in North America. This is important because as the PA profession expands, decisions surrounding the profession and future research should be evidence-based and consistent with current best practices identified through research. By defining contribution as the role of PAs in rural emergency medicine centers, this paper will determine the areas that have been concentrated on and identify gaps in the research. A secondary objective is to identify the outcomes resulting from PA practice in rural EDs.

RESEARCH QUESTION

The efficiency and productivity of PAs in rural EDs throughout North America are still being determined. However, to evaluate this, we need more information about PAs' roles and responsibilities in a rural setting. Therefore, this review will try to answer the following question: In rural EDs in Canada and the US, what is the role and impact of PAs in terms of their contributions to healthcare, specifically characterizing clinical practice and level of autonomy in rural EDs?

METHODS

To understand PA practice in rural EDs, a literature review of published research was conducted. The review allowed for a broad search of the North American literature and identified the key themes that emerged regarding the target population (PAs) in a specific practice setting (rural ED).

Search Strategy

A comprehensive article search was completed on December 13, 2023, in consultation with a librarian experienced in literature reviews using Embase and Ovid-MEDLINE databases. The search included key terms listed in Appendix Table 1.

The MEDLINE search revealed 110 results, and the Embase search revealed 112 results. The 222 studies were imported to Covidence for literature screening, where 93 database duplicates were identified and removed. One hundred and thirty studies' titles and abstracts were screened, and 102 did not meet the inclusion criteria. A full-text review of these 28 articles was performed, excluding three due to inability to access the text, two for being the wrong setting, two for not separating PA and NP data, eight because of wrong indication, and four for being conference abstracts. The three texts that were excluded due to unavailability were because the University of Manitoba libraries server did not have access or were unavailable online; no further investigation was performed into retrieving these papers. This left nine articles to be included in this literature review, all containing information about PAs working in rural emergency departments in the United States and Canada (Appendix Figure 1).

Inclusion and Exclusion Criteria

The criteria used to determine the suitability of research for inclusion were as follows: all published study designs in the English language, isolated to North America, included rural emergency departments/services, and no date restrictions. Literature using "Physician Assistant" and other variations were used to define the target profession. It is important to note that rural is a fluid term with no standardized definition; thus, all papers that used the term rural were included no matter the definition. Literature that encompassed both PAs and nurse practitioners

(NPs) and grouped them in a similar category of “midlevel providers” were only included if the provider type was explicitly stated and the PA data could be isolated and extracted.

The articles were examined by two reviewers using a review matrix approach to identify common themes throughout the research by analyzing the data across the various included articles. Data from each of the articles was extracted verbatim, following a data extraction table developed specifically for this review. The reviewers created a charting table which included data related to bibliometrics, study objectives, PA tasks and services provided, PA patient acuity, role autonomy and independence from supervising physician(s), and measures and outcomes of PA patient care. Only research that reported on PA tasks and services and the nature of PA practice in rural EDs was analyzed. As the purpose of this review was to describe the current corpus of research on this topic, the quality of the included studies was not assessed.

The findings from this data are presented using the following themes: PA practice and role in rural EDs, the level of autonomy for rural ED PAs, and factors surrounding PA patient outcomes.

RESULTS

Physician assistants in the US have been reasonably well-researched since implementation in the US health system in the 1960s, while there has been less research on Canadian PAs since implementation in 1999 (22,23). However, there has only been a minor focus on rural emergency PAs in both. It is generally understood that PAs are utilized in rural emergency centers across North America, therefore, the research that has been done to explore what these PAs are doing and how their role in the rural emergency department is showcased here. The relevant features of the nine articles meeting inclusion criteria are presented in

Appendix Table 2, which provides an overview of each study's design, country, focus, objective, conclusion, and limitations. The studies were completed between 1974 and 2021. Eight of the studies were based out of the United States, and one was from Canada. Findings from the nine studies included in this literature review are arranged around three themes focused on in the current research on PAs working in rural emergency departments: PA practice and role in the rural ED, the level of autonomy within the rural ED PA role, and the outcomes that have been examined.

PA Rural Practice and Roles

When exploring the research published on PAs in rural emergency medicine, there was limited description of the PA in rural practice and how and what services they provide to patients. However, many of the studies referred to the ways in which PAs were utilized to provide ED coverage and the kinds of issues and acuity levels encountered in rural EDs.

