Prehospital nurses' professional competence – utilization and development

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Faculty of Health, Science and Technology

Nursing Science

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"Our patients did not choose us. We chose them. We could have chosen another profession, but we did not… …We must either embrace this responsibility or surrender it. We must give to our patients the very best care that we can - not while we are daydreaming, not with unchecked equipment, not with incomplete supplies and not with yesterday's knowledge"

(National Association of Emergency Medical Technicians et al., 2011).

Abstract

The overall aim of this thesis was to explore nurses' professional competence with a focus on scope of practice, content, utilization, and development within the ambulance service in Sweden.

Methods: Integrative review (I), qualitative (II, III) and quantitative methods (IV) were used. The integrative review was based on 25 studies. The qualitative studies were based on interviews with 13 (II) and 16 prehospital nurses (III), and data was analyzed using content analysis (II) and grounded theory (III). In the quantitative study (IV), 105 nurses answered a digital questionnaire and descriptive and analytical statistics were used in the analysis.

Main findings: Advanced nurses' and paramedics' assessments, treatments, and referrals were safe and of high quality and were characterized by a high degree of autonomy. Patients were satisfied with the care provided, reduced waiting times, and the avoidance of unnecessary transportation to hospital (I). Broad medical and nursing competence was required, and personality traits and contextual awareness were emphasized as unique competences (II). Prehospital emergency nurses reported higher levels of professional competence compared to registered nurses or other specialist nurses. No differences were identified between nurses with master's or bachelor's degrees, and clinical experience was a predictor of nursing competence (IV). At the start of their careers, the ambulance service represented a developing environment for nurses. When focus, education, roles, responsibilities, and requirements remained the same, continued competence development risked stagnation (III).

Conclusions: Personality, clinical competence, prehospital experience, and contextual competence were emphasized. Academic competence was neglected and not demanded. This thesis provides new knowledge that can contribute to the continued development of the ambulance service and to a more efficient utilization of the full spectrum of nurses' professional competence.

Keywords: ambulance service, prehospital care, professional competence, registered nurses, specialist nurses.

Sammanfattning

Det övergripande syftet med avhandlingen var att utforska sjuksköterskors professionella kompetens med fokus på arbetsuppgifter, kompetensanvändning och kompetensutveckling i ambulanssjukvården i Sverige.

Metoder: Integrativ litteraturöversikt (I), kvalitativ (II, III) och kvantitativ metod (IV) användes. Litteraturöversikten baserades på 25 artiklar. De kvalitativa studierna baserades på intervjuer med 13 (II) respektive 16 sjuksköterskor i prehospital vård (III), och data analyserades med innehållsanalys (II) och grounded theory (III). I den kvantitativa studien (IV) besvarade 105 sjuksköterskor ett digitalt frågeformulär och beskrivande och analytisk statistik användes för att analysera data.

Huvudresultat: Avancerade sjuksköterskors och paramedics bedömningar, behandlingar och hänvisningar var säkra, av hög kvalitet och kännetecknades av en hög grad av autonomi. Patienterna var nöjda med vården, reducerade väntetider och undvikande av onödiga transporter till sjukhus (I). Bred medicinsk och omvårdnadskompetens fordras i den svenska ambulanssjukvården. Personlighetsdrag och kontextuell medvetenhet framhölls som unika kompetenser och skiljde sig från sjukhusvård i termer av miljö och resurser (II). Ambulanssjuksköterskor rapporterade högre kompetens jämfört med legitimerade sjuksköterskor och andra specialistsjuksköterskor. Inga skillnader mellan sjuksköterskor med magister- eller kandidatexamen identifierades, och klinisk erfarenhet var en prediktor för omvårdnadskompetens (IV). Ambulanssjukvården representerade en utvecklande miljö för sjuksköterskor de första åren i karriären. När fokus, utbildning, roller, ansvar och krav förblev desamma riskerade fortsatt kompetensutveckling att stagnera (III).

Slutsatser: Personlighet, klinisk kompetens, prehospital erfarenhet och kontextuell kompetens betonades. Akademisk kompetens och forskningsanvändning var eftersatt och efterfrågades inte. Denna avhandling bidrar med ny kunskap som kan bidra till fortsatt utveckling av ambulanssjukvården och till ett mer effektivt utnyttjande av sjuksköterskors hela spektrum av professionell kompetens.

Nyckelord: ambulanssjukvård, prehospital akutsjukvård, professionell kompetens, sjuksköterskor, specialistsjuksköterskor

Terms, abbreviations, and descriptions

Terms/abbreviations	Definitions and descriptions
Advanced practice	Advanced practice refers to advanced paramedics or nurses who possesses the skills and capacities to undertake practice outside the basic scope of practice and thereby differ from basic practice through their level of specialisation, advancement, and role expansion. The International Council of Nurses defines advanced practice as: registered nurses who has acquired expert knowledge, complex decision-making skills, and clinical competence for expanded practice. Advanced clinical practice defines the role but also the responsibility and integration of evidence-based practice, practice development, education, research, consultation, and administration.
Nurse or Paramedic practitioners	"Practitioner" roles have developed internationally as a strategy to meet increased health care demand, to reduce transports to ED, to compensate for the lack of physicians and to increase patient satisfaction. The "practitioner" often works autonomously and performs extended scope of practices i.e assessments, treatments, diagnostic tests, and prescription of medicine. Practitioner roles are common in primary care settings.
Nurses with advanced level of education (AN)	Advanced nurses refer to registered nurses with specialist or advanced level of education. Education at specialist level could include a bachelors or master's degree. Nurse practitioners are also referred to as advanced nurses and they are presumed to hold master's degree. Advanced nurses can be engaged in prehospital and hospital care settings.
Paramedics with advanced level of education (AP)	Advanced paramedics includes paramedics with specialist or advanced level of education. Education at specialist level could include a bachelors or master's degree. Paramedic practitioners are also referred to as advanced paramedics. Advanced paramedics are normally engaged in prehospital care settings.
PEN	PEN is an abbreviation for Prehospital Emergency Nurse i.e., nurse with specialization in prehospital care (Specialist and advanced competence)
RN	RN is an abbreviation for registered nurse.
Scope of practice	Scope of practice refers to the tasks and activities which an advanced paramedic or advanced nurse is legislatively permitted to undertake, and which are based on their education, training, experience, and competence.
SN	SN is an abbreviation for specialist nurse (Specialist and advanced competence)
Specialist and advanced competence	Refers to practice outside the scope of practice of paramedics or registered nurses. The degree of decision-making and accountability separates specialist and advanced practitioners rather than the tasks undertaken. Specialist roles are common in acute care settings.

Original papers

I. Jansson, J., Larsson, M. & Nilsson, J. (2021). Advanced paramedics and nurses can deliver safe and effective pre-hospital and in-hospital emergency care: An integrative review. Nursing Open 8 (5), 2385-2405. doi: 10.1002/nop2.866.

II. Jansson, J., Josse Eklund, A., Larsson, M. & Nilsson, J. Prehospital nurse professional competence: A qualitative interview study (Submitted manuscript).

III. Jansson, J., Larsson, M., Nilsson, J. & Josse Eklund, A. Development of professional prehospital nursing competence – A grounded theory study (In manuscript).

IV.
Jansson, J., Josse Eklund, A., Larsson, M. & Nilsson, J. (2020). Prehospital care nurses' self-reported competence: A cross-sectional study. International Emergency Nursing 52, 1-7. https://doi.org/10.1016/j.ienj.2020.100896.

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Introduction

International studies show that a high level of nursing competence is important for the provision of evidence-based and high-quality healthcare (Blegen et al., 2013, Aiken et al., 2003; Aiken et al., 2014; Aiken et al., 2017; Audet, 2018, WHO; 2018; ICN, 2021a). Global healthcare being able to achieve its goals in terms of quality and safety is completely dependent on nurses (ICN, 2019; WHO 2020) and due to the global shortage of millions of nurses, it is crucial that nurses' competence is effectively utilized (WHO, 2020, ICN 2021a). According to the Swedish National Board of Health and Welfare (Socialstyrelsen, 2018), Sweden is among the large number of countries that are experiencing a shortage of nurses, a lack of nursing competence, and a lack of opportunities for nurses to develop their competence.

The adaptivity of the Swedish ambulance service, in terms of the utilization and development of nurses' professional competence, has to my knowledge not been previously described or evaluated. Indicative documents exist (SOSFS 2009:10; Svensk sjuksksköterskeförening, 2017; Riksföreningen för ambulanssjuksköterskor & Svensk sjuksköterskeförening, 2022) but they are subject to regional interpretation. Nationally coordinated and sustained efforts are required to maximize the contributions of healthcare professionals. This will require policy interventions that enable maximum impact, by optimizing prehospital nurses' scope of practice and investing in their education, competence, and work conditions (WHO, 2020).

Background

The Swedish ambulance service

Swedish ambulance service is defined by the National Board of Health as “Healthcare performed by healthcare personnel in or in connection with an ambulance” (SOSFS 2009: 10). Sometimes the term “prehospital emergency care” is used, which is usually understood as ambulance care but may also include other personnel who perform emergency care outside hospitals. In the Swedish ambulance service, nurses are responsible for both medical and nursing care. Since November 2005, only registered nurses (RNs) and specialist nurses (SNs) are allowed to administer drugs, as amended by previous decisions of the National Board of Health (SOSFS 2001: 1; SOSFS 2005: 24). As a result, since the end of 2005, it is a requirement to have at least one RN in every ambulance. In addition to RNs and SNs, the ambulance service is also staffed by prehospital assistant nurses. Airborne ambulance services are usually staffed by physicians and/or SNs (Sveriges Kommuner och Landsting, 2012; Interreg Sverige-Norge, 2014). According to data from 2017, Sweden has 275 local ambulance stations with 518 ambulances of which 372 operate 24/7 (Lennquist (ed), 2017).

Governance of medical and nursing care

In the ambulance service, assessment, treatment, and level of care decisions are guided by various forms of protocols and guidelines such as clinical treatment protocols, triage systems, or algorithms (FLISA, 2022; Widgren et al., 2008; Ebben et al., 2013). Clinical treatment protocols are formulated at a national level by a collaboration of ambulance physicians (FLISA, 2022) and then adapted locally by each ambulance service organization. The clinical treatment protocols include directives on how different patient categories are to be assessed and treated and which drugs are recommended in each clinical situation. Clinical protocols and triage systems have been developed over time to reduce individual variation in the assessment and treatment of patients and to improve quality of care in both prehospital and in-hospital emergency care (Robertson-Steel, 2006; Lambert et al., 2006; Farrohknia et al., 2011; Khorram-Manesh et al., 2011).

However, adherence to prehospital clinical protocols is sometimes compromised, which may result in patients not receiving appropriate care (Ulrich Hansen et al., 2022). The quality of clinical protocols in terms of evidence-based guidelines can also vary (Turner et al., 2021), and studies focusing on the effect of evidence-based guidelines are limited (Lugtenberg, 2009).

The triage systems used by ambulance and emergency department staff show the "severity classification" that patients receive (SBU, 2010; Widgren & Jourak, 2011, Wireklint et al., 2018; Habbouche et al., 2022). Together with the dispatch center, the ambulance service also uses a three-degree triage system, where priority one transportation refers to time-critical situations (life threatening conditions where lights and sirens are used during transportation) and priority two and three indicate that a reasonable waiting time will not affect the patient's condition (SOSFS 2009: 10).

Despite the existence of prehospital protocols, RNs and SNs need to develop their critical thinking skills and clinical decision-making competence, and protocols must be used with judgment (Atack & Maher, 2010). Wireklint and Dahlberg (2010) argue that medical assessment via protocol can be an obstacle to optimized prehospital care, that prehospital care includes more than following protocols, not least the aspects of person-centered care. Recent studies indicate that a simple clinical assessment could be a superior approach and that precision in triage decisions is weak (Khorram-Manesh et al., 2011; Mirhaghi & Christ, 2016; Wireklint et al., 2018; Iversen et al., 2019; Habbouche et al., 2022). A feature relating to the triage of patients that appears to be increasing in importance and complexity is the balancing of efficient resource management and patient safety (Gardett et al., 2013).

