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Critical Incident Technique – A useful method for the paramedic researcher's toolkit

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Research

Critical Incident Technique - A useful method for the paramedic researcher's toolkit

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Abstract

Introduction

Critical Incident Technique (CIT) is a research method that has been used to investigate activities across many fields including psychology, medicine, nursing, counselling, education, learning and marketing. Given this, the method has potential to explore the knowledge and work of paramedics, with capacity to enhance paramedic practice and improve patient outcomes. This paper explores this potential by investigating the use of CIT as a research method for the paramedic and pre-hospital environment.

Methods

A search using the term 'Critical Incident Technique' was conducted using the University of Tasmania 'MegaSearch' facility. Some 2935 papers were then filtered to include one or more of the terms: ambulance, pre-hospital, paramedic, transport, retrieval, emergency medical service/s, EMS, emergency medical technician/s and EMT. Using these terms, four research articles used CIT as a methodological approach. Searching CINAHL, Scopus and MEDLINE via PubMed individually, contributed one further article. A further search with the same terms was conducted using Google Scholar, which identified an additional seven relevant papers.

Results

Although CIT has been used as a research method since 1954, its use in the examination and study of paramedic practice (pre-hospital care) was limited and quite new. An analysis of the articles indicated five distinct themes relating to how CIT was used: physical dimensions of job performance (equipment and technology), teamwork and communication (how team members work and communicate), psychological dimensions of work (how paramedics felt about their work), student learning and experience and patient care.

Conclusion

Critical Incident Technique is a research method that has been used effectively to inform various psychological and physical dimensions of paramedic practice. Asking participants about positive or negative, effective or less effective elements of practice encourages open responses that build a picture of optimal practice. Paramedic practice is about caring for those who require pre-hospital care, and further consideration of the application of CIT in pre-hospital research may increase our understanding of this work to improve service delivery and patient outcomes.

Keywords

paramedic; ambulance; emergency medical services; pre-hospital; Critical Incident Technique; methodology

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Introduction

Critical Incident Technique (CIT) is a research method suited to the direct observation and examination of significant behaviours in order to suggest means by which practice may be improved (1-3). The term 'critical incident' refers to episodes that contribute either positively or negatively to a range of social and occupational contexts (1-3). Critical Incident Technique has been used to study and increase understanding of workplace behaviour in several areas, including communications, nursing, job analysis, counselling, education and teaching, medicine, marketing, organisational learning, performance appraisals and social work (4). For example, in primary care areas such as emergency departments, CIT has been used to investigate clinical performance of residents (5), general practitioner referrals to emergency departments (6), nurse perceptions of triage systems (7), and patient care outcomes (8-11). Critical Incident Technique is a method of research that lends itself to examination of the work of personnel in an array of clinical settings. This paper explores the evolution of CIT, how it has been used to inform evidence based aspects of paramedic practice, and how the method could benefit the investigation of patient outcomes in paramedic care.

Critical Incident Technique

Critical Incident Technique is generally credited to John Flanagan (3), whose original paper explained how CIT evolved from studies conducted in the Aviation Psychology program of the United States Army Air Forces during and following World War II. In this paper, CIT was defined by Flanagan (3: p.327) as: 'a set of procedures for collecting direct observations of human behaviour in such a way as to facilitate their potential usefulness in solving practical problems and developing broad psychological principles. The critical incident technique outlines procedures for collecting observed incidents having special significance and meeting systematically defined criteria'.

Flanagan (3) defined an incident as any observable human activity that allows for inferences and prediction about the person performing the act. Further to this, a critical incident is a specific event, about which the person involved is able to judge positive or negative, effective or non-effective elements, and the behaviour observed makes a significant contribution to the aim of the activity (1-3). Being observable does not always imply overt observation on the part of a researcher. Critical incidents may also be apparent and examined through reflection with self-reports or interviews (4). One particular use of CIT in nursing research (12) demonstrated three different ways to gather data on critical incidents including: direct observation by researchers, individual reflection and documentation, and the use of critical incident forms to document incidents in a timeframe close to their actual occurrence.