ED Coverage

When exploring research on rural EDs, staffing and coverage were variables that emerged from the literature, which identified many different systems that can be utilized. Most of the studies addressed how their ED was run, ranging from 24/7 coverage by only a PA (24) to alternating between PA and physician coverage (25–29) to having both a PA and physician present (25,26,28,29). The details regarding ED coverage in multiple rural hospitals were outlined in Nelson and Hooker's (25) study; this included PAs seeing 75% of patients without a nurse triage, PAs working independently but rounding with the physician prior to their departure from the hospital, a PA working with two nurses, and responsibility split between PAs, nurse practitioners, and physicians (25). The study from 1975 (27) had PAs covering the ED with physician backup if required, however, the system of this ED was unique because they provided

a written statement to the patient explaining that a PA would initially be managing their care and that they could request to see if a physician if they preferred. It was also mentioned in this study that if the nurse ever felt there was a question about the severity of the patient's condition, they would contact the physician before calling the PA (27).

Patient Acuity and Care

Nearly all the studies in this review investigated the acuity of the patients seen by PAs and the nature of the tasks PAs performed in rural EDs (4,24–27,29,30). PAs seem to manage a wide array of patient presentations in rural EDs, from life-threatening to non-urgent illnesses and injuries (4,25,27,30). More particularly, cardiac arrest (4,25), childbirth (4,25), trauma (4,25), stroke (4), gastroenteritis (30), respiratory disorders (30), and skin disorders (30) were all reported as PA-managed cases in the rural ED setting. Sawyer and Ginde's study from 2014 noted procedures that were performed by rural PAs, including laceration repairs, procedural sedation, bedside ultrasound, lumbar puncture, and bag-valve-mask ventilation (4). The most recent study in 2021 (24) determined the acuity of patients being treated in the rural ED using a validated emergency severity index (ESI), where ESI 1-3 requires higher levels of care. They found that the mean ESI of PA patients was 3.3, and the mean ESI of physician patients was 3.2 (24). Several studies also noted the PA case presentations were similar to what the physicians were seeing, suggesting that in the setting of rural EDs, physicians and PAs fulfill similar roles (4,24–26,31). Nelson and colleagues' 2016 study noted that PA's scope of practice varied depending on experience; junior PAs were only permitted to see patients of lower acuity, while senior PAs could treat all patients (25). These studies demonstrate the broad scope of practice and the wide variety of patients that PAs assess and manage in the rural ED setting.

Autonomy

Most of the studies analyzed in this review highlighted the autonomy of PAs working in the rural ED setting (4,24–30). Autonomy is described in varying ways throughout the research, such as practicing without a physician's presence, making independent decisions and clinical judgements regarding diagnostic testing and treatments, or only relying on a supervising physician for backup if required; regardless, it was a focus across current research (4,24,25,27–30). It was commonly identified that PAs worked with no to very little amount of physician involvement in the rural ED setting (4,24–30). Notably, a study from 1975 (27), and a less older case study (25), stated physician presence was always required. More often and among the more recent studies, PAs were practicing quite independently, and studies referred to physician backup that was available when required or physicians were on call (26). In such cases, the physician was also working the ED, available by telephone, or available on-site within a designated time frame (4,25–29). The parameters of autonomy were outlined by several studies; Maxfield and colleagues' study from 1975 stated that a PA was never permitted to cover the ED without an immediately available physician, which was defined as being in another area of the hospital or able to be on-site within 15 minutes (27). For others, some procedures, such as CT scans, required physician approval (25), or an expectation that consultation with a physician would be suitably determined by the PA if there was any question regarding patient care (25,27). Other solutions that were suggested to ensure adequate care was being provided while working without direct supervision included diagnostic algorithms and protocols that could be followed by the PA before contacting the supervising physician (29). Tighter regulations regarding patient criteria that were deemed appropriate for a PA to handle independently were outlined in the two oldest studies, including specific patient presentations (common diseases, prescriptions for routine

medications) (27,30). With these defined criteria, it was stated that PAs were capable of adequately assessing and treating greater than 50% of patients without direct physician involvement (27,30). Of the most recent studies, full-time ED coverage was often managed solely by a PA, suggesting that with the development of the profession over time, autonomy has evolved alongside (4,24,25). Of the studies that captured the PA perspective of autonomy in their role, in one study, one reported that a third of PAs listed autonomy as a benefit, while a second study found PAs in rural EDs preferred enhanced autonomy, highlighting an important possible discrepancy among rural ED PAs thoughts on autonomy (4,25). Upon analysis of the nine papers, it is evident that the autonomy of the PAs and their supervising physicians was an important factor emerging across studies of PAs roles.