Development

In recent decades, the Swedish ambulance service has gradually developed into a qualified emergency care resource, within the framework of the total healthcare system (Gårdelöf, 1998; Suserud, 2005; Skogvold et al., 2015). This development is due to, among other things, the National Board of Health's increased demands regarding

staff competence, the ambulance organizations' own competence requirements, medical technology achievements, and changes in healthcare structures that have resulted in more specialization and fewer emergency hospitals. This is also in line with recommendations from the World Health Organization (WHO) that highlight the importance of nurses within all healthcare systems (WHO, 2006). The ambulance service has naturally been involved as a key player in various care processes for time-critical conditions i.e., trauma, myocardial infarction, stroke, or sepsis (Skogwold et al., 2015; Wibring, 2020). An ageing population along with high numbers of multi morbidities has resulted in an increased demand on healthcare, especially at community level [www.framtidensvardkompetens.se]. Therefore, both the national government and local governments have agreed on establishing competence-enhancing initiatives for the ambulance service, with primary care planned to be the hub of the system (Socialdepartementet & Sveriges Kommuner och Regioner, 2021). The development of the Swedish ambulance service includes suggested advancements to be made in highly specialized care as well as in community level care.

Challenges faced

The public's expectations of accessible and professional ambulance care have increased (Riksrevisionen, 2012) and high expectations that are not met risk leading to patient dissatisfaction. Public expectations of the ambulance service can be a reason for increased demand, as can the increased proportion of older people who often have complex health problems (Akner, 2010; Fors et al., 2013). A national report interviewing Ambulance station managers found that there has been an increase in the burden placed on the ambulance service and also that the large proportion of "unnecessary transportations" was increasing (Hjärt- Lungsjukas Riksförbund, 2013). In year 2007, Hjälte et al. (2007) found that, according to ambulance staff, many patients requiring transportation did not need prehospital care. In a study by Norberg et al. (2015) it was found that 16% of patients transported by ambulance to emergency rooms could have been advantageously treated at a lower level of care. The combination of fewer emergency hospitals leading to extended transport distances, an increased

number of assignments, and more patients who do not need an ambulance reduces the ambulance service's ability to meet expectations in regard to availability. Already in 2010, a lack of research related to how the ambulance service as a system will meet challenges such as increased demand and the large variation in assignments was described (Turner, 2010).

In recent decades, both prehospital and emergency care settings have experienced challenges such as increased patient numbers including many patients with low priority conditions, which has impacted emergency resources, patient satisfaction, and patient safety (Muntlin et al., 2006; Hjälte et al., 2007; Hoot & Aronsky, 2008; (Lowthian, Cameron et al., 2011; Lowthian, Jolley et al., 2011; Jarvis, 2016; Jansson et al., 2020). Increased demands on prehospital resources are interrelated with emergency department attendances and contribute to overcrowding as well as an increased strain on hospital systems (Lowthian, Cameron et al., 2011). Factors driving these changes include ageing populations, declining health, changes in social structures, changes in the organization of primary healthcare, and increasing community health awareness (Lowthian, Cameron et al., 2011).

Nurses in the ambulance service

A small number of countries (Sweden, Finland, Belgium, the Netherlands, Great Britain) base their ambulance service staffing on RNs (van Schuppen & Bierens, 2011; Williams, 2012) rather than paramedics (Sedlar, 2020; NASEMSO, 2020).

In Sweden, to become an RN or SN you must complete a bachelor's or a master's degree in nursing, respectively. However, educational programs for advanced practice roles differ in terms of objectives and content, and professional titles vary between countries (Schober & Affara, 2006). Sheer and Wong (2008) reviewed 69 advanced practice roles in 35 different countries. This heterogeneity makes it difficult to fully understand the roles and scope of practice of advanced nurses (Gardener et al., 2007; Pearson, 2011; Lowe et al., 2012; Stasa et al., 2014). Stasa et al. (2014) concluded that the international variations of terms such as "advanced practice nursing" and "advanced nursing

practice" make understanding them difficult and confusing. SNs and advanced nurses are educated for practice outside the scope of the general practice of RNs. According to Begley et al., (2013) and Beagly et al., 2014) the degree of decision making and accountability separates specialist and advanced nurses from RNs rather than the tasks undertaken. Specialist roles are common in acute care settings (Canadian Nurses Association, 2008).

In the Swedish ambulance service, there is no distinct difference in the scope of practice between RNs and SNs with or without their specialization being in prehospital care. Despite their different levels of education, they are generally assumed to have the same responsibilities and there are no clear distinctions regarding their roles in the protocols and guidelines that govern prehospital emergency care (Rantala et al., 2019; Wihlborg, 2018). However, ambulance organizations themselves can make local decisions regarding how they utilize different categories of nurses i.e., in the staffing of ambulances, roles, and responsibilities as well as the induction of RNs into the ambulance service.

Registered nurses (RNs)

In Sweden, RNs must adapt and develop their competence for the prehospital context through continuing education and compulsory training after being employed by the ambulance service.

Since 1993, the RN education program has followed a three-year curriculum that results in both a professional degree and a bachelor's degree, which is the same in other Scandinavian countries (Råholm et al., 2010). To be able to administer medication in the Swedish ambulance service, staff members must be registered in the healthcare system i.e., be at least an RN, so every ambulance in Sweden is staffed by at least one RN. The competence description for RNs is based on the core competencies (Svensk sjuksköterskeförening, 2017).

Of the Swedish ambulance service's approximately 4827 fulltime nurses (RNs and SNs who make up 81% of workforce), 1681 are RNs (28% of workforce) (Wallin, 2022).

Specialist nurses (SNs)

An increasing proportion of the nurses employed by the Swedish ambulance service are SNs. Many SNs are specialist nurses in areas relevant to the ambulance service and the prehospital context i.e., Prehospital Emergency Nurses (PEN) (Riksföreningen för ambulanssjuksköterskor & Svensk sjuksköterskeförening, 2022). Previously, the competence description for PENs included: nursing, medicine, context, collaboration, leadership research, development, and education (Riksföreningen för ambulanssjuksköterskor & Svensk sjuksköterskeförening, 2012) while the current competence description is based on the core competencies (Riksföreningen för ambulanssjuksköterskor & Svensk sjuksköterskeförening, 2022).

The specialist education required by SNs builds on their former RN education and usually consists of a one-year program at post-graduate level, such as a one-year master's degree (Swedish Higher Education Act, 1992:1434). These additional education programs are directed towards specific fields of nursing (Affara, 2009), which also prepare RNs for research level programs (Swedish higher education act, 1992:1434). SN roles may include aspects of clinical work, teaching, administration, research, and consultations (Affara, 2009). In addition to PENs, several other categories of SN serve in the ambulance service, e.g., anesthesia nurses, district nurses, and intensive care nurses.

There are approximately 3146 fulltime SNs employed by the Swedish ambulance service (53% of workforce) (Wallin, 2022).

Nurse competence

Concept development

Nurse competence as a concept is not easily defined and has changed over time. Just over 40 years ago, Benner (1982) defined nursing competence as the ability to perform clinical nursing with the desired results in varying circumstances. She placed the "competent" nurse in the center of the scale, based on the Dreyfus & Dreyfus model, and explained a stepwise development, from novice to advanced beginner,

to competent, to skilled, and finally to expert (Benner, 1984). As a complementary statement, Girot (1993) argued that nurse competence was about both the ability to perform tasks and psychological ability (cognitive, affective, and psychomotor ability). Chapman (1999) and Winskill (2000) made distinctions between competence related to nurses' "actions" and competence related to what nurses "understand". According to Locsin (1998), competence could be described both as the nurse's theoretical knowledge and the ability to perform tasks. Pearson et al. (2002) reasoned that competence could be difficult to observe and was better described as a set of characteristics or attributes that affect nurses' performance. This set also included self-knowledge i.e., nurses knowing their own limitations. Later, Way (2002) suggested a holistic perspective on competence; that knowledge, skills, attitudes, cognitive ability, psychological and emotional attributes were important components for developing competence. Cowan et al. (2005) summarized that practical nursing required complex combinations of knowledge, performance, skills, values, and attitudes. In several studies, practical nursing skills have been defined to include cognitive, affective, and psychomotor skills such as critical thinking and problem solving using theoretical knowledge, values, and attitudes (Girot, 1993; Gonczi, 1994; Eraut, 1998; Redfern et al., 2002; Watson et al., 2002; McGaughey, 2004; Cowan et al 2005; Defloor et al., 2006). Cowan et al. (2007) and Black et al. (2008) argued that the holistic perspective on competence should include knowledge, skills, performance, attitudes, and values.

The concept of nurse competence has thus developed gradually, and different definitions exist. Recently, definitions have become more consistent and seem to emphasize a holistic perspective with different forms of knowledge always being included. In the majority of descriptions, three basic parts of nurse competence seem to be included; the nurse's approach to and implementation of nursing, generic knowledge including problem solving and critical thinking, and values, attitudes, and judgment (Leksell & Lepp, 2019).

Core competencies

Both internationally and inter-professionally there is a consensus on which areas of competence are essential for the provision of high-qualitative and safe healthcare, and these are referred to as the core competencies (Cronewett et al., 2007; Cronewett et al., 2009). The six core competencies encompass Person-centered care, Team collaboration, Evidence-based care, Quality improvement, Safety, and Informatics. The concept of core competencies was developed in the United States by the Institute of Medicine (Greiner & Knebel, 2003) and by the Quality and Safety Education for Nurses (Cronenwett et al., 2007; Cronenwett et al., 2009). The core competencies are considered central for planning, implementing, evaluating, and developing care and nursing (Svensk sjuksköterskeförening, 2010).

The competence description for RNs in Sweden is based on the six core competencies (Svensk sjuksköterskeförening, 2017) and the recently updated competence description for PENs is also based on the core competencies (Riksföreningen för ambulanssjuksköterskor & Svensk sjuksköterskeförening, 2022).

WHO defines quality of care as “the extent to which healthcare services provided to individuals and patient populations improve desired health outcomes.” To achieve this, healthcare must be safe, effective, timely, efficient, integrated, equitable, and people centered. The WHO definition of effective care also includes “services based on scientific evidence and evidence-based guidelines.” WHO definitions, to a high degree, seem aligned with the core competencies used in Sweden.

Nurse professional competence

Based on several professions, Cheetham and Chivers (1996; 1998) developed a comprehensive general holistic model of professional competence. The content of the model’s different dimensions changes depending on the competence required for a specific profession or role. The model’s four dimensions are; cognitive competence, functional competence, personal competence, and ethical competence. In addition to these dimensions, meta-competencies (communication,

creativity, problem-solving, learning, analytical ability, and reflection) and super-meta-competencies (reflection) were also described. The model also includes personality and motivation.

Nurses' professional competence can be seen from a holistic perspective, involving a complex integration of knowledge, experience, judgment, skills, values, attitudes, and personal aspects to adapt practice to unique contexts, situations, and individual preferences (Benner 1984; Guerrero & De los Rios, 2012; WHO, 2015; Rantala, 2017; Fukada, 2018). The core competencies add further perspective to nurse professional competence, and are central to planning, implementing, evaluating, and developing care and nursing practices (Cronenwett et al., 2007; Cronenwett et al., 2009).

Professional development

Continuous professional development can be seen as a crucial element of lifelong learning and nursing practice (Mlambo et al., 2021). Lifelong learning can be defined as a dynamic process, encompassing personal and professional life and can be formal or informal (Davis et al., 2014), and is essential for ensuring high quality and safe nursing care (Takase, 2013; Church, 2016). Both employers (Moore, 2007) and individual nurses (SOU: 2018:77; ICN, 2021a) are responsible for maintaining nurses' professional competence and adapting it to the current conditions of healthcare. According to Davis et al. (2014) characteristics such as critical thinking, reflection, questioning, motivation for learning, understanding of the dynamics of learning, and actively seeking new knowledge are essential for lifelong learning. Further, Davies et al. convey that lifelong learners must continuously challenge the current perspective of knowledge to avoid the risk of stagnation of thoughts and values.