The flexibility of CIT is also illustrated by what is 'significant' about a critical incident and how this is determined. Flanagan (3) claimed that the nature of the activity will impact on significance.

In this regard, CIT can take either a quantitative, qualitative or mixed method approach. For example, if the general aim of a central activity is production, then a significant contribution might be one that causes a directly measurable and appreciable change in production. For subjective activities such as attitudes in a company, a significant contribution might be one that influences at least one in 10 persons to change their vote on an issue of importance. Norman and colleagues (2) suggested that critical incidents often have no clear demarcation, and that descriptions of an incident may be a combination of several similar events rather than a description of one event. In their study of high and low quality nursing care, they questioned whether it is an incident that is critical, or whether it is observed activities or 'happenings' that are revealed by the incident that are meaningful to the question at hand. The authors suggested using the term 'revelatory' in preference to 'critical' in that an incident displays 'happenings' which are critical by virtue of being significant to the investigation.

As a descriptive method, and in pursuit of evidence for which there is little prior knowledge, CIT comes to the fore. Critical Incident Technique has been incorporated with methodologies such as grounded theory, ethnography or phenomenology. The use of CIT in phenomenology, for example, allows the researcher to investigate 'real life' experiences, reporting in a way that protects the context of those experiences (13). In ethnography, these 'real life' experiences may be examined from the perspective of an outsider who used participant observation (14). Grounded theory can be used to inform the analysis of data collected using CIT, and in this context has provided new information in a number of areas of healthcare practice. Examples include the role of nurses in helping elderly gain access to community resources (15); the process of care provided by community based geriatric teams (16); understanding of the need for mental healthcare nurses (17); clinical decision making of paediatric rehabilitation specialists (18); the professional identity of social workers as counsellors and psychotherapists; prescribing decisions of doctors (19,20); and the identification of the needs of breast cancer patients from the patient point of view (21).

Given the use of CIT in the exploration of human behaviour and its use across a range of fields, this paper explores the use of the method specifically in relation to pre-hospital paramedic healthcare.

Methods

A literature search incorporated three main steps (Figure 1). The aim was to locate papers relevant to paramedic practice and which utilised CIT as a research method.

The first step consisted of a search using the University of Tasmania 'MegaSearch' facility, which allows search terms to be utilised across numerous databases, including but not restricted to MEDLINE, SCOPUS, CINAHL, Web of Science and Web

Figure 1. Steps used in literature search

of Knowledge. The search used the combined term 'Critical Incident Technique', was limited to the title and/or abstract of retrieved sources and research papers in the English language. All papers where healthcare professionals performed pre-hospital work for ambulance services were considered. This included both qualified staff and students, and other professions such as nursing, where those professionals performed pre-hospital work for ambulance services. The earliest year of publication for all articles retrieved was 1960.

The number of research articles retrieved with 'Critical Incident Technique' in the abstract or title was 2935. These papers were then filtered further to include the terms: ambulance, pre-hospital, paramedic, transport, retrieval, emergency medical technician, EMT, emergency medical service and EMS either singularly or in combination where these terms appeared in the abstract. Using these terms, four research articles were identified that related to ambulance or paramedic practice and which used CIT as a methodological approach.

In the second step, in order to independently check results from the MegaSearch, the same terms were used with CINAHL, Scopus and MEDLINE. This contributed one further article.

In the third step, due to the small number of relevant papers, a further search using the same terms was conducted using Google Scholar. A further seven relevant papers were identified.

Results

As a result of the literature search, a total of 12 papers were retrieved. Although Critical Incident Technique has been described as a research method since 1954, its use in examination and study of paramedic practice (pre-hospital care) is limited. Of the 12 studies identified relating to pre-hospital care, the earliest dated from 1989. Table 1 provides brief descriptions of each of these studies subject to this review. Aims and outcomes of each paper were examined for main areas and then grouped according to five major themes. For example, studies on multidisciplinary teams (22,23) had a main area of how team members worked together. These were then grouped under a major theme of teamwork and communication. Where more than one area appeared in a paper, the dominant theme took priority. For example, in a study into aeromedical retrieval incidents (24), which was largely equipment and technology related but also offered insight to general teamwork, the paper was grouped in terms of the dominant theme. In this case, physical dimensions of job performance. The major themes identified were physical dimensions of job performance (equipment and technology related), teamwork and communication (how team members work and communicate together), psychological dimensions of work (how paramedics felt about aspects of their work), student learning and experience (prior to qualification) and patient care

(elements related to paramedic care of patients).