Practice Outcomes

Over half of the studies included in this review measured factors related to patient outcomes, such as the number of patients seen by PAs (21,26,28), the length of stay in the ED for PA patients (21,23,24), and overall satisfaction with PA-provided care (24–27). In the 1980 study by Newkirk (29), it was reported that on shifts covered by the PA, the relative increase in the number of patients seen was 86% when compared to physician shifts; however, it should be noted that the PA was always available in the ED whereas the physicians were not (29). The other studies reported that PAs saw comparable numbers of patients to physicians (4,24). When looking at the length of stay for patients (the time from entering the building to leaving the facility), it was found in two of the studies that PA patients did have slightly longer times when compared to their physician colleagues (24,26). Conversely, Maxfield et al. reported overall decreased wait times after the implementation of PAs on-call for their ED (27). Many of the studies made mention of satisfaction when it came to PA care, whether the patients provided

positive feedback (24,27), other hospital personnel provided complimentary remarks (25,27), or as a reflection of the little to no errors that were made by PAs with regards to diagnosing and treating patients (25,29).

DISCUSSION

This is review examined the practice of PAs in rural EDs within North America. From the nine studies that met inclusion criteria, themes addressing PA practice and roles, including patient acuity, as well as levels of autonomy and reported outcomes were used to provide further description.

It was commonly reported throughout the literature in this review that PAs are often the sole providers in the rural ED setting and manage a wide variety of patient presentations. A recent review (32) found similarities to the results from this literature review in terms of the nature of the PA role in rural ED, with several studies highlighting PAs' ability to see more patients, order fewer investigations, and consult with other specialties more frequently. A Canadian scoping review (31) of PAs in the ED also found a breadth of duties performed by the PAs, many of which were consistent with those reported in this review, however also uniquely describing a patient navigator role for PAs and their role in liaising between the ED and primary care, particularly as part of a transition team. This same review also suggested PAs managed 53-62% of ED patients, noting that many were younger and non-urgent or less likely to need to be admitted. Another Canadian study (33) examining PA and NP roles in Ontario EDs found that PAs saw patients with a wider range of acuity levels than NPs. Gettel and colleagues (34) examined independent billing among rural practice advanced practice providers (APP) (mainly PAs and NPs). They found that the average APP is seeing moderate to high acuity patients as

APPs independently billed 22.8% as high acuity and 72.6% as moderate acuity, which was higher than in urban settings. The same study also reported that APPs employed in the ED have additional skills provided during training to prepare them for expanded practice.

While this review and other supporting literature recognize that PAs provide high-level care to a wide variety of patient presentations, more research is needed that is specific to rural ED practice. Not only does the literature suggest PAs are capable of a direct patient care role, but there is evidence of improved patient flow, raising interest in these alternative roles considering the ongoing physician shortage (33). In fact the observed trends in APP's practice suggest that rural settings do not have physicians available 24/7 for all EDs and that APPs are increasingly filling a notable void (34). As such, there is an opportunity to consider the ways in which PAs might contribute to the current health workforce crisis and potentially increase access to care in rural communities. An additional consideration is to ensure that PAs are well-prepared for this responsibility, and educational training may be framed around this.

The studies in this review identified that the level of autonomy is variable, with PAs working quite independently with supervising physicians available on-site or reached by phone. The rural setting seems to be a factor that impacts the staffing model within EDs, as previous research has demonstrated variability. This is supported by Temin and colleagues (35), who reported that 23% of EDs were staffed with PAs/NPs without 24/7 attending physician coverage, and these tended to be smaller, rural, lower-volume EDs (35). Similarly, a recent report (36) out of the US noted that an emergency physician stated PAs work fairly autonomously with minimal physician oversight, specifically in rural critical access hospitals where patient volume is low and have a hard time attracting physicians to those sites. However, for PAs and their choice of practice location, one study (37) found that some participants liked the increased autonomy in

the rural setting and was a factor in choosing rural practice, however, there was a desire for additional training, specifically in emergency medicine.

