CHAPTER 74

Using Goal Directed Task Analysis to Identify Situation Awareness Requirements of Advanced Paramedics

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ABSTRACT

Advanced paramedics, known in the UK as emergency care practitioners (ECPs) are employed by ambulance services to meet the demand for urgent care in the community. The role has been evaluated in terms of patient outcomes. To further understand and evaluate the role, Goal Directed Task Analysis (GDTA) was conducted. Based on the analysis, situation awareness requirements among ECPs were identified. The results of the GDTA are presented and their implication discussed in terms of goal hierarchy structure, patient as source of information, and sociotechnical system. We discuss recommendations for the role with regard to the ECPs' SA. Further SA studies to evaluate and develop the ECP role are also outlined.

Keywords: Situation Awareness, Goal Directed Task Analysis, Decision Making, Pre-hospital Care, Socio-technical Systems

INTRODUCTION

In the UK, advanced paramedic, known as emergency care practitioner (ECP), is a work role designed and introduced to the Ambulance Services to lighten the burden on ambulance and hospital resources. Not all 999 calls require the use of ambulance to transport patients to hospital. The ECP role was introduced to meet "the urgent care needs of patients by providing the right skill at the right time in the right place" (Department of Health, 2004, p. 2). As practitioners providing pre-hospital care in the community, the ECPs have more autonomy and freedom to make decisions compared to other ambulance crews. They are able to treat patient on scene and refer patients to other care pathway including the hospital (emergency department, ward), other healthcare services (out-of-hour services, general practitioner, bed bureau), and other services (social, psychiatry).

By providing pre-hospital care in the community, ECPs can reduce the number of unnecessary patient transport to the hospital. The avoidance of hospital attendance can free up resources of the ambulance services as well as the hospitals. Nonetheless, ECPs are not exclusively assigned cases that can be treated on location. Because they are part of the pool of ambulance services' human resource, they are also being deployed to respond to emergency cases. Therefore, for any given patient, the need to treat patients in the community or somewhere else is not always apparent and decided at the start.

Available evidence shows that there are significant avoidance of patient transports and admissions to hospital (Mason et al., 2007). These patient outcomes are in line with the role's objectives. However, it is not clear what the factors that influence these outcomes are. Given the autonomy of the role, the decisions made by the ECPs are important to consider. The cognitive aspect of ECP, especially their decision-making, needs to be examined to gain a better and more comprehensive understanding of this role.

To support decision-making in domains as complex and safety-critical as healthcare, situation awareness (SA) has increasingly receive attention from researchers. SA is defined as "...the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future" (Endsley, 1998, p.97). Based on this definition, Goal Directed Task Analysis (GDTA) was introduced as a method to identify SA requirements (Endsley et al, 2003). This method is used to identify the goals and the data of which the operators require to be aware. This method is particularly useful to create a user-centred system.

GDTA has been applied in various domains including healthcare (Wright et al., 2004), military (Jones et al., 2003), and power transmission and distribution industry (Connors et al., 2007). More recently, the GDTA was used to develop a protocol (Goal Directed Information Analysis) to identify information requirements of emergency first responders in the fire and rescue service (Prasanna et al., 2009). In their study, Prasanna et al developed the new protocol to overcome the constraints of GTDA. However, the protocol produced goal-decision-information

hierarchy which is similar to the hierarchy produced using GDTA.

For this study, the GDTA which is based on Endsley's definition of SA is used. The GDTA is applied in a novel setting namely pre-hospital. By identifying the SA requirements of ECPs, the role can be further understood. This understanding can help to evaluate how the role is developing against its original aims and objectives. Additionally, in a recent development, electronic patient records are being introduced to an Ambulance Services in England. It is envisaged that an analysis of the ECPs' SA can provide input for the integration of this information technology into the existing work system.

An analysis of the existing literature reveals gaps in method applications and work practices. The GDTA as a method to analyse cognitive task has not been reported for pre-hospital care domain. On the practical side, the ECP role has not been investigated using a cognitive approach. It is recognised that the ECP role need to be further developed and designed especially in light of the introduction of new information technology. Towards fulfilling this need, we address the identified gaps in the literature. For this paper, the objective is to describe an application of GDTA in the domain of pre-hospital care. The second objective is to discuss the SA requirements of advanced paramedics within a sociotechnical system.

METHOD

The participants in this study were recruited at one Ambulance Services NHS (National Health Services) Trust in the England. Prior to data collection, ethics approval was obtained from the NHS. The participants were recruited through the Director of Operations of the Ambulance Services. Documentations (job description, organisational chart, work guidelines) about the ECP work role from the Ambulance Services were obtained to understand the context of the work role. In addition, observations of ECPs on the job were conducted through ride-out sessions with two ECPs during their shifts. The ride-out sessions involved meeting the ECPs at their base (ambulance station) and following them to treat patients at different locations. The ride out sessions were carried out in four sessions covering 40 hours. The documentations and observations form the basis of the interviews to discover the goal structures of the work role.