Physical dimensions of job performance

Four papers were concerned with physical aspects of paramedic practice and were investigated using CIT. Issues associated with physical aspects of work included, needlestick injuries (25), aeromedical retrieval incidents (24) and stretcher loading systems (26,27).

When conducting an examination of needlestick injuries, McIntosh and Rever-Moriyama (25) involved paramedic students as part of a process that was later applied to other health professionals (nurses). The authors included 78 paramedic (Southern Alberta Institute of Technology, Canada) and nursing students (University of Calgary, Canada) in one part of their investigation. Students were administered a questionnaire developed from an earlier CIT focus group discussion with qualified nurses. While the direct link with paramedic practice was limited, the authors argued that CIT was a suitable investigative starting point for development of questionnaires.

The study of critical incidents experienced in aeromedical retrieval demonstrated that CIT does not always incorporate an interview process for primary data collection (24). The authors retrospectively examined records of retrieval team (doctor/paramedic) attendance by the CareFlight medical retrieval service based in Sydney (New South Wales, Australia) between December 1990 and November 2001. Records examined were either adverse or positive, and incidents were clearly documented as having reduced safety margins for the patient or team. With this approach, the authors identified 216 documented incidents from 1198 records. Data were presented numerically in a descriptive way, and by comparing adverse and positive incidents, identified areas where team and patient safety could be improved. For example, one outcome of the study was to suggest the potential of crew resource management training to enhance team operations. The report did not provide a breakdown of the results by profession and so explication to paramedic care specifically was not possible. The work by Flabouris (24) does however represent a different way of analysis and presentation of data than work such as that by Sveinsson and Fridlund (28) and Gustafsson and colleagues (29) where incidents were coded by into sub-categories, categories and main areas.

A number of papers investigated the physical dimensions of job performance in paramedic practice were produced from one doctoral thesis by Jones (27), and this review refers to the thesis and one main paper (26). Both illustrate the use of CIT in the process of selecting appropriate stretcher loading systems for ambulances. Rather than rely solely on observation of stretcher loading techniques or postural analysis of paramedics, the authors used CIT to ask paramedics about incidents they had experienced using different stretcher types.

Although the number of critical incidents was not stated, a thematic analysis of incidents resulted in five primary codes relating to stretcher use: system failure, environment, patient-related, equipment and coping strategies and adaptation. The findings were included in national specifications for ambulances in the United Kingdom (UK) (26,27).

Teamwork and communication

The review identified four studies using the CIT method that examined teamwork and communication within multiprofessional teams that involved paramedic participants. Reddy and Spence (22) explored a multidisciplinary team in a rural emergency department in the United States (US). One member of this team was a paramedic. The researchers followed team members and observed what they deemed as critical incidents in real time. The paper did not define what critical incident was other than stating they ranged from 'unexpected problems' to 'less urgent' treatment decisions. Reddy and Spence (22) used interviews as part of CIT to determine what questions were asked by team members, and who asked them, in pursuit of patient care.

Siemsen et al (23) recognised Danish paramedics as part of a multidisciplinary team when they included five paramedics in a study of professional attitudes and experiences with patient handovers. The authors used CIT in a traditional way with semi-structured interviews that identified 265 critical incidents. These were thematically analysed to identify eight main factors associated with handover: communication, information, organisation, infrastructure, professionalism, responsibility, team awareness and culture.