The ability for PAs to practice with a significant degree of autonomy, particularly in rural EDs, has also raised attention among the public. Recent Canadian media coverage (38) reported on the wide scope of practice. When patient care is within the PA's scope of practice, and the PA is comfortable with the situation, reaching a supervising or attending physician by phone is suitable and particularly helpful in rural settings where physicians may not be on-site. The level of independence appears to be an appealing complement to staffing; however, the level of autonomy of PAs is currently quite variable across practice locations and the profession. It would be valuable to explore the level of experience and education that coincides with the level of autonomy individual PAs experience.

This review explored the outcomes related to PA practice in rural EDs and identified that the PA role is generally accepted, with satisfaction reported from PA patients and colleagues, as well as positive patient outcomes. The King and Helps (32) scoping review of existing literature on the impact and perceptions of PAs in emergency departments largely agreed with this; reporting that patients were generally satisfied with the level of care and willing to see a PA, particularly where longer wait times may be required to see physicians (32). Staff were also generally satisfied with the work of PAs and reported no adverse clinical outcomes. As was noted in this review, there were not studies identifying patient outcomes. Doan and colleagues' (31) systematic review of PAs also reported no study of patient outcomes after receiving treatment by a PA in ED but did find that PAs provided comparable quality of care to that of emergency physicians and found several studies describing the evolving role of PA in the ED.

Although some studies in this literature review identified longer lengths of stay time for PA patients compared to their physician colleagues, additional research would dispute this. The King and Helps (32) review found that PAs had several benefits, including shorter wait times, a reduction in the number of people leaving without being seen, and shorter lengths of stay. Overall, the review concluded that PAs appear to have a positive impact on the ED, however they also noted that PAs are often compared to nurse practitioners (32). This would suggest a need to consider research that is more focused on PA practice in future. Although there is growing awareness and acceptance of the PA role, one study in this review identified the need for patients to better understand the role of PAs (32).The PA role is becoming more widely accepted, and advocacy for the growing profession to both patients and other healthcare providers is an important factor if PAs are to be used more frequently in rural settings.

Study Limitations

This literature review aimed to examine the role of PAs working in rural emergency departments in North America. With this, decisions surrounding the expansion of the PA profession in Canada can be evidence-based and consistent with best practices. An important limitation to make note of is the fluid description of rural; not all studies followed the same definition of rural, which makes comparison of the data difficult. It is also important to mention that there were three studies that were excluded from the review process due to unavailability; these studies may have been applicable to the research question. Another important limitation is that there were only nine studies found that met the inclusion criteria, which may threaten the generalizability of the findings. It should also be noted that few of the studies directly examined the rural context while others provided limited data that was specific to rural practice.

The scope of this review was limited to North America, which has two different national systems of healthcare. The intent was not to compare or investigate macro-level contextual factors, but to explore the nature and extend of research regarding PA practice in rural EDs. The studies by Golomb et al. and Maxfield et al. were the first of their kind and laid the foundation for subsequent research, but they are reaching fifty years old and the PA profession has shown much growth and evolution since their publishing (27,30). There were also various study designs incorporated in this review which included retrospective observational (24,27,29,30), mixed-methods exploratory (25), a literature review (26), a systematic review (31), a cross-sectional analysis with a survey (4), and a telephone survey (28). The quality of the research was not assessed; therefore, this study is limited in conveying practice recommendations other than a summary of those provided by the authors of the included research articles.

Future Directions

This study aimed to capture research in North America. However, only one study included Canadian data. Therefore, more exploration into the Canadian rural ED PA role would be beneficial. Following the expansion of the Canadian body of research, it would also be of interest to investigate the significant differences between Canadian and United States PAs working in rural emergency departments. There would also be value in research that could answer questions surrounding how the training and years of practice influence the PA role. Another avenue to explore would be how the level of autonomy affects PA practice and what the PA's opinion is on this. Finally, more research to focus on the patient's perspective on PA-provided ED care would help progress the profession further in a patient-centred approach.