Rationale

This thesis is intended to be a contribution towards developing knowledge about prehospital nurses' professional competence in the ambulance service. Prehospital care has changed with competence levels increasing among the staff, changes in the ambulance assignment, closer collaboration with hospital care, and more comprehensive guidelines for assessment, treatment, and triage. Prehospital nurses' professional competence is crucial for evidence-based and high-quality prehospital care. Educational programs for RNs and SNs focus on both clinical and academical content, and research utilization has become a necessity. How nurses' professional competence is viewed, internalized, and developed in clinical practice has not yet been studied. The proportion of specialist nurses specializing in the pre-hospital context (PENs) has increased, but there is also very limited knowledge about how their unique competence differs from other nurses' professional competence, and how their competence is utilized and can be further developed. The broad and varied assignment of the ambulance service also entails challenges for nurses developing as prehospital specialists.

Nurses' professional competence must be utilized in an optimal manner in order to get maximum effect in the ambulance service. Effective prehospital care could include strategies to use staff with specific and adapted competence for specific roles. Prehospital nurses' professional competence needs to be studied and perimeters agreed upon for the sake of patients, nurses, ambulance organizations, and educators.

Overall and specific aims

The overall aim of this thesis was to explore nurses' professional competence with a focus on scope of practice, content, utilization, and development within the ambulance service in Sweden.

Specific aims in the studies were:

I. To conduct and present an international overview of scope of practice among registered nurses and paramedics with an advanced level of education in pre-hospital and in-hospital emergency care, and

II. To explore perceptions of what constitutes professional nursing competence in the Swedish ambulance service, and

III. To explore registered nurses' understanding of professional competence development in the Swedish ambulance service, and

IV. To investigate and compare self-reported professional competence of nurses working in the Swedish ambulance service and to explore associations between potentially predictive background factors and self-reported professional competence.

Perspectives

The ideas behind this thesis are based on my experience working as a specialist nurse in the Swedish ambulance service and as a course director and lecturer for PEN education programs. I have thought about whether PEN education programs focused on the right content, whether education programs and examinations were at the right level, and whether PENs' professional competence was used effectively in the ambulance service. Over a 20-year period (2000-2020) I noted that the number of the ambulance service's assignments had greatly increased, in particular assignments regarding patients with low-priority conditions. In addition, I have also reflected on how I previously have prioritized content in the PEN education program to focus on time-critical conditions and on the fact that the ambulance service's compulsory training also seemed to prioritize time-critical conditions. These experiences combined make up the core of my pre-understanding that I had when starting the present project. As a doctoral student, I have therefore tried to draw on my experience to ask critical questions regarding the phenomenon of interest, prehospital nurses' professional competence, the competence of PENs in relation to the competence of other nurses, and the effective utilization and development of nurse's competence. My experiences also included insights about how the discourse of nurse professional competence differed between universities and the ambulance service. Entering a research area with this experience and level of pre-understanding also includes risks (Guba, 1981; Nyström & Dahlberg, 2001; Kvale & Brinkman 2014). Not infrequently I have had perspectives too close to the clinical perspective, where my supervisors have supported me to relate to the research perspective.

My perspective on nurse professional competence (epistemology) rests well within the framework of stated theory formation although my own might not be as comprehensive, that is that the combination of education, experience, values, and personal characteristics will be of decisive importance for nurses' professional performance.

Based on the previous description of how discourse differs between universities and the ambulance service, theory of nurse professional

competence and clinical reality (ontology) are not particularly synchronized. From my perspective, the ambulance service organizations seem to have placed focus on a number of specific degrees, common treatment protocols, and a constant ambulance assignment rather than on the complex and broad meaning of professional competence and the effective utilization and development of nurse's professional competence in a changing prehospital context. Further, they seem to almost unilaterally focus on clinical competence and thereby neglect academic competence and all it entails with regard to critical thinking, problem solving, research utilization, and self-reflection, despite RN and SN education programs including a significant amount of academic content.

From my perspective, it would be very meaningful to contribute to a move towards offering qualified and in-demand nursing education programs where prehospital nurses' professional competence is used effectively and continuously further developed within a changing ambulance service.

Methods

Methodological approaches

Initially, an integrated review was carried out to explore the scope of practice of advanced nurses and paramedics internationally (I). Based on an assumption that the Swedish ambulance service largely places the same requirements on all its nurses and uses different categories of nurses in the same roles, there were hopes that the integrated review would contribute with important perspectives for the upcoming data collections. To understand what constitutes nurse professional competence in the Swedish ambulance service, an exploratory qualitative design was used where nurses in the ambulance service were given the opportunity to describe their perception of professional competence (II). Furthermore, to study how prehospital nurses develop their professional competence, the third study, again using a qualitative explorative design, aimed to explore nurses' experiences of how competence is developed in the ambulance service (III). The fourth study, which was a quantitative cross-sectional study, aimed to describe and compare registered nurses and specialist nurses' self-assessed professional competence (IV). This mixed method approach (Table 1) was decided upon to increase the validity of the thesis but also to provide complimentary results that can serve as a basis for a deepened understanding of the phenomena at hand (Polit & Beck, 2021).

Table 1. Characteristics of the included studies in the thesis

	Studies			
	I	II	III	IV
Approach/ design	Integrative review	Qualitative/ explorative	Qualitative/ explorative	Quantitative/ cross-sectional
Aims	To conduct and present an international overview of scope of practice among registered nurses and paramedics with an advanced level of education in pre-hospital and in-hospital emergency care	To explore perceptions of what constitutes professional nursing competence in the Swedish ambulance service	To explore registered nurses' understanding of professional competence development in the Swedish ambulance service.	To investigate and compare self-reported professional competence among nurses working in the Swedish ambulance service and to explore associations between potentially predictive background factors and self-reported professional competence
Sample/ Setting	25 studies (15 in-hospital and 10 pre-hospital)	13 nurses (four RNs and nine SNs) from five regions	16 nurses (five RNs and 11 SNs) from five regions	105 nurses (34 RNs and 71 SNs) from three ambulance organization's
Data collection	Databases: PubMed, CINAHL, Scopus and Web of Science March 2017-Sep 2018	Qualitative interviews Nov 2020-March 2021	Qualitative interviews Nov 2020-May 2022	Questionnaire ANC-scale Jan -March 2019
Data analysis	Thematic analysis	Qualitative content analysis	Grounded theory	Descriptive and analytic statistics

Integrative review study (I)

Design

Already at the planning stage of this study the option of using a more specific perspective and narrow aim was ruled out. This was based on preliminary searches and assumptions on limited studies i.e., the development of prehospital care and the development of prehospital advanced paramedic and nurse roles is a later phenomenon, and that essentially paramedics, instead of nurses, are used internationally in ambulance services. A more precise aim would have meant that only a handful of studies, providing limited examples, could have been included. The aim in this case was rather to explore a variety of international examples taken from different perspectives. Therefore, paramedics, nurses, and prehospital and emergency care settings were included, and formed the basis for the research question i.e., an international overview of scope of practice among registered nurses and paramedics with an advanced level of education in pre-hospital and in-hospital emergency care settings.

Data collection

The search strategy (Table 2) was applied to four databases: PubMed, CINAHL, Scopus, and Web of Science. Assistance was provided by a university librarian.

Table 2. Search strategy.

Search strategy: search terms related to modified PICO	
Population:	"Nurse Clinicians" OR "specialist ambulance nurse*" OR "Emergency nurse*" OR "Critical care nurse*" OR "emergency medical technicians" OR "Specialist nurs*" OR "Paramedic practitioner" OR "Emergency care practitioner" OR "Acute care nurse practitioner" OR "advanced paramedic" OR "Advanced nursing practice
AND	
Setting:	"Emergency service, hospital" OR "Prehospital care" OR "Emergency medical services" OR "Emergency care"
AND	
Outcome:	Competenc* OR " Professional knowledge" OR "Nursing knowledge" OR "Nursing skills" OR "Clinical competence*" OR "Nurses role"

Limiters: Publishing date: January 2006-September 2018, English Language and Peer Reviewed. In the database Scopus studies in press were included.

Data were selected and evaluated, first individually, then by the research team, until consensus was reached. The PRISMA flow diagram (Figure 1) displays identified articles and duplicates, the screening and eligibility process, and the included articles for analysis (Moher et al, 2009).

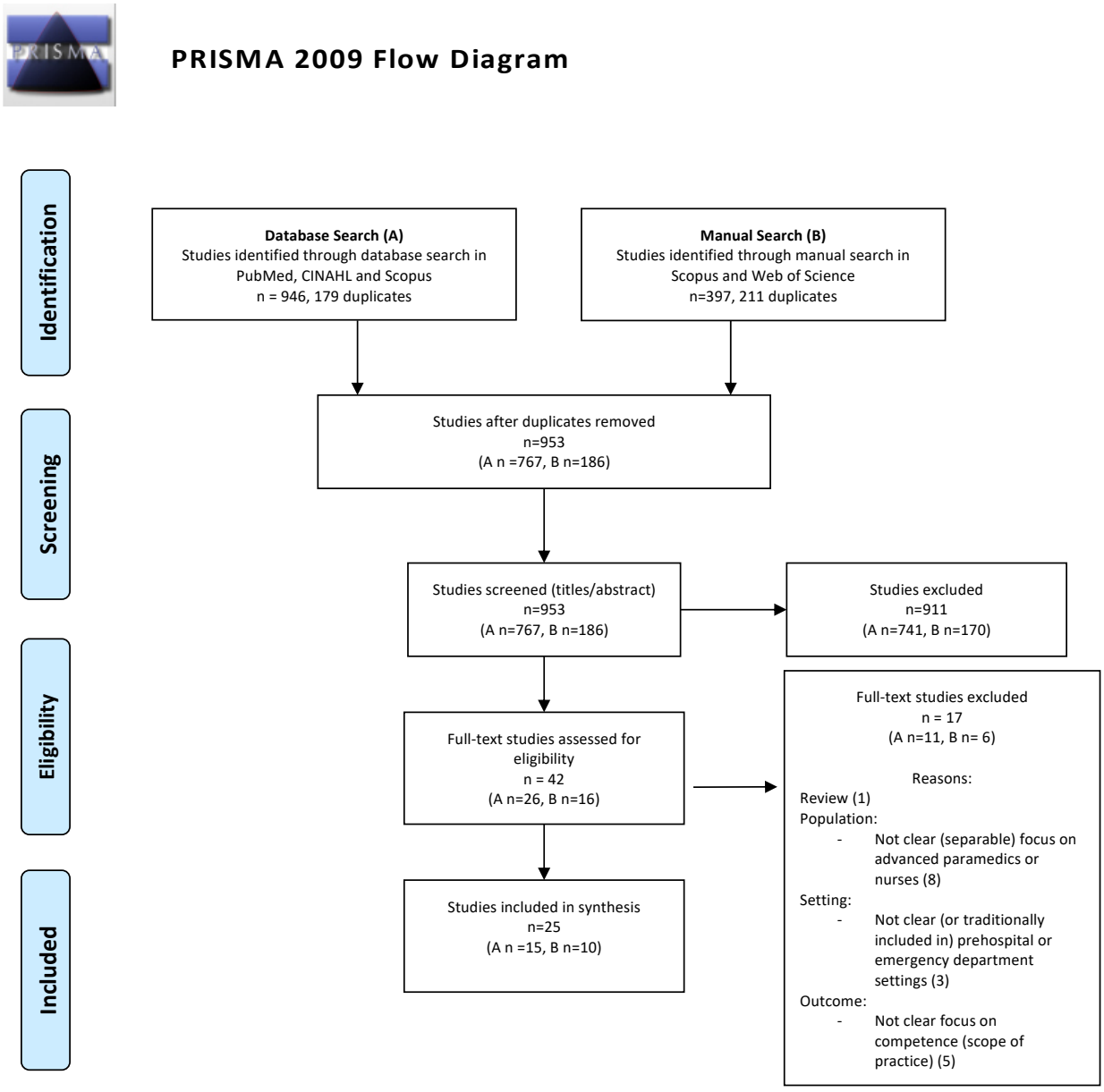

Figure 1. PRISMA flow diagram (Moher et al., 2009).

Data analysis

Data extraction focused on examples of how advanced competence was used, where it was used, which patients were affected by its use, and the received outcomes of performance.