Communication and decision making within teams was also a theme in papers by Klein and colleagues (30) and Mishra and colleagues (31). Klein and colleagues (30) described a method of investigation they termed 'Critical Decision Method' (CDM), a variant of CIT. The process of CDM as described by the authors was similar to that of CIT, with interviews forming a major component. Rather than critical incidents, they developed a 'Critical Cue Inventory' (CCI) for use with CDM. In this descriptive paper, the authors cited their previous work with paramedics in order to demonstrate CCI. The authors argued that paramedics employed a number of critical cues to identify heart attack patients including skin tone, eyes, breathing and mental state. Their paper suggested CCI could assist in the development of training materials. The study reported by Mishra and colleagues (31) described how activity theory can be used to explore information practices in emergency management. In this study, CIT interviews with UK police, fire and ambulance emergency commanders provided baseline information for activity theory.

Psychological dimensions of work

Two of the 12 papers directly examined psychological elements of paramedic practice, and both looked at 'worries' and concerns of ambulance based nurses in Sweden.

Papers by Gustafsson and colleagues (29) and Svensson

and Fridlund (28) highlighted 'psychological' dimensions of paramedic practice in their articles, describing critical incidents in which Swedish ambulance nurses performing pre-hospital care experienced worry in their professional life, and how they coped with this. Gustafsson and colleagues (29) looked specifically at specialist nurses with experience in anaesthesia, intensive and pre-hospital care, who performed ambulance transports. While Svensson and Fridlund (28) looked at general ambulance nurses from three small to medium size ambulance services across Sweden.

Both papers defined 'critical incident' and asked selected participants about times they had experienced such incidents. Svensson and Fridlund (28) started with an open question, ie. emergency situations where they had experienced worry and the actions taken to deal with it. The authors then asked how participants felt and what they meant when describing these situations as worrying. In the study by Gustafsson and colleagues (29) participants were asked two open main questions; the first concerned critical situations in connection with ambulance transports, the second how these situations were handled. Again, more in depth questions followed.

The participants determined what they regarded as a critical situation. In both papers thematic analysis was used to group critical incidents. Descriptions of critical incidents were first grouped according to similarities and differences; incidents were then organised into sub-categories; sub-categories grouped by similar content into categories; and finally, categories classified according to main areas. For example, from the study by Svensson and Fridlund (28) one sub-category included situations involving children. This theme appeared in 14 critical incidents, along with four critical incidents about childbirth. These were grouped to the category of worry about specific types of emergency call-out. Similarly, knowing the patient and associating a situation with personal experience formed a category about situations where there was personal involvement (with the patient). Both these categories then formed a main area of worry related to specific emergency situations (28).

Student learning and experience

One paper was specifically concerned with learning and experience of students in pre-hospital care. Wallin and colleagues (32) used CIT to describe the ambulance service placement experiences of pre-hospital nursing students and the effect these placements had on their learning. The work was specific to Sweden where pre-hospital nursing students graduate to work with ambulance services. In a traditional approach to CIT, participants were asked two questions: one to describe a situation (relating to placement) that had positive effects on their learning, the other to describe negative effects. The authors further asked more in-depth questions about their responses. Coding interview transcripts into sub-categories, categories and main areas, three main areas important to clinical placement were revealed in the analysis including the clinical supervisor, the clinical placement setting and learning strategies.

Patient care

Patient care in paramedic practice was the focus of only one paper retrieved and again, needs to be understood in the context of a Swedish ambulance system. Wahlin and colleagues (33) chose to examine how 'loving care' was carried out in the Swedish ambulance service. This care was characterised as that which induced in the patient, or their next of kin, feelings of any one of safety, confidence, closeness, delight in bodily contact, a will to listen, consolation, hope, peace and quiet, or wellbeing and satisfaction. Twelve Swedish paramedics were asked to describe critical incidents where they had offered 'loving care'. These areas of care were entirely subjective on the part of individual paramedics. A total of 167 critical incidents were identified by the participants, which were then subject to thematic analysis to identify three key dispositions related to the provision of 'loving care'. Cognisance (ability to judge and treat based on monitored symptoms), solicitude (through humbleness, closeness, consideration and rapport) and empathy (capacity and knowledge about crisis) were seen to be present in the care provided.