CONCLUSION

This literature review aimed to explore the existing body of research on North American PAs working in rural emergency departments and identify their role. The findings suggest that rural ED PAs provide care to a wide variety of patient presentations with varying levels of autonomy. Although the PA role appears to largely be accepted and commonly has positive effects on the ED, more research needs to be done in this area. For this relatively novel profession in Canada to grow into a staple in the current health system, primary research on PAs working in rural emergency departments should be prioritized to improve access to care, improve the patient experience, and advance the profession further.

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APPENDIX

Table 1: Search Map – the top Horizontal words were AND searches and the vertical words are OR searches.

Physician Assistant	Rural Health	Emergency Service
Doctor assistant	rural	Emergency unit
Physician assistants	Non urban	Emergency department
Doctor assistants	Non-urban	Emergency room
Physician associate	Remote	Emergency ward
Doctors associate		Emergencies
Physician extender		Emergency centre
Doctor extender		Emergency center
		Emergenc*

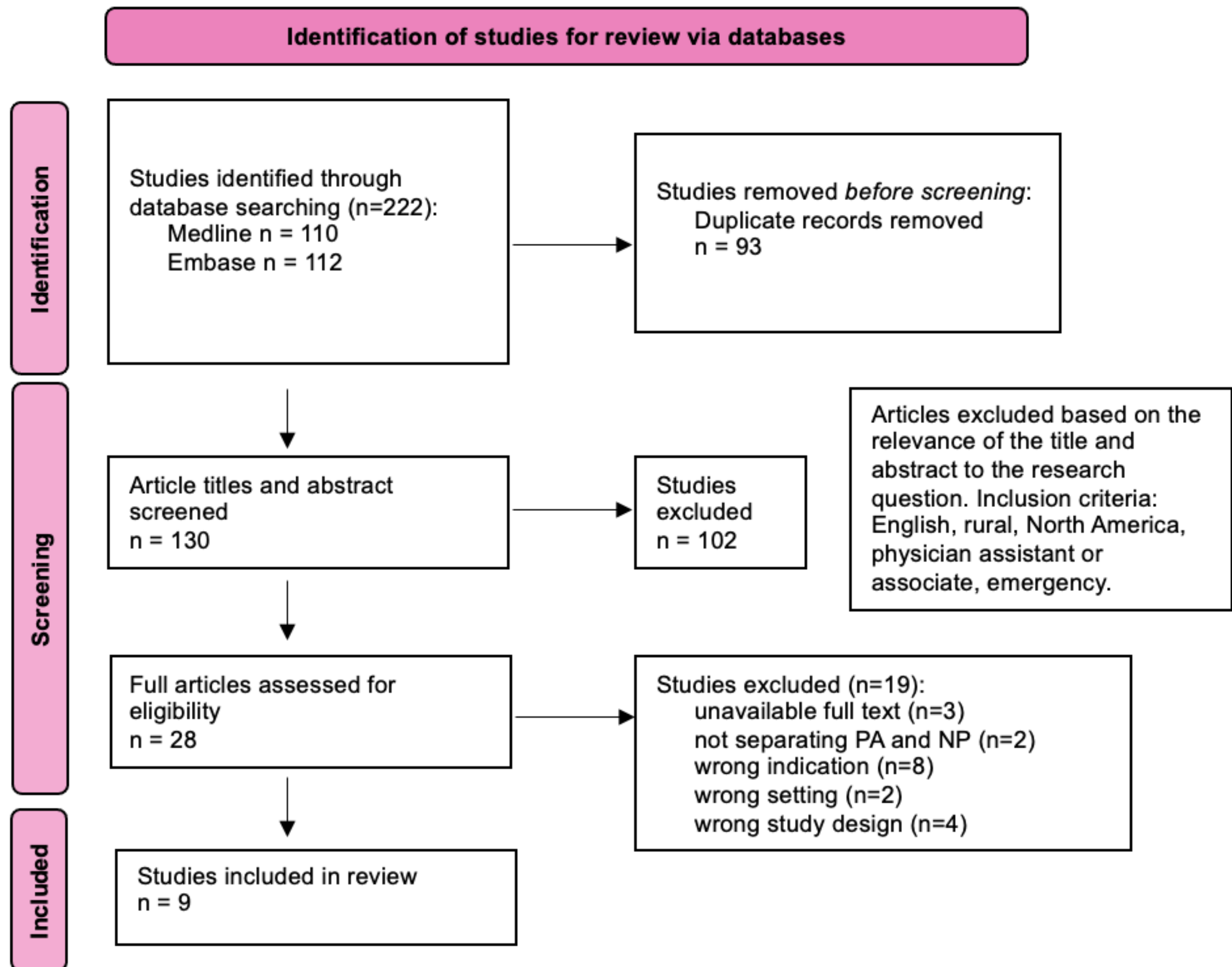

Figure 1. Overview of the review process.

Table 2: Summary of the six articles used in this literature review.

Study	Design	Study Country	Study Focus	Objective	Conclusion	Limitations
Maxfield et al 1975 (27)	Retrospective, observational study	US	PA focused	To determine how many of the patients were cared for initially by a PA alone over a 2-month period.	Led to emergency room care that has been more efficient and prompter than had been previously but not reduced in quality, according to patients, ED nurses, and supervising physicians.	Focused on a single facility and was observational.
Nelson et al 2016 (25)	Exploratory mixed-methods study	US	PA and NP focused	To determine the roles of PAs and NPs in rural EDs by collecting data through phone interviews or in person site visits.	Further and broader research into PAs in rural hospitals needs to be performed, however they found that PAs increased accesses to rural populations.	Exploratory research, not all hospital sites were visited and not all hospital administrators were interviewed.
Moore 2021 (24)	Retrospective, observational study	US	PA focused	Observing PAs as solo providers in rural EDs by comparing ED metrics and patient characteristics between physicians and PAs	PAs can provide care that meets common ED metrics.	Focused on a single facility and was observational. Diverse levels of experiences among the PAs in this study make it difficult to apply the findings to other PA-provider models who also have differing experiences.