Fifteen ECPs (including one from the ride-out session) and three ambulance dispatch staff were interviewed using semi-structured interview schedules. The ambulance dispatch staff were considered as subject matter experts due to their knowledge of the different pre-hospital care personnel. Moreover, they provide a view of the ECP job from a control room point of view where the decisions on the assignments of 999 calls are made.

The ambulance dispatch staff and the ECPs work full-time with the Ambulance Services and had working experience ranging from 1 to 6.5 years. All except one interview were conducted during their regular working hours. The interviews were used to discover the physical tasks, and later, the goals associated with each tasks. Due to time restrictions imposed by an unpredictable work pace, each ECP was

interviewed once. The tasks and goals structure was validated by each successive ECP to produce the hierarchy of goals, decisions, and information requirements.

RESULTS AND IMPLICATIONS

As with other types of cognitive task analysis, GDTA can generate a huge amount of detailed information. This section presents selected portions of the information obtained from the GDTA. These portions are selected to aid the presentation of implications and recommendations for the ECP role.

GOAL HIERARCHY

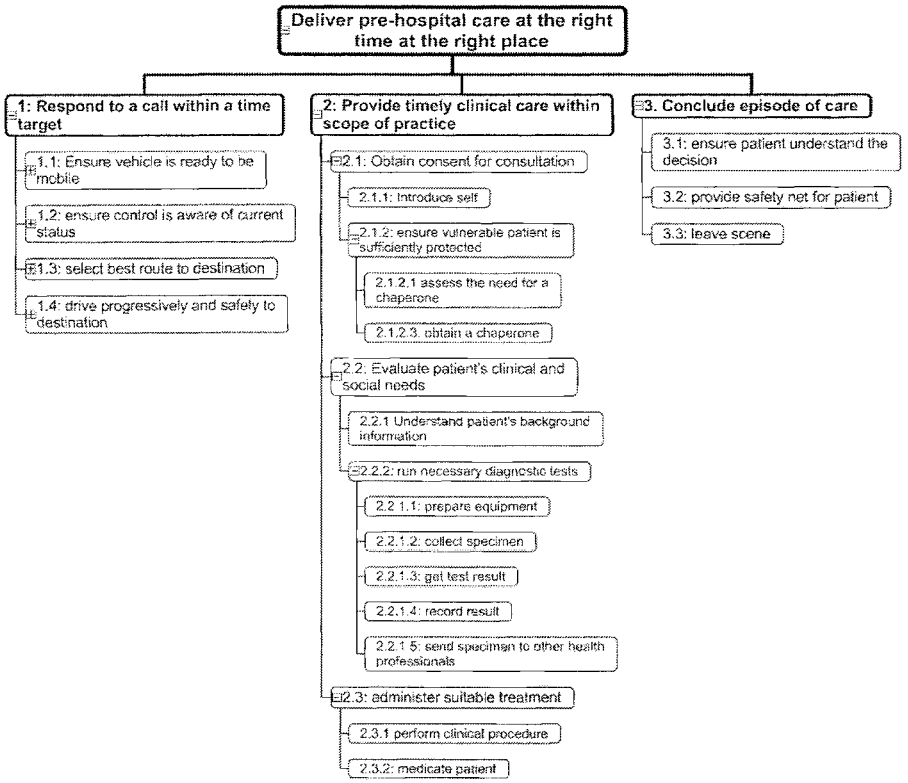

FIGURE 1.1 Goal hierarchy of an ECP showing the goals and sub-goals only.

The scope for the task analysis covers activities of responding to a call to discharging the patient (Figure 1.1). Both emergency (life-threatening) and urgent (non-life threatening) patient care were considered. The main goal for the ECPs is derived from the document published by the Department of Health (2004). The goal of "delivering pre-hospital care at the right time at the right place" runs in close

parallel with the mission statement of the Ambulance Services. However, this goal seem to be more directly applicable with ECPs than other ambulance crews (paramedics, ambulance technicians) whose main goals are more towards transporting patients to an appointed care environment.

PATIENTS AS SOURCE INFORMATION

The information that the ECP receive from the ambulance dispatcher room are usually brief. The information that patients provide to the call taker or triage nurse at the ambulance dispatcher room will be condensed before relayed to the ECPs. They would receive a code representing the general condition of the patient (based on a computerised triage system), age, sex, and address (postcode) on their mobile data terminal that is installed at their vehicle. Therefore, the patients themselves are important source of information to understand what kind of medical attention that they need.

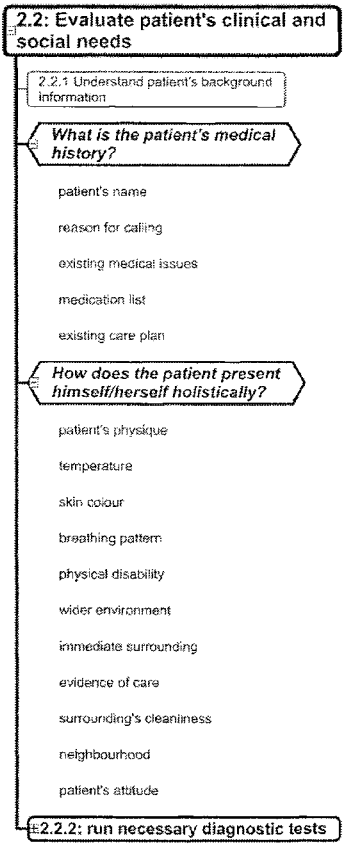

FIGURE 1.2 Information requirements for evaluating a patient's need.