Data analysis and synthesis were performed as a descriptive thematic analysis inspired by Whittemore and Knafl (2005) i.e., data reduction, data display, data comparison, conclusion, and verification.

Qualitative interview studies (II-III)

Design

Since knowledge about the phenomenon was limited, that use of qualitative explorative methods was considered justified (II, III). The interview data were analyzed using qualitative content analysis (II) and grounded theory (III).

Content analysis (II) has naturalistic underpinnings; changes in reality must be understood and described through the indirect interpretation of people's experiences in context, and reality is a product of social processes (Graneheim & Lundman, 2004; Elo & Kyngäs, 2008). Inductive content analysis was considered to be a suitable analysis method as the phenomenon had not been studied before and data (transcripts of interviews) described informants' experiences or perspectives (Graneheim & Lundman, 2004; Kyngäs et al., 2020).

In the 1960s, grounded theory (Glaser & Strauss, 1967) was seen as revolutionary in the field of qualitative research. Studies using a qualitative method could stand their own ground, rather than just be pilot studies for quantitative studies. At the time, qualitative research was considered unsystematic, impressionistic, and unreliable (Hallberg, 2006). Proponents of grounded theory make a clear distinction between qualitative descriptive research and grounded theory (Glaser and Strauss 1967; Corbin & Strauss, 2015; Charmaz, 2014). Corbin & Strauss (2015) claimed that it is the overall framework that explains why things happen that distinguishes grounded theory

from qualitative descriptions. Grounded theory, with findings clearly grounded in empirical evidence, also favors practical utility.

Of three main versions of grounded theory (Glaser & Strauss, 1967; Strauss & Corbin, 1998, Charmaz, 2014), the Strauss and Corbin (1998) and Corbin and Strauss (2015) description of the method was selected as the most appropriate (III). According to Strauss and Corbin's description of grounded theory, there are prerequisites for understanding complex social issues and for choosing and combining the best adapted methods. In this variant, objectivity is not emphasized as in Glaser and Strauss's (1967) description. Instead, the researcher should strive for a balance between objectivity and sensitivity i.e., the researcher should be open, able to listen, perceive nuances, be aware of his own pre-understanding, use pre-understanding and at the same time keep it at a certain distance. This version (Strauss & Corbin, 1998, Corbin & Strauss, 2015) can thus be attributed to more openness and reflexivity than the version of Glaser and Strauss (1967).

Data collection

The two qualitative studies (II-III) were planned together and data collection was carried out jointly (first 13 interviews). In study III, four additional interviews were conducted, as new questions arose during the analysis process.

For the first 13 interviews (II), informants were recruited with the help of station managers and research-development managers from five different ambulance organizations. The informants were RNs (n=4) and SNs (n=9), and included seven men and six women. As station managers have a sizable impact on their local discourse as role models and leaders, five informants were also station managers (1 RN and 4 SNs). The recruitment regions included both urban and rural areas.

The overall interview guide focused on themes such as: own area of responsibility (introduction), perspectives on nurses' competence, on competence utilization, on competence development, core competences and competence shortage. Follow-up questions relating

to the different themes were included to deepen exploration, explanations, and examples, and to ensure in-depth answers.

Theoretical sampling as described in grounded theory (Strauss & Corbin, 1998) was not applied in its ultimate sense (III). Based on the first 13 interviews and related notes, and as the analysis progressed, four additional interviews (interviews 14-17) were conducted for the study III. The informants were recruited on a strategic basis to further explore nurse competence development levels, progression in continued education and conditions for running development projects. Therefore, a station manager who had already been interviewed, two instructors, and a PEN who ran a development project were chosen. The three additional informants (one RN and two SNs) contributed together with the previously interviewed station manager, by validating parts of the findings and providing further explanations of professional competence development. In total, 16 informants were interviewed, and 17 interviews were conducted (Table 3). The first 13 interviews were conducted using the digital platform Zoom, and the additional four interviews were conducted over the telephone, due to the Covid-19 pandemic. The Zoom interviews were audio recorded. Three pilot interviews were performed and pilot interviews two and three were included in the analysis (studies II-III).

Table 3. Overview of informant characteristics, qualitative studies (II, III).

Interview/ Informant	Study/Region	Sex	Age	Education	Experience RN/ambulance service (years)
1/1	1 & 2/1	Man	41	SN (PEN)	13/9
2/2	1 & 2/1	Man	49	RN	16/27
3/3	1 & 2/1	Woman	47	SN (RNA)	22/22
4/4	1 & 2/1	Woman	37	SN (PEN)	11/10
5/5*	1 & 2/2	Man	38	SN (PEN)	8/10
6/6*	1 & 2/3	Man	46	RN	23/21
7/7*	1 & 2/1	Man	46	SN (RNA)	16/27
*8/8**	1 & 2/4	Man	45	SN (PEN)	21/18
9/9	1 & 2/3	Woman	50	SN (ICN)	29/18
10/10	1 & 2/2	Woman	33	RN	7/3
11/11*	1 & 2/3	Woman	58	SN (AEN, RNA)	31/22
12/12	1 & 2/3	Man	47	RN	23/21
13/13	1 & 2/5	Woman	40	SN (ICN)	15/2
14/14	2/5	Man	50	RN	26/24
15/5	2/5	Man	38	SN (PEN)	8/10
16/15	2/2	Man	50	SN (PEN)	16/15
17/16	2/1	Man	43	SN (RNA)	21/6

*=Station manager
RN=Registered nurse
SN=Specialist nurse
PEN=Prehospital emergency nurse
RNA=Registered anesthesia nurse
ICN=Intensive care nurse
AEN=Accident and emergency nurse

Data analysis (II)

Qualitative content analysis focuses on topic and context, emphasizes variation, and can be used to analyze qualitative data, including both manifest and latent content (Graneheim and Lundman, 2017). The phenomenon of interest often includes opinions, attitudes, perceptions, or experiences. A category describes what or which data have been sorted based on similarities (Morse, 2008). According to Graneheim et al. (2017) it is a challenge to maintain the same logical, congruent abstraction and interpretation through all the stages of analysis work. For study II, with the intention of exploring nurses' perceptions of what constitutes professional nursing competence, content analysis was judged to be a suitable method with the potential to manage large amounts of data (Graneheim & Lundman, 2004). However, the richness and variations of data and examples made it

difficult to consistently use codes without losing meaning and context, therefore a combination of codes and condensed meaning units was used. This was a deviation from Graneheim & Lundmans (2004) description of the analysis process.

Data analysis (III)

In study III, grounded theory was used for the analysis of data (Strauss & Corbin, 1998; Corbin & Strauss, 2015). Grounded theory was judged to be an appropriate method to process (and collect) data, in particular when it came to understanding and exploring the development of nurses' professional competence, which can be seen as a process and a phenomenon that spans over time. Grounded theory studies often focus on the development of social experiences and involve social processes and structures (Polit & Beck, 2021). Various guiding documents describe the professional competence and development of RNs and SNs in the ambulance service. By using grounded theory as a method, professional competence development could be explored as a phenomenon, i.e., as local social constructions, as a process, and in dimensions. Through constant comparison, via abstracting memos and data into codes, codes into preliminary sub-categories and categories, and the continued exploration of interrelationship and dimensions within categories, a logical, simple, yet complex and transferable core category was identified. Based on previously described personal prehospital experiences (preunderstanding), classical Glaserian grounded theory (Glaser & Strauss, 1967) was not judged to be a relevant approach. Instead, the Strauss and Corbin (1998) and Corbin and Strauss (2015) model appeared to be relevant due to it being seen as a tradeoff between objectivity and sensitivity, where pre-understandings could be used to facilitate interviews and the analysis.

Quantitative cross-sectional study (IV)

Design

To assess the self-rated professional competence among nurses in the ambulance service and to be able to compare the competence of different nursing categories (the unique competence of PENs), the

instrument Ambulance Nurse Competence (ANC) scale was deemed appropriate for data collection (Nilsson et al., 2019). Studies of nurses' professional competence within the ambulance service were limited in number and studies comparing the professional competence of PENs with other nurses in the ambulance service were absent. RN and SN education programs place great focus on evidence-based care, which is one of the core competencies (Cronenwett et al, 2007; Cronenwett et al, 2009). Evidence-based care requires the use of research, and therefore the instrument Research Utilization Questionnaire (RUQ) was also deemed appropriate for data collection (Champion & Leach, 1989).

A quantitative cross-sectional design was therefore deemed suitable for this study (IV) that investigated and compared the self-reported professional competence of different categories of nurses and background factors.

Data collection

The data collection was carried out via a digital questionnaire and included three ambulance organizations, 33 ambulance stations, and a total of 62 ground ambulances and nine single responders. Combined, the organizations managed approximately 170,000 ambulance calls per year.

Prehospital nurses (n=500) working for the selected organizations were invited to participate. Prehospital assistant nurses were excluded from participation. Organization managers supported data collection. Three reminders were sent to potential participants during the data collection period. A total of 105 nurses responded.

The instrument used for measuring nurses' professional competence was the Ambulance Nurse Competence (ANC) scale (Nilsson et al., 2019) which is based on the former competence descriptions for PENs (Swedish National Association of Ambulance Nurses and Swedish Society of Nursing, 2012). The ANC scale covers eight competence areas i.e., Nursing Care, Value-based Nursing Care, Medical Technical Care, Care Environments Emergency, Care Environments Serious

Events, Leadership Management, Leadership and Supervision, and Research and Development (Table 4). Self-reported competence for each item was graded on a 7-point Likert scale with response alternatives ranging from “to a very low degree” (1) to “to a very high degree” (7). Mean scores were calculated for all eight competence areas and transformed onto a 1–100 scale, with a higher score indicating a higher level of self-reported competence. The ANC Scale has been systematically tested and has a Cronbach’s alpha ranging from 0.71 to 0.88, with the exception of one competence area (Leadership) that was rated 0.54. An explorative factor analysis showed that the factor solution explained 59.2% of the total variance (Nilsson et al., 2019).

Background data were also analyzed and included age, gender, education, work experience and the indexes in the Research Utilization Questionnaire (RUQ) (Attitudes towards research, Availability, and support to implement research findings and Research use in daily practice) (Champion & Leach, 1989). RUQ consists of 29 items (Wallin et al., 2003), was developed for nurses, and has been used in several studies (Wallin et al., 2003; Boström et al., 2009). A 5-point Likert scale (strongly disagree, partly disagree, no opinion, partly agree, and strongly agree) are the given response options. The indexes were calculated by adding the respondents’ scores and dividing the sum by the number of items included in the respective index area. Higher scores indicate a more positive attitude towards research and better accessibility and use of research. Cronbach's alpha values measured by Wallin et al. (2003) and Boström et al. (2006) for the index areas were as follows: “Attitudes towards research” 0.88 and 0.89, “Availability and support to implement research findings” 0.75 and 0.51, and “Research use in daily practice” 0.84 and 0.88.

Table 4. Competence areas and items, Ambulance Nurse Competence scale.