Discussion

While CIT has been used by many health disciplines such as nursing and medicine, it has only seen fledgling use since the late 1980s in the investigation of paramedic practice. CIT is used to expose positive or negative elements of practice (1-3,28) or, in different terms, effective or less effective aspects (17). Despite limited use in paramedic services to date, paramedic research has been able to demonstrate CIT as a flexible and effective research method, well suited to examine several aspects of pre-hospital work.

Although flexible, CIT does offer a systematic set of research procedures that allows for replication by others. As a systematic process Flanagan (3) suggested five stages to CIT: to establish general aims, establish plans and specifications, collect the data, analyse the data and interpret and report (34). In applying CIT, of major importance is the identification and definition of 'critical incident' by the investigators such that this is readily understood by participants. For example, in a topic as potentially vague as 'loving care', Wahlin and colleagues (33) were careful to explain to participants the meaning of 'loving care'.

The studies drawn on for this review illustrated the diversity of data collection methods used with CIT. Most utilised a semi-structured interview, yet there was also use of focus groups (25), direct observation (22,26,27) and retrospective document review (24). The analytical stage of CIT usually followed a process of identification of similarities and differences between incidents, which are then grouped into sub-categories, categories and, finally, main themes or areas, even with numeric data (vide: Flabouris (24)). Common to all the studies presented, and in support of CIT as a valid and reliable approach, was the crosschecking of data by more than one researcher. To illustrate, Wallin and colleagues (32) stated

that their study demonstrated an 86% agreement level between researchers when identifying categories of critical incidents.

From a careful review and synthesis of the methodologies and procedures described in the papers reviewed, it is possible to build on the five stages suggested by Flanagan (3) to propose an expanded, more detailed account of the steps or stages common to CIT. This sequence is shown in Figure 2 and drawn largely from the studies reported by Wahlin and colleagues (33), Svensson and Fridlund (28), Gustafsson and colleagues (29) and Wallin and colleagues (32). The seven stages are analogous to the provision of paramedic patient care. On being dispatched to attend a case (a problem), the critical incident will be defined (eg. chest pain). On arrival, the means of gathering information will be decided (eg. vital signs, electrocardiogram [ECG], history) then gathered. The information will be analysed based on positive and negative aspects of the incident (eg. what has relieved the pain, what has made it worse, does the ECG show changes). Data will be validated (cross checked with a colleague, guidelines). Finally, an interpretation will be made and treatment initiated.

In this review, five areas of paramedic practice were subject to investigation using CIT: physical dimensions of job performance, teamwork and communication, psychological dimensions of work, student learning and experience and patient care. Critical Incident Technique builds a picture of what is effective or not effective, positive or not positive and in some cases, the results of investigation resulted in a positive change to practice. For example, studies into stretcher-loading systems where CIT was used as an investigative method have resulted in the adoption of results into national specifications by UK ambulance services (26,27). Another study that used retrospective case data, identified areas in aeromedical retrieval where critical incidents were likely to occur, and offered suggestions for further incident monitoring and crew resource management training (24).

Although each of the five areas where CIT has been used to investigate paramedic practice is important, ultimately paramedic practice is about caring for those who require pre-hospital care. This review located only one paper, from a specific ambulance system, in which patient care by paramedics was examined, that of 'loving care' (33). This suggests that the contribution CIT could make to care improvement and patient outcomes has not been fully realised.

The potential of this contribution finds illustration in the use of CIT to examine aspects of patient care in the hospital emergency department. Although only using a small sample of five, Jay (9) interviewed patients to identify the nature of psychological care given by accident and emergency nurses, as well as patient perceptions and feelings following serious trauma. Griffiths and colleagues (8), modified CIT slightly to include cross-referencing of transcripts from both doctors and patients, and develop themes relating to reducing emergency admissions to hospital for asthma.

Figure 2. Seven stages for CIT

(Adapted from Flanagan (3), Wahlin, et al (33), Svensson & Fridlund (28), Gustafsson, et al (29), Wallin, et al (32))

Treatment of stroke patients admitted to emergency departments in Brazil has also been examined using CIT, with interviews designed to identify changes in family relations that occurred after one family member suffered a stroke.