Golomb et al 1974 (30)	Retrospective study	US	PA focused	Evaluate trends in ED use by patients, and the potential for use of PAs in a small rural ED.	Once ED need is established for more than one physician, a PA should be utilized as the second member of the team.	Focused on one small rural community hospital.
Sawyer et al 2014 (4)	Cross-sectional analysis followed by a survey	US	PA focused	Comparing the autonomy and scope of practice of emergency medicine PAs in rural versus urban settings.	Rural PAs had more autonomy, broader scope, and less access to physician supervision when compared to urban PAs.	Found relative differences between rural and urban PAs but could not discern how these differences affect quality of care and patient safety. Response bias may be possible.
Hooker et al 2011 (26)	Literature Review	US	PA focused	Examine efficacy and utilization of ED patient care with the proposition that more PAs will be needed to aid in the delivery of urgent care.	PA use in EDs is increasing due to necessity in staffing and economy of scale. Identified gaps in research using appropriate outcome measures in studying clinical effectiveness of PAs.	Cited studies are small, many lack the specificity needed to understand outcomes and differences in providers or patients.

Study	Design	Study Country	Study Focus	Objective	Conclusion	Limitations
Doan et al 2011 (31)	Systematic review	US and Canada	PA focused	Describe the role and impact of PAs in the ED.	PAs are reliable in assessing certain presentations and performing procedures, and are accepted by ED staff and patients. Limited evidence to whether they are cost effective or improve ED flow.	No good data from controlled trials assessing the role or impact of PAs on ED patient care.
Casey et al 2008 (28)	Survey	US	Not PA focused	Describe how rural hospitals are staffing their EDs across the US.	Rural ED staff would benefit from more education opportunities, in terms of specialized skills surrounding pediatric and trauma patients, as well as training surrounding effective teamwork.	Response differences may have occurred due to different health professionals in different positions responding, relied on 1 person per hospital to report on training for all providers in their ED.
Newkirk 1980 (29)	Retrospective study	US	PA focused	Answer if patients would be willing to see a PA in place of a physician, what provider would have the greatest impact on utilization, relative costs of PAs and physician utilization, how is adequate medical control used for the PA, what advantage do PAs and physicians have for improving quality of medical care.	Using physician extenders in small rural emergency departments as coverage may be preferable to the more traditional rotating medical staff system.	Focused on a single rural hospital.