ANC-scale, competence areas	Items (n=43) Do you have the ability to…
Nursing care 8 items	- apply a systematic approach in nursing care of sick and/or injured patients* - identify symptoms and signs of illness, promote well-being, and prevent care- related suffering - adjust the pace of care to sick and/or injured patients - make use of the patients' experience and knowledge ensuring that nursing care and treatment are based on the patients' dignity and rights - document, evaluate, and report the assignment ensuring patient safety - organize nursing care to promote the well-being of patients and their close relatives - identify infection and carry out infection prevention in nursing care - adjust information and education to sick and/or injured patients and their related persons
Value-based nursing care 5 items	- promote patients' and families' involvement in health promotion and self-care* - lead nursing care of deceased patients and their closely related in cooperation with other professions - identify patients with risk behavior and interact with optimal care levels - identify patients and related relatives suspected of being subjected to abuse or violence and report according to legislation - identify ethical issues in relation to resource shortage and organize care
Medical technical care 5 items	- assess the patient's condition according to ABCDE, carry out investigations, decide and evaluate interventions - interpret values and vital parameters as a basis for decisions for health care interventions - independently decide, administer, and evaluate pharmacological treatment based on local guidelines, - make use of medical technical equipment - carry out and evaluate care and treatment based on care pace during transport
Care environment – community 4 items	- apply a professional approach with respect to the patient's home environment - apply ethical approach in nursing environment at the injury scene and in the public environment - interact and communicate with representatives of the community and caregivers to ensure good and safe care - move and transport sick and/or injured patients in a traffic and patient safe manner
Care environment – serious events 8 items	- make use of and apply information and communication technology - identify risk environments and create safe care space - establish preparedness for threats and violent situations* - carry out triage of patients in serious events - systematically plan and address ill health in connection with CBRNE injuries - take responsible for medical leadership, prioritization of care at the injury scene - carry out triage to the relevant level of care in collaboration senior leaders - collaborate with rescue service and police in serious event
Leadership management 3 items	- initiate exchanges of experience between colleagues as well as lead reflective communication with colleagues - respect and make use of associates' knowledge and experience from care and rescue work toward common goals - contribute to cost-effectiveness and optimal resource utilization in care
Supervision and professional conduct 4 items	- initiate and take responsibility for supervision in nursing care - apply an attitude that promotes the profession's reputation and public confidence - understand the importance and consequences of following or deviating from treatment guidelines - take responsibility for in-depth and continuous supervision of students
Research and development 6 items	- identify knowledge gaps in ambulance care and contribute to clinical- and patient-related research* - implement evidence-based care - take responsibility for developing information and communication support for the management of nursing data - participate in the development of new technology and equipment - identify shortcomings in relation to safety and contribute to safe and comfortable transportation - share knowledge of the profession's responsibilities to other professions, the general public and to patients

Data analysis

Parametric statistics were used as the sum score in the included instruments (areas of competence and indexes) was measured. Analysis was performed using chi-square, independent t-test, and one-way ANOVA. The post-hoc Tukey test was used to find significant differences between more than two groups. Multiple linear regressions were performed using a general linear model to assess possible associations between nursing competence and predictive background factors. Data were analyzed using IBM SPSS version 24.

Ethical approval and considerations

Ethical considerations according to the Declaration of Helsinki were followed throughout the realization of this thesis, i.e., risks/benefits, voluntariness, informed consent and that no unauthorized person had access to the data (World Medical Association, 2013). The local ethics committee at Karlstad University reviewed and approved the study schemes, i.e., study IV (C2018/370) and for studies II and III (HNT 2020/189). In the empirical studies, approval was obtained from all operational managers within the ambulance service and all participants in the studies received written information about the respective study and gave written consent to participate. The information covered study aim and methodology, that participation was voluntary, that no sensitive personal data would be collected, and that informants' names or workplaces would not be able to be traced during analysis or in the published articles.

The ICN code of ethics (2021b) describes the importance of conducting and disseminating research exploring the links between nurses' continuous learning and competence. Before data collection began, pilot tests of interview questions (II and III) and a web-survey (IV) were conducted. In study IV, psychometrically tested instruments formed the basis of the web-survey. With this, obvious doubts and risks could be avoided in the data collection (Castillo-Montoya, 2016). Professional nursing competence is not easy to comprehend and can be perceived as difficult to discuss among informants. Repeated attempts to carry out data collection (II, III) via focus group interviews, where

informants had been able to share and develop ideas, thoughts, and perspectives (support each other) were made, but unfortunately could not be carried out due to the ongoing Covid-19 pandemic.

It was deemed that there was a risk that the participants (studies II-IV) would feel questioned, that they might perceive that they themselves did not have sufficient professional competence or that they had limited interest in prehospital research. Hopefully, these concerns were reduced with the information that preceded the empirical studies (World Medical Association, 2013; ICN, 2021b).

Collected data is stored on Sunet Drive, a cloud service provided by Karlstad University. This storage solution meets the basic legal requirements of data storage and IT security.

Main findings

Advanced paramedics and advanced nurses' scope of practice (I)

The findings, based on 25 studies from the pre-hospital (n=10) and in-hospital (n=15) context, included advanced paramedics (APs) and advanced nurses (ANs) with 13 different professional titles. The majority of studies focused on care related to patients with low priority conditions.

The international overview of scope of practice among APs and ANs disclosed four themes: Versatile care, Safe care based on precision and accuracy, Autonomous performance within boundaries, and Beneficial towards patients and society.

Versatile care reflected the diversity of assignments in different settings relating to the management of different patient categories, with different medical needs, at different levels of care. APs and ANs were prepared and able to take care of all categories of patients who entered the emergency departments or called an ambulance. This included all situations ranging from childbirth to those dying of old age and all types of illnesses and injuries both acute and less acute. Some studies also focused on practice related to defined patient categories. Mostly this concerned low-priority conditions where, for example, ANs took care of minor orthopedic injuries, administered pain relief or APs assessed and treated the elderly in their homes. In one study, it was described how paramedics were part of critical care teams and then handled patients with the most critical conditions. The findings show the breadth and the many areas included in APs and ANs' practice.

Safe care based on precision and accuracy reflected APs and ANs' diagnostic and decision-making abilities, treatment of patients, and the level of care decisions they had to make. In some studies, APs and ANs were involved in the entire care process, while in others they were mainly involved in assessment and treatment. Assessment and treatment were also described as being carried out with the support of triage systems, clinical protocols, X-rays, and ultrasound, and involved both low- and high-priority patients. A variety of clinical procedures

were described. APs and ANs' assessments, treatments, and decision-making were characterized by precision, accuracy, and safety.

Autonomous performance within boundaries reflected APs and ANs' assignments and performance, which was characterized by autonomous practice. However, much of the autonomous practice was conditional depending on defined categories of patients, assessments, treatment protocols, and other providers. APs and ANs also worked in teams. Autonomous practice was shaped by culture, traditions, regulations, and leadership, making it difficult to fully extend their performance into advanced practice.

Beneficial towards patients and society reflected the outcome of APs and ANs' service, which was of high quality and facilitated the care processes with less resource utilization. A high level of patient satisfaction was associated with APs and ANs' services, e.g., reduced waiting times, pain management, communication, and counseling. Another example where patient satisfaction was demonstrated was when patients were assessed and treated at home, and unnecessary transfers to hospital could be avoided.

What constitutes prehospital nurse professional competence (II)

Descriptions of professional prehospital nursing competence in the ambulance service was divided into three categories; Integrating education programs and activities for care quality, Executive power in the prehospital context, and Character traits and generic capability (Figure 2).

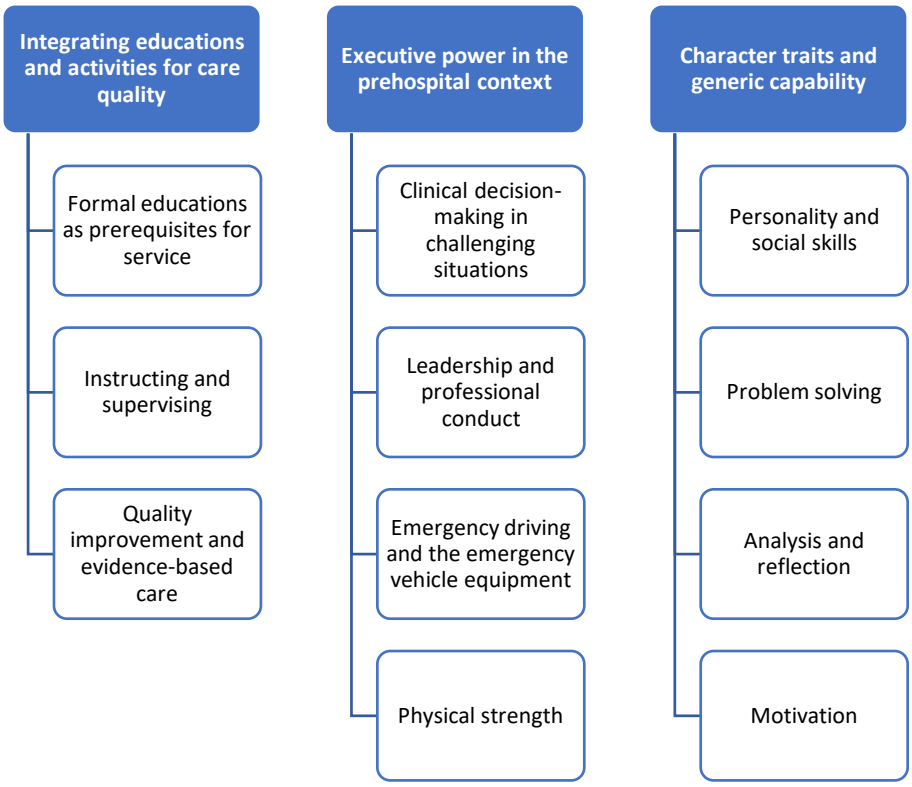

Figure 2. Overview of the findings, categories and sub-categories which together constituted prehospital nurse professional competence.

Integrating education and activities for care quality represented competence relating to formal qualifications, how nurses contributed to developing and maintaining formal competence as instructors and supervisors, and how nurses contributed to the development of the ambulance service through quality improvement and evidence-based care. Formal qualifications were represented by higher education (RN or SN qualifications) and broad medical and nursing competence was described as important. However, there was no clear agreement on which SN specialty was the most appropriate. Furthermore, formal qualifications included compulsory training or continuing education. The fact that nurses themselves contributed as instructors and clinical supervisors was also motive for the instructors and supervisors, to keep themselves updated. Several nurses were also involved in projects or development of care processes, and this was described as important competence. Research utilization was described as low, and academic competence was described as being of little relevance.

Executive power in the prehospital context represented competence related to clinical decision making, leadership, and professional

conduct specific to the context. These competences were also partly described in contrast to hospital competence. Other competences specific to the ambulance service were mastering emergency driving, and having the physical strength required to be able to transport patients. Executive power in the context was about being able to manage situations in vulnerable positions i.e., with limited resources and bases for decision-making, and still have readiness to act effectively in various, sometimes new, situations.

Character traits and generic capability represented competence that was primarily innate, such as having a positive personality, social skills, and the ability to problem-solve, analyze, reflect, and maintain motivation. The importance of these competences was also exemplified with descriptions on how the ambulance organizations valued these competences more than an SN education. A distinguishing factor, identified in the analysis, was that character traits and generic capabilities were described as innate, as these could not be learned through education.

Development of prehospital nurses' professional competence (III)

An intertwined process of learning and practice described nurses' development of professional competence. A seven-level description of development for nurses in the ambulance service also emerged, and descriptions of how the ambulance service environment supported nurses' development during the first levels, and how later nurses' development risked stagnation (Figure 3).

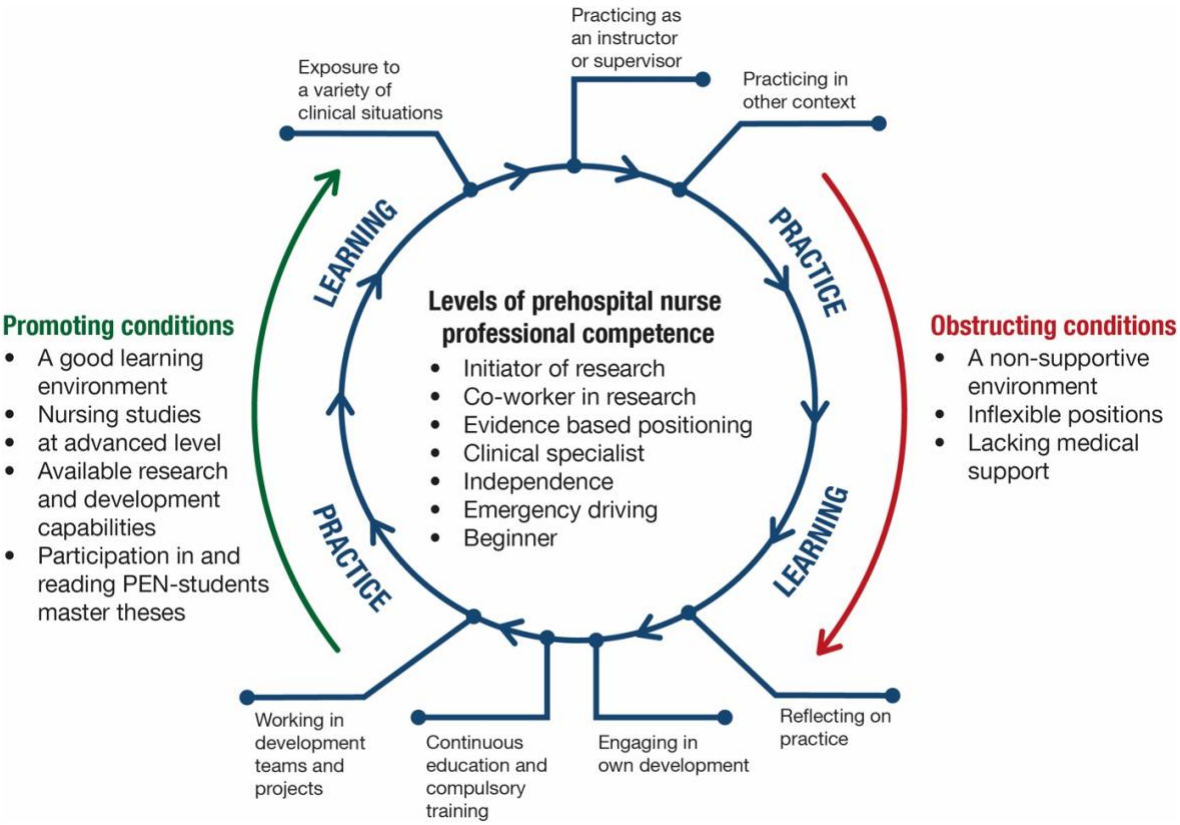

Figure 3. Illustration of development of prehospital nurse professional competence through an intertwined process of learning and practice, activities, and promoting and obstructing conditions.