The interaction with the patients would help to unpack the initial information that the ECPs received from the ambulance dispatchers. The information can be obtained through direct interaction with the patient or through observation. Evaluating a patient's clinical and social needs (Figure 1.2) involves both ways of gathering information. The ECPs need to get directly the information from the patient or an accompanying person regarding the patient's medical history. In contrast, the holistic evaluation of the patient involves observation that may or may not be supplemented by direct verbal report from the patient. The holistic evaluation is important to make a decision on the best care pathway for the patient.

The information that provide a picture of underlying physical conditions can be obtained by running diagnostic tests (sub-goal 2.2.2) that may involve tools like ECG machine (recording electrical activity of heart muscles) and oximeter (measuring oxygen saturation). These tools provide information via printed and electronic display. In this light, the patients and their immediate surrounding can be thought of as *displays* from which the ECP get vital information. The patients are a rich source of information including visual (skin colour), auditory (breathing sound), and thermal (skin temperature). Their display can change during the consultation time. Of great importance is sudden deterioration of the patient. This highly dynamic situation requires the ECPs to regularly update their SA. The diagnostic tools can be combined with the information obtained from the patient to create a better understanding and projection of the likely patient conditions.

Having patient as an integral part of *information display* poses challenges to the ECPs for building and maintaining accurate SA. Endsley et al. (2003) outlined major threats to SA such as attentional tunnelling, workload, data overload, and misplaced salience. These threats are applicable to the interaction with technology as well the interaction with humans. The field of social psychology can provide further insight into the threats to the SA of ECPs. Our understanding of the world via social interaction can be distorted by priming effect of the schema, confirmation bias, stereotyping, and other reasoning biases. More recently, Rahman (2009) explored the role of affect in naturalistic decision making.

SOCIOTECHNICAL SYSTEM

The GDTA generates information requirements that are technology and process independent. Useful information gained from this analysis can be considered for the integration of electronic patient record (EPR) into the work of the ECPs. EPR can support the goal of evaluating clinical and social needs (goal 2.2). Not only the EPR can offer a source of reliable information, the timeliness of the information can be improved. The EPR can potentially start feeding information to the ECP even before they arrive at the patient's location. This advantage can overcome the limitations of current technology that represents the micro-level influences to the ECP work.

The GDTA also highlight the clarity of the ECP role. The ECP are expected to provide pre-hospital care at the right time at the right place using the right skills.

Currently, the emphasis is on the right time: the nationally set response time target is used to measure their performance. This macro-level influence place emphasis on part of the goal hierarchy that may not be shared by the ECPs themselves. With a time-based performance assessment, the all important goal is goal 1 (respond to a call within a time target). In contrast, with a clinical-outcome performance assessment, the emphasis will be on goal 3 (conclude episode of care) where an appropriate safety netting are likely to meet the patient's clinical and social needs. There are calls to review the assessment of ECPs performance which is currently based on time-target to clinical outcome-based (Gray and Walker, 2008).

CONCLUSION AND FUTURE WORKS

This paper presented the application of GDTA to identify SA requirements of advanced paramedics. The GDTA is expected to be a valuable input for fully implementing the EPR in the Ambulance Services. More important, the GDTA is found to be useful to understand the cognitive aspect of the ECP job. Not only the micro level of the work system is identified as influencing SA, the macro level influence is also recognised. The information generated by the GDTA is valuable to address and consider the cognitive, technical, and social aspects of a work system.

The work reported here is based on a limited number of participants due to staffing constraints. The range of clinical cases that can be observed was also limited because of practical constraints. The occurrence of the more dynamic emergency cases (relative to the urgent cases) cannot be predicted. The range of cases observed during the ride out sessions was not as diverse as hoped for. Nonetheless, the observations had proved useful in producing a draft of the goal hierarchy.

Further works are proposed to follow up the present study. Case studies involving observations and ride-out sessions will be conducted to further validate the extant GDTA. The case studies are hoped to be able to overcome the limited range of cases observed in this present study. A measure of SA can be developed based on the SA requirements identified. These measures can be used to evaluate how much the EPR support, or impede, the ECP's SA. The third line of investigation that can be pursued is validating the source of information available to the ECPs. Not only the source should be identified, the timeliness and reliability should also be measured. This validation can reveal what additional advantages can be offered by the EPR system. The role of ECP has much to offer in delivering unscheduled care in the community. A comprehensive evaluation would assist in developing the role to maximise its potentials.

Acknowledgement

The study is supported by a scholarship from the International Islamic University Malaysia and Ministry of Higher Education Malaysia to the first author.

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