Eleven families with 34 participants were asked to think of situations that happened after the patient returned home, and to tell about positive and negative alterations to the family environment (10). Similarly, 10 patients and six carers where the patient had suffered myocardial infarction and required emergency angioplasty were asked to provide positive and negative aspects of their experience 1–4 weeks after their procedure. This use of CIT helped reveal generally positive aspects around the medical care itself, and negative aspects concerning practical problems such as car parking, hospital food or discharge processes (11). Based on such research situated in emergency medicine, and returning to the paramedic care analogy of CIT, an opportunity exists for CIT in investigation of patient care and outcomes in the pre-hospital arena.

In realising this opportunity, an enhanced awareness of positive and negative, effective and less effective elements of pre-hospital patient care will result. It is an effective yet flexible method based on 'critical incidents'. The technique has strong positivist roots in aviation psychology, however, even Flanagan (3) acknowledged the largely subjective classification of incidents. What makes up positive or negative, effective or less effective incidents is open largely to subjective determination (34). Just as with the example cited of the paramedic gathering information to provide appropriate patient care, researchers using CIT adopt a systematic approach to study design, gathering, analysis and reporting of data.

Limitations of this study

The scope of this review was limited to discussion of CIT in regard to paramedic practice and the terms commonly used to identify such work. The specific search engines and journals accessed by the University of Tasmania MegaSearch facility limited the literature selected, however, this was expanded by additional use of Google Scholar. Although peer reviewed journal articles conference proceedings, reports and proceedings were all considered, other relevant literature might exist among the 'grey literature'. The papers reviewed were conducted in countries that often had different interpretations of what constituted paramedic practice. Thus, paramedic practice could be quite different across settings and impact on the type of activities or phenomena that were able to be selected for investigation using CIT. Finally, a wider selection of papers may have further informed our staged model of CIT.

Conclusion

The Critical Incident Technique has been used to examine

behaviour since its development for aviation psychology. This investigative method has since informed practice in numerous areas, including those related to medicine and patient care. Despite use across a wide range of fields, CIT use in the work of paramedics is infrequent.

Being of limited use with paramedics to date however, does not equate to CIT being of little use to pre-hospital research, the method has been used effectively to inform five important areas of paramedic practice. Physical dimensions of job performance, teamwork and communication, psychological dimensions of work, student learning and experience and patient care are areas that have been investigated. The area of patient care is of particular interest, in that the use of CIT has resulted in investigation of a wide range of patient care outcomes, from asthma to stroke and cardiac patients in the emergency department, but remains underutilised by researchers interested in the pre-hospital environment.

Importantly, CIT, in asking participants to comment on positive or negative, effective or not effective elements of practice, encourages open responses that build a broader picture of an event or incident. The technique follows a systematic approach that can be replicated. Paramedic practice is about caring for those who require pre-hospital intervention and further consideration of CIT in pre-hospital care research may lead to improved practice and better patient outcomes. It is a useful method to include in the paramedic researcher's toolkit.

Conflict of interest

The authors declare they have no competing interests. Each author of this paper have completed the ICMJE conflict of interest statement.

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Table 1. Overview of articles using Critical Incident Technique in ambulance work