The development of professional prehospital nursing competence was the result of a stepwise and intertwined learning and practice process gained through meetings with patients, being in various situations, having roles and responsibilities as instructors and supervisors, and from projects, networks, and education. The development of nursing competence could be promoted or obstructed and was dependent on individual motivation, leadership and organizational positions, colleges, and medical factors, research and development support. Among the informants, there was an agreement that competence must be utilized in order for it not to be lost or stagnate. This was described in terms of SNs who had not worked in their area of specialty for a long time and who no longer maintained their SN competence, or SNs (midwives, anesthesia nurses, psychiatric nurses) who needed a clinical anchoring in their specialty in order to be able to contribute fully to ambulance services.

Seven levels of nursing development were identified. It appeared that most nurses, through ambulance service experience and compulsory

training, reached the level of clinical specialist, with exceptions being consumers of research and of practicing evidence-based care. Taking positions based on research was described as rare, however the informants gave examples of colleagues who were engaged in research, such as PhD students and those with completed PhDs who had related research roles in their organization. The seven levels of nursing competence development were confirmed after the last four interviews, and although the first levels of development do not necessarily require taking an evidence-based position, some nurses could, or preferably should adopt this position earlier.

The first years in the ambulance service were described as developmental years, with clear strategies for development in place. These strategies, the environment, and practice were described as important prerequisites. However, around the time when nurses reach the stage of clinical specialist, development tended to stagnate – among other things it was found that at this level the same internal courses and educational content were repeated. As one informant (clinical specialist) said; *"There won't be much more than refresher courses now"*. Clinical specialists with ambitions to advance further described how they needed support from their local management team and the responsible physicians, and how it sometimes felt that they were up against the organization in trying to get this.

Nurses' self-reported professional competence (IV)

Self-reported professional competence was measured and compared between the nurse categories PENs, SNs (excluding PENs), and RNs. In total, 105 nurses (RNs n=34, SNs n=27, and PENs n=44) responded to the questionnaire (response rate 21%).

Of these categories, PENs reported the highest professional competence, which was significantly higher than RNs in four competence areas, and significantly higher than SNs in the competence area Care environment serious events. Furthermore, this study confirmed that research utilization was limited and that there were no significant differences between nurses with a master's respectively bachelor's degree (Table 5).

Table 5. Self-reported competence measured with ANC scale competence areas and categorized in gender, nurse categories, experience, and academic degree.

	Nursing care	Value-based nursing care	Medical technical care	Care environment-emergency	Care environment-serious events	Leadership management	Leadership and supervision	Research and development
Gender, mean (SD)								
Women	81.91 (8.9)	73.21 (8.3)	88.28 (9.1)	84.34 (9.0)	76.54 (10.8)	74.76 (12.4)	77.95 (10.5)	64.17 (15.7)
Men	81.05 (9.2)	72.64 (11.5)	91.76 (8.1)	86.00 (8.9)	82.43 (10.8)	75.66 (10.9)	79.88 (11.2)	70.66 (17.8)
Ind. t-test	0.646	0.773	**0.048**	0.364	**0.011**	0.699	0.385	0.063
Nurse categories, mean (SD)								
RNs	78.72 (7.3)	70.18 (8.6)	87.53 (8.3)	82.67 (9.1)	74.67 (10.4)	72.44 (11.2)	75.87 (9.7)	61.69 (14.8)
SNs	80.49 (11.6)	72.31 (11.1)	90.44 (9.5)	85.71 (8.2)	81.50 (11.5)	76.01 (10.0)	78.17 (10.1)	70.63 (15.4)
PENs	84.15 (7.8)	75.17 (10.5)	92.52 (7.7)	87.16 (8.9)	83.84 (9.8)	77.27 (12.2)	81.98 (11.6)	70.93 (19.2)
ANOVA test	**0.028**	0.110	**0.042**	0.087	**0.001**	0.176	**0.044**	**0.042**
Experience ambulance service, mean (SD)								
≤ 3 years	78.84 (8.2)	70.27 (8.2)	86.58 (8.4)	82.36 (9.4)	72.41 (10.4)	70.27 (11.8)	75.44 (9.7)	62.87 (15.6)
>3 years	82.62 (9.2)	74.03 (10.9)	92.18 (8.1)	86.70 (8.4)	83.88 (9.4)	77.80 (10.5)	80.65 (11.1)	70.15 (17.7)
Ind. t-test	**0.048**	0.086	**0.002**	**0.020**	**0.000**	**0.001**	**0.024**	**0.039**
Academical degree, mean (SD)								
Bachelor	79.72 (9.6)	71.06 (9.6)	89.52 (9.4)	83.85 (4.9)	79.30 (11.7)	74.80 (10.7)	78.57 (10.7)	67.01 (15.5)
≥ Master	83.11 (8.0)	74.04 (10.3)	90.76 (7.9)	85.94 (8.5)	81.13 (10.7)	75.70 (12.1)	79.96 (11.6)	68.20 (19.9)
Ind. t-test	0.066	0.153	0.490	0.259	0.438	0.704	0.541	0.744

RNs=Registered Nurses, SNs=Specialist Nurses (excluding PENs), and PENs=Prehospital Emergency Nurses.
A 7-point Likert scale, with response alternatives ranging from: "to a very low degree" (1) to "to a very high degree" (7) was used. In each competence area respondents scores were calculated, ranging from 1-100. A higher score indicates higher self-reported competence.

In a multiple regression analysis of the associations between potential predictive background factors and competence areas in the ANC-scale, ambulance service experiences were significant in four of eight competence areas. Significant differences between nurses with less than three years' experience and nurses with more than three years' experience were found in seven of eight competence areas. Descriptive cross-sectional data (not published) indicates that RNs start their ambulance service careers at a lower level of professional competence than SNs. Figure 4 shows correlation between ambulance service experience (years) and level of self-reported competence, in the ANC-competence areas respectively. However, after RNs have accumulated ambulance service experience, they seem to catch up with SNs, at least in most competence areas.

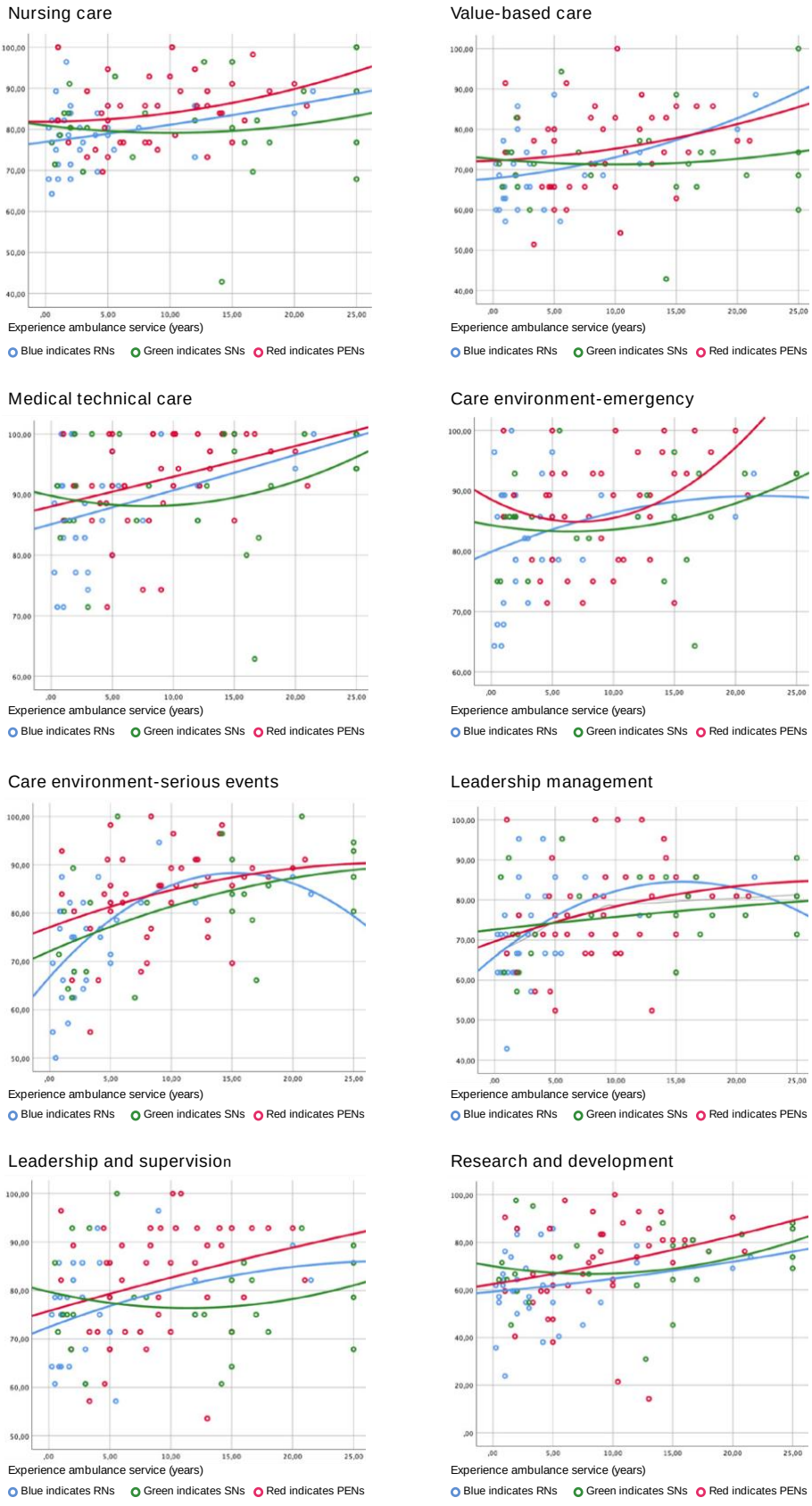

Figure 4. Ambulance service experience impact on professional competence, divided in the eight competence areas in the ANC-scale. Note that the plot diagram does not illustrate individual development, only different individuals with varying ambulance experience.

In relation to PEN education content, learning and relevance, four questions were only given to PENs (Table 6). The content of PEN education was described as relevant, clinical competence was utilized while academic competence was less utilized.

Table 6. Relevance in PEN education (IV)

Items related to PEN education content, learning and relevance	**PENs n=44**
	mean (SD)
Clinical	
Relevant educational content related to current assignment	4.91 (1.24)
Utilization of clinical specialist competence	4.43 (1.53)
Academical	
Utilization of academical competence	3.79 (1.85)
Demand of academical competence (from others)	3.16 (1.55)

Likert scale 1-7 (low-very high degree), mean (SD).

Summary of findings

The summary of findings is presented in accordance to the overall of this thesis: to explore nurses' professional competence with a focus on scope of practice, content, utilization, and development within the ambulance service in Sweden.

Scope of practice/utilization
Paramedics and nurses with an advanced level of education had a wide range of applications, in different contexts. Their assessments, treatments, and referrals were safe, of high quality, and were characterized by a high degree of autonomy. Patients were satisfied with the care provided, reduced waiting times, and the avoidance of unnecessary transfers to hospital (I). Registered nurses and specialist nurses assessed, treated, and transported patients to hospital based on the same protocols. Only limited divergences in the utilization of professional competence were identified i.e., pedagogical roles. Nurses' competence levels thus influenced roles, responsibilities, and accountability to a very small extent (II).

Content
The importance of being a good person, having good social skills, and having the ability to solve problems were important competences. These competences were something that the informants described as difficult to acquire through education and they were considered to be more important than having a specialist nurse qualification. The content of nurses' professional competence was clearly linked to the pre-hospital context, where resources, environments, and competences differed from hospital care. It was judged to take time to master and understand the prehospital context. Qualifications for working in the ambulance service were obtained at nursing programs at different levels and through compulsory training and continuous education (II). Prehospital emergency nurses reported higher professional competence than registered nurses and other specialist nurses (significant in four out of eight competence areas). No significant differences in self-assessed professional nursing competence between nurses with a master's or bachelor's degree were identified. In a regression analysis, ambulance service experience was

a significant predicting factor for nurse professional competence in four out of eight competence areas (IV).

Development

Nurses' professional competence was developed through an intertwined process of learning and practice, and this dynamic process could be promoted or obstructed. The ambulance service was seen as a positive environment for competence development for nurses in the early years of their careers. When focus, education, roles, responsibilities, and requirements remained the same over time, nurses' continued development risked stagnation. Research utilization and academic knowledge was given little focus and was not generally developed, although exceptions were described (III).

Discussion

The overall aim of this thesis was to explore nurses' professional competence with a focus on scope of practice, content, development, and utilization within the ambulance service. The findings showed how examples of extended practice for advanced paramedics and nurses were mostly related to care of patients with low-priority conditions. However, their practice was effective, safe, and appreciated. The perspectives on nurse professional competence in the Swedish ambulance service was focused on clinical competence, specific for the context and personality, rather than having an SN qualification. Professional experience was the most important factor for the development of prehospital professional competence for nurses. The ambulance service represented a learning environment during the first years of service. The fact that the ambulance assignment has changed and continues to move towards higher numbers of less acute care assignments while prehospital education mainly focuses on acute care, and how the increasing proportion of clinical protocols affects professional competence and competence development was only fragmentarily reflected on.

Scope of (advanced) practice

The findings from the integrative review study (I) supported changes in the demand of emergency care (Lowthian, Cameron et al., 2011; Lowthian, Jolley et al., 2011; Norberg et al., 2015; Skogvold et al., 2015; Jansson et al., 2020; Wibring et al., 2020), where different advanced nurses and paramedics' scope of practice was adapted to the management of patients with low-priority conditions. Effective resource management is essential for sustainable healthcare. In the integrative review, APs' and ANs' service was found to hold the same quality as the alternatives, standard care, or physician-led care. Striving for sustainability in prehospital and in-hospital emergency care includes optimal use of APs' and ANs' professional competence.

The future global deficit of nurses and other healthcare professionals has accelerated the demand for more effective practice and for advanced nurses' extended practice (WHO, 2013). In our Swedish findings (II, III) there were no such reflections. There were regional

differences in required educational backgrounds for certain instructor roles, otherwise the same scope of practice was described for both RNs and SNs.

According to Affara (2009), SN and advanced nursing roles may include aspects of clinical work, teaching, administration, research, and consultations. In the findings (II, III) the main focus was on clinical work and educational roles, however all roles could be noted, although some only to a very small extent. To my knowledge there is no international or national consensus in the definition of advanced nursing roles. However, common barriers for the advanced nursing role development are described i.e., lack of role clarity, resistance from physicians, opposition from other nurses, lack of education, absence of policies for the development of role potential (Schober, 2016; Bryant-Lukosius et al., 2017; Schober, 2017).

Content

The findings (II, III, IV) showed that clinical competencies were preferential to core competences or academic competencies. Executive power in the context, personality, and social skills were emphasized as being important factors of professional nursing competence. According to the findings (II) there were usually only two people taking responsibility in clinical situations, they had to exercise leadership and come to clinical decisions often with insufficient information, and they experienced vulnerability, which was also described by others (Daggenvoorde et al., 2021). The environments were also described differently; care and assessment were practiced at accident sites and in patient's homes and patients who could not move themselves had to be carried (II). In parts, these findings are shared with Wireklint Sundström et al. (2019), who emphasized the importance of professional building relationships with patients. The different context for prehospital care, the experiences of vulnerability, and the broad and varied assignment may explain the emphasis put on personality, social skills, and building relationships. Nurses in the ambulance service have no chance of understanding all the underlying causes of a patient's problems, and building a positive relationship is probably the most professional thing they can do. Taking interest in patients and listening to relatives' narratives and preferences also aligns with person-

centered care (Cronenwett, 2007; Cronenwett 2009), which is preferably included in all contact with patients. Personality and social skills may also serve as prerequisites for the performance of other competences (Chetam and Chivers, 1998).

Nurse professional competence based on the integration of knowledge, experience, judgment, skills, values, attitudes, and personal aspects to adapt practice into unique contexts, situations, and individual preferences was described in the findings (II, III), while systematic quality improvement, research utilization, evidence-based care, and academic competence were described as having low priority (Benner 1984; Cronenwett et al., 2007; Cronenwett et al., 2009; Guerrero & De los Rios, 2012; WHO, 2015; Rantala, 2017; Fukada, 2018). The university education programs for RNs, SNs, or PENs include more than clinical content, which according to the findings was of limited value (II, III, IV). The informants described how clinical competence that was not used risked being lost but did not reflect over the risk that academic competence achieved during nursing education risked being lost if it was not used. Falk and Lindström (2022) also experienced weak competence related to research utilization and evidence-based nursing, in a study on nurses entering emergency care- and PEN-education. If parts of the content in nursing education programs are not requested, utilized, or further developed in the ambulance service, neither universities nor the ambulance service appear to be effective. And, most importantly, quality improvement, evidence-based care, and academic competence is about providing safe, effective, and high-quality pre-hospital care for patients.

The findings indicated that PEN's professional competence was useful and relevant, however in many respects the competence of other SNs was described as being equally useful (II). The content in compulsory training and continuing educational courses was primarily related to time-critical conditions (Skogvold et al., 2015; Wibring et al., 2020). This focus and type of education was also appreciated by the informants (II, III). It was mentioned that one university (PEN-education program) had started to include educational content of a more sub-acute nature, more in line with the distribution of what the ambulance assignment looks like today. Otherwise, the findings

showed (II, III) that the asynchrony of educational content and assignments was unreflected. The ambulance service and universities should be encouraged to address the content of PEN education together to ensure that it aligns with the needs of the ambulance service.

Utilization

Higher competence among nurses is associated with improved quality of care (Blegen et al., 2013; Aiken et al., 2014) and effective competence utilization requires strategies to use the profession which can provide conventional care quality at the lowest cost (SOU: 2016:2). RNs and SNs assess and treat patients based on the same guidelines or protocols, responded to the same calls (II, III), and based on this, it was difficult to perceive the optimal effective utilization of professional nursing competence. Beagly et al. (2013) state that the level of decision-making and accountability differs between RNs and SNs, even if they perform the same nursing tasks, and from that perspective it comes down to the utilization of clinical protocols. The findings included different descriptions on how clinical protocols were used; some described them as being supportive and others as governing, and there were also indications of regional differences (II). Some interest should therefore be directed towards investigating how and if clinical protocols may counteract possibilities for higher levels of decision-making and accountability, especially if they are considered regulatory. The ambulance service has put a lot of effort into securing a basic level of nursing skills (important from a quality perspective) but very little effort into the utilization of “expert" skills (Benner, 1984). If there is any truth in this, a deeper investigation into the implications of unilaterally securing basic nursing skills could also be of interest.

Studies that focus on how different nurse competences can be used more optimally (roles, tasks, and responsibilities) in the ambulance service must be encouraged. If there were opportunities to target certain assignments towards units with adapted education, where nurses successively gain experience in the current orientation, it would mean higher degrees of specialization, efficiency, and quality. Large parts of healthcare structures are built on the concept of specialization,

e.g., division of units into medicine, surgery, neurology, pediatrics etc., which simplifies nursing development and specialization within a certain area. In a study of emergency departments, which also provide care for all patient categories, Boman et al. (2020) suggested using the novice-expert generalist-specialist continuum as a future guide to different RNs' and SNs' competence. The novice-expert generalist-specialist continuum could also be used in the ambulance service, to explore the implications of being a prehospital specialist. Wilson et al. (2015) suggested that prehospital care providers should primarily be generalists.

An evidence-based ambulance service takes on the responsibility to integrate research into clinical care, which is a challenge described in other studies (Grant et al., 2012; Yoder et al., 2014, Orton et al., 2020). In the findings (II, III), research utilization was described as low, even though it is a prerequisite for evidence-based practice. Research utilization is associated with both individual and organizational factors such as roles, climate, staffing, support, motivation (Meijers, 2006; Forsman et al., 2012). Barriers for evidence-based practice also include not defining evidence-based practice as an organizational goal and insufficient commitment and support from organizations and leaders (WHO, 2020). A first step for the ambulance service could include securing appropriate conditions (support) for prehospital leaders and defining organizational goals for evidence-based prehospital care. In the findings (II, III) there were good examples of how regions, with support from PhD holders included in the organizations, benefitted from prehospital research, research capability, and evidence-based care. These regional differences implicate the importance of such capabilities in the organizations and serve as good examples for others.

Development

According to Benner (1982), contextual work experience is a necessity for developing clinical competence, and this was supported in the findings (II, III, IV), and also that clinical competence can be developed in ways other than through formal education. Having executive power in the prehospital context depended on experience. Wihlborg et al. (2017) described the importance of reflecting over experiences, and

maybe nurses in the ambulance service are more dependent on ambulance service experience to develop competence, as clinical situations depend on a flora of contextual variables that must be experienced and reflected upon over time, in context. In contrast to other fields of nursing, where nurses can more easily bring and use experiences between, for example, community, medical or surgical care, it seems hard to develop competence in e.g., traffic accidents, transporting patients in cramped spaces, or co-working with other rescue organizations in contexts other than prehospital.

The development of professional competence was a process of integrating practice and learning (III), among other ways by being exposed to different situations and reflecting on situations specific to the ambulance context (Wihlborg et al., 2017; Sjölin et al., 2020). In the interviews there were informants who described how it could take five to ten years to become a specialist in prehospital care. Nurses with more than three years of experience self-reported significantly higher competence in seven of the eight competence areas in the ANC-scale than nurses with less experience (IV). This delineation (three years of experience) was set to correspond to the included regions' criteria for when nurses in the ambulance service are considered for independent practice, and the findings seem to support such a delineation.

The findings showed that the ambulance service is largely an environment where nurses can develop and grow (III). This must be considered an important asset and a success factor for the ambulance service and for prehospital nurses looking for opportunities for competence development. Through clinical exposure to patient situations, clinical guidelines, experienced colleagues, supervision, and continuous education, nurses gradually develop competence within the profession. However, when prehospital nurses have practiced for a few years (reached a level of independent practice, feel confident, and perhaps hold an instructor role), insights and wishes for additional competence development (not only mandatory training, courses, tests etc.) also emerged. In this regard, ambulance organizations were not favorably described. Lifelong learning (Davis et al., 2014) is essential for high quality and safe nursing care (Takase, 2013; Church, 2016).

Both employers (Moore, 2007) and individual nurses (SOU: 2018:77; ICN, 2021a) have a responsibility for maintaining and adapting nursing competence to prevailing circumstances. Davis et al. (2014) argues that lifelong learners must continuously challenge the current perspective of knowledge to avoid the risk of stagnation of thoughts and values. In the findings there were examples of the risk of stagnation of nurse's competence development, that there was an asynchrony between the educational focus and the ambulance assignment, and that, in general, nurses' competence development was not based on individual needs.