Author/s	Setting	Sample	Aim	Number of incidents	Type of analysis	Main findings
Klein, Calderwood & Macgregor (1989) (30)	United States	Not specified	Describe use of CDM with fire commanders, paramedics and others	Not specified	Descriptive	Suggests CDM as an efficient way to gather data on proficient performance. CDM includes a focus on non-routine cases, is case based and involved semi-structured questions (probes)
Wahlin, Wieslander & Fridlund (1995) (33)	Sweden	12 paramedics	To examine loving care in one ambulance service	167	Thematic 16 subcategories Six categories Three main areas	Loving care includes cognisance (judging and treating based on symptoms), solicitude (through humbleness, closeness, consideration and rapport) and empathy
McIntosh & Rever-Moriyama (1997) (25)	Canada	Focus group of six nurses and four others	Investigate causes of needlestick injury	Not specified	Analysis of CIT not stated. Results of CIT used to develop 68 item questionnaire tested with 78 nursing and paramedic students	Identified a number of factors influencing needlestick injury including job stress, procedural stress, conflicting or unrealistic procedures, reporting, knowledge and safety environment
Flabouris (2003) (24)	Australia	1198 patient records	Describes events documented by aero-medical staff	257, 41 of which were positive	Retrospective document review of positive and adverse events	Adverse incidents occurred mostly on dispatch, prior to arrival and while on scene. Most commonly (24.3%) were equipment related
Reddy & Spence (2006) (22)	United States	Six nurses, 2 physicians, one family nurse, one paramedic, one unit secretary	Examined information needs rural emergency department team	Not specified. Noted that participants asked 602 questions during critical incidents	Thematic Seven categories	Most commonly asked questions relate to patient specific information but also a number of organisational questions. Non-clinical members of the team had a critical role in finding information
Jones (2007) (27)	United Kingdom	36 front line ambulance staff	Comparison of stretcher loading systems and ambulance mobility equipment	Number of CIs not stated (10 interviews provided information about critical incidents)	Thematic analysis Five primary codes from CIT Quantitative analysis of other data	Concluded that automation is the way forward to reduce manual handling risks for ambulance workers. Resulted in change to national specifications for ambulances in UK
Jones & Hignett (2007) (26)	United Kingdom	CIT with 31 UK paramedics and ambulance technicians. Also observation and postural analysis	Evaluation of preferred safe and useable stretcher loading systems	Critical incidents described in 10 of 31 interviews	Thematic 53 primary codes from CIT (categories) Five higher level codes (main areas) Quantitative analysis of other data	Five types of areas around stretchers identified: system failure, environment, patient-related, equipment and coping strategies and adaptation

Author/s	Setting	Sample	Aim	Number of incidents	Type of analysis	Main findings
Svensson & Fridlund (2008) (28)	Sweden	13 male and 12 female Swedish ambulance nurses	Describe incidents in which ambulance nurses worry in their professional lives	262	Thematic Divided into experiences and actions. 12 experience categories with five sub-categories and two main areas. 13 action categories, six sub-categories and two main areas	Worry experienced by ambulance nurses in emergency situations requires flexible response by ambulance services. Nurses must be given opportunity to address worries in ways appropriate for each individual
Gustafsson, Wennerholm & Fridlund (2010) (29)	Sweden	30 nurse specialists working with ambulance	To study and describe specialist ambulance nurses' cause of worries and concerns	469	Thematic Separated into meaning and managing causes of worries. 327 meaning critical incidents. Analysed to 16 subcategories, five categories and two main areas. 142 managing critical incidents. Analysed to 11 subcategories, four categories and two main areas	Shared experiences between colleagues should be encouraged. Teamwork enhanced by local and national training, unambiguous work guidelines
Mishra, Allen & Pearman (2011) (31)	United Kingdom	20 semi structured interviews with commanders (seven police, seven fire, six ambulance)	Utilises CIT as an adjunct to activity theory to explore information practices in emergency management	Not stated	Process of analysis not outlined	Tensions and personal factors between levels of commander constrain communication. Information is influenced by subjectivity. Doubts about reliability of tools and technologies in emergency crisis situations. System designers need to take minimalist approach
Siemsen, Madsen, et al (2012) (23)	Denmark	23 nurses, 3 nurse assistants, 13 physicians, 5 paramedics, 2 orderlies, 1 radiographer	Explore healthcare professionals' attitudes and experiences with critical episodes in patient handover	232 critical incidents	Thematic Eight main factors	Factors impacting patient safety in handovers were communication, information, organisation, infrastructure, professionalism, responsibility, team awareness and culture. Work was done in silos and handover barriers were due to only a few having a full picture of the patient
Wallin, Fridlund & Thoren (2013) (32)	Sweden	28 pre-hospital emergency nurse students from six universities	Describe clinical placement experiences of pre-hospital emergency nursing students	265 critical incidents identified	Thematic 30 sub categories Nine categories Three main areas	Clinical placement experience depends on support and structure. Learning strategy should be based on reflective dialogue, clinical supervisor continuity and learning structure based on pre-hospital environment