The intertwined process of practice and learning (III) aligned with theories of community of practice described by Wenger (1998; 2000). Community of practice is characterized by groups with a consensus around goals, practice, motivation, identification, approach, and values, which builds a framework for the view of professional competence and learning. The findings focused on individual nurse's professional competence, however, the informants' individual views of professional competence were socially constructed between peers, at local and regional level, and were based on experiences, collaboration, and reflection. Similarly, Wihlborg (2018) described that professional competence development is reinforced by the fact that nurses are part of the socio-cultural environment and by interaction between community and professionals. According to the findings, "inflexible positioning" in the organizations were a hindrance for nurses' competence development, where culture and uncritical consensus over time can make organisations resistant to new ways of thinking and developing. "Brokers" (Wenger, 1998) can link and connect perspectives from different communities of practice and perhaps the ambulance service may have to think in similar terms. Employment of PhD holders in the organisations had positively impacted attitudes towards academic competence and evidence-based care (II, III), as a kind of link between clinical competence and academic competence.

Professional competence development for paramedics can be enabled through supportive leadership, and supporting factors described by Tanninen et al., (2023) are: recognizing competences, using qualified supervisors, transparent corporate culture, clear objectives, and a

supportive work environment. These described factors can most certainly be transferred to prehospital contexts including nurses.

The Swedish ambulance service has made important efforts to increase the level of competence among its nurses, both from organizational and individual perspectives, and prehospital emergency nurses are now the dominant category of specialist nurses in their employment. If it is not a conscious strategy that all nurse categories perform on the bases of the same protocols, it still remains to differentiate nurses' professional competence to various roles and assignments.

Methodological considerations

The use of a multi-method approach provided a deepened understanding of the phenomenon of interest and findings included various examples of the broadness of professional competence and versatility of nurses and paramedics with advanced competence. The approach was enriched by the different perspectives, e.g., those of RNs, SNs, PENs, managers, instructors, participants in projects, we well as regional variation, utilization, development, and based on the previous competence description for PENs (ANC-scale). This knowledge is important for continued prehospital development and for the understanding of the whole spectra of professional prehospital nursing competence. To my knowledge, this is the first thesis with such a focus, and against that background the thesis seems justified.

In an attempt to gain continuity and to logically connect the four papers to each other, paper II was initially analyzed deductively, by using the ANC scale's competence areas for categorization (IV). This resulted in information not being able to be included i.e., perspectives on different SNs' competence, physical strength, character traits, and generic capabilities. The consequences of not using a deductive analysis meant that nursing and medical competence were not able to be expressed in more detail in the findings.

The integrative review (I)

Synthesizing the findings was a challenge, due to the studies' different methodological approaches, variables, and levels of detail. With such a

broad phenomenon of interest, specificity may be lost in the synthesis of findings, which was a calculated risk justified by the possibility of contributing to future policy making, competency strategies, and research (Whittenmore & Knafl, 2005).

By using broad inclusion criteria, the review provided the desired richness and variety of examples. The inclusion criteria for paramedics and nurses with an advanced level of education was a strategy to minimize the risk of missing relevant professional titles, which worked to some extent, but also led to some articles being excluded during the selection process. The strategy also led to the inclusion of paramedic and nurse practitioners, who possibly are not considered to be "nurses in the ambulance service" as they have different educational backgrounds. This reduces transferability of findings to the Swedish ambulance service, however, examples (strategies, methods, aims, etc.) can most likely be translated and adapted to Swedish prehospital contexts.

The selection of studies and data evaluations was considered a strength. All three authors were involved in every step of the selection process and the authors reached consensus on inclusion and quality assessments. With a more comprehensive understanding of the heterogeneity of professional titles, the search terms used could have been improved to further strengthen the study. Use of paramedical search filters may possibly have improved the sensitivity and specificity of database searching (Olaussen et al., 2017). Refinement of search terms appears to be most motivated in relation to the 'outcome' related terms, i.e., paramedical role, scope of practice, additional variations of competence, skills, and to the domains of advanced nursing practice (Dowling et al., 2013; Jokiniemi et al. al., 2012). The integrative review was reported following the PRISMA checklist: 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (Page et al., 2020). The execution and the quality of the study could probably have been improved through international collaboration, where knowledge and experience of paramedics could have influenced search terms and search strategies.

The qualitative studies (II & III)

The purposeful sample process guided by clear inclusion criteria had limitations since the recruitment of the informants was left to ambulance and research managers. This includes a risk that the sample was overrepresented by motivated and informative nurses. The data collection was carried out for two studies at the same time, with different interview questions for the respective study. As the phenomenon was not easy to understand for the informants, the simultaneous data collection provided data richness for both studies, as the informants sometimes responded with information not related to the current study, but instead to the other study. Data were collected via the digital platform Zoom (n=13) and telephone (n=4), due to the ongoing Covid-19 pandemic. The firsthand choice was to collect data through focus group interviews, which perhaps had made it easier for the informants to discuss prehospital professional competence and possibly generated further data. The strategic goal of representing a variation in the informant's characteristics was achieved.

The first author had extensive experience of prehospital care, and this was considered a strength when formulating questions and conducting interviews. This experience also includes a risk of insufficient exploration during the interviews and an obstacle to openness and objectivity during the analysis process (Nyström & Dahlberg, 2001). To counteract this risk, the co-authors without prehospital experience provided continuous critical input.

Scientific criteria commonly used for judgement of trustworthiness of qualitative research according to Lincoln & Guba (1985; 1986) are credibility, dependability, confirmability, and transferability. Trustworthiness (II, III) was considered strong and was built up through close collaboration in the research group and through continuous critical discussions with a conscious effort to put preconceptions aside (Lincoln & Guba, 1985; 1986; Strauss & Corbin, 1998; Nyström & Dahlberg, 2001; Graneheim & Lundman, 2004). Aspects of credibility (confidence that the findings are true and credible) were created through the interviewer's familiarity with the context and the prehospital narrative, pilot interviews, interview notes/memos, use of quotations, and the conscious effort made to set

pre-understandings aside. Aspects of dependability (ensuring the findings are repeatable) were created through descriptions of methods, detailed descriptions of informants, and repeated analysis meetings that led to agreement in the research group. Aspects of confirmability (extended confidence that findings will be confirmed by others) were created through the research teams different perspectives brought to data interpretation. Aspects of transferability (degree to which the findings can be transferred to other settings/contexts) were created through a purposeful sampling method and achieved variance of informant characteristics, operational and theoretical data saturation and rich descriptions. Several findings in the qualitative studies are evident in other studies (e.g., Benner, 1984; Ryan et al., 2013; Tavares, 2012; Smith et al., 2013 Wihlborg et al., 2014; Holmberg et al., 2017; Wireklint Sundström et al., 2019; Anderson et al., 2019; Bennett et al., 2020). The qualitative studies have been submitted (II) and will be submitted (III) following the consolidated criteria for reporting qualitative research checklist (Tong et al., 2007).

The quantitative study (IV)

The instruments ANC-scale (Nilsson et al., 2019) and RUQ (Wallin et al., 2003; Boström et al., 2006) have previously been tested and found to have satisfactory psychometric properties. In the quantitative cross-sectional study, reliability was demonstrated, and internal consistency was rated as satisfactory to excellent, with the exception of the competence areas Leadership Management and Leadership and Supervision, perhaps due to the limited number of items (Streiner et al., 2015).

The response rate (21%) and small sample sizes also represent important limitations to reliability. However, other studies have also experienced low response rates (Lozar Manfreda et al., 2008). An extensive questionnaire (two other instruments including 61 questions, not yet analysed, were also included in the questionnaire) may partly explain the low response rate in the quantitative study. Nurses who started but did not complete the questionnaire (n = 60) were considered non-responders. All nurses were contacted via their respective ambulance stations' staff email lists and for various reasons

(sick leave, training etc.) some nurses may not have had the opportunity to answer the survey.

Based on data from two of three ambulance organizations, the total population of nurses was younger, included slightly more women, PENs, and RNs, and fewer had a master's degree than in the study population, which may affect the generalizability of the findings. Self-rating studies are supported in the literature (Lauder et al., 2008) but as discussed by Forsman et al. (2019) and Lauder et al. (2008) self-assessments can be characterized by both overestimation and underestimation. The sample included three nurse categories working at 33 ambulance stations, and their self-reported professional competence represents their own judgments.

Conclusions

This thesis provides new knowledge about the scope of practice, content, utilization, and development of prehospital nurse professional competence. This knowledge can contribute towards the continued development of the ambulance service and to a more efficient utilization of the full spectrum of nurses' professional competence.

Internationally there were various examples of extended scope of practice for advanced nurses and paramedics and their practice was characterized by being effective, safe and a benefit to the public. Similar findings were not found in national studies, where all nurses were expected to provide the same level of care, indicating sub-optimal use of professional competence.

The most important nurse professional competences were described in terms of personality, social skills, and executive power in the prehospital context. Prehospital emergency nurses had the highest self-reported competence, but other specialist nurses could be equally relevant, depending on the situation. Clinical competence was emphasized over other competences and being a clinical specialist did not normally include research utilization and evidence-based care.

With some exceptions, research utilization, academic competence, and evidence-based care seemed to be almost neglected in the studied regions, as if they were someone else's responsibility. These types of competences were not demanded nor utilized and there was no difference between nurses with a bachelor's degree vs. nurses with a master's degree, indicating a loss of SNs' acquired academic competence.

The ambulance service was found to largely be an environment where nurses can develop and grow in the early years of their career. When focus, education, roles, responsibilities, and requirements remained the same over time, nurses' development of professional competence risked stagnation. Further efforts are needed to investigate barriers to the development of the full spectrum of nurses' professional competences and to adapt competences, roles, and tasks for the future ambulance service.

Future research

Prehospital competence appears to be “specialist nurse competence” (specialist vs generalist) in terms of specific context of care, and in contrast to in-hospital care. However, nurses and specialist nurses seem to share responsibilities, roles, accountability, guidelines, and they respond to the same assignments. From that perspective it is harder to define a prehospital specialist nurse within the context. Future research needs to ask the question if there is a reason to define a prehospital nurse specialist (not only in terms of an academic degree).

Effective and evidence-based ambulance services are dependent on well-educated nurses with high professional competence. Future research needs to focus on a more effective utilization of nursing competence (allocating tasks and roles, within and between professional groups, and if necessary, reconsidering professional boundaries) in the ambulance service.

If a specialization of roles and practice for nurses, within ambulance services, lies within reach, it would be interesting to explore the extent to which extended practice or new roles safely could be directed towards the care of patients with high priority conditions.

The ambulance organizations seem to provide excellent clinical learning environments at the beginning of a nurse’s career. Future research needs to focus on how this period of learning can be extended, so nurses continue to learn and engage, instead of stagnating or leaving the ambulance service.

Clinical competence that is not used risks being lost, according to the findings. Does this also apply to academic competence? If academic competence is not used in the ambulance service, then educational efforts and financing seems wasted. Future research needs to be directed towards defining educational content relevant for an effective evidence-based ambulance service.

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Prehospital nurses' professional competence – utilization and development

Ambulance services are included in changing healthcare systems where nurses have a central role in providing safe and high-quality care. Therefore, it is crucial that prehospital nurses' professional competence meets the needs of patients and the ambulance service. The overall aim of this thesis was to explore nurses' professional competence with a focus on scope of practice, content, utilization, and development in the ambulance service. Advanced nurses' assessments, treatments and referrals were safe, of high quality and characterized by a high degree of autonomy. Within Swedish ambulance services, prehospital emergency nurses reported higher competence than registered nurses and other specialist nurses. No differences between nurses with a master's or bachelor's degree were identified, and clinical experience was an important predictive factor for nurse competence. Ambulance services were a developing environment for nurses during the first years. When focus, training, roles, responsibilities, and requirements remained the same over time, continued competence development risked stagnation. This thesis provides new knowledge that can contribute to the continued development of the ambulance services and to a more efficient utilization of nurses' competence.

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