Forms, Boards and Bleepers
media and mobility in accident and emergency

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ABSTRACT
We examine the collaborative nature of medical artefacts within the medical environment. Taking the domain of the Accident and Emergency Department (A&E, known in the US as the Emergency room, or ER), we consider the use and role of representational media (such as the whiteboard and paper documents) in the work routines and interaction of doctors, nurses and other medical personnel.

INTRODUCTION
Hospitals are technology-intensive centres of information where vast amounts of data flow through the system and are touched and affected by a range of people in different situations with different skills, and who have different uses and requirements of that information. Groups coalesce and fragment on the fly and collaborate around a range of technological and non-technological artefacts. One very noticeable aspect of the medical setting from the perspective of CSCW is that very little communications technology is used other than the ubiquitous bleeper and fixed line telephone. Despite the efforts put into the areas of telemedicine and medical informatics over the last few years, little of this technology has found its way into the everyday working environment of the hospital, let alone the highly dynamic and informationally intensive setting of the A&E department. Whilst there are a number of possible reasons for this (see 4), what we seek to explore here is the role of the representational media in supporting collaboration. The results of this study were developed from ethnographically inspired fieldwork that took place in a number of UK hospitals over a period of several months in 2000.

ACCIDENT AND EMERGENCY IN A UK HOSPITAL
The hospital environment: The hospital environment is a complex one, and the larger building is home to a number of different work sites [5] that operate as entities in their own right. However, the boundaries between these work sites are blurred and the sites frequently co-operate in the treatment trajectory of the patient (ibid.). A&E is a department that is constantly occupied by people from these other work sites, which is a necessary and routine part of their work, and involves information sharing at a number of levels, between people and across a range of organisational artefacts.

The 'process' of A&E is such that a patient is admitted, either by an ambulance crew or themselves, and a paper form is handed to the nurses who then triage the patient using a paper protocol. The patient information is then transferred to a whiteboard, which indicates that they are ready to be treated (although in emergencies, there is no time for these procedures). At the treatment stage, a medic will evaluate the patients, questioning them, witnesses and other personnel (ambulance staff, etc.), and via the requesting of tests or physical examinations. He/she will record this on another paper protocol (discussed below). Following tests and investigations, the patient may be referred onto a specialist medic and at this point the information about the patient will be communicated to that medic both verbally and via the use of the completed protocol sheets. The patient is then either admitted to a ward or discharged. If admitted to a ward, their paper records will follow them, or else they will be scanned in and the paper copies destroyed.

It is clear from this that *information* needs to be shared at all times to communicate the various stages and processes to those involved. The three main methods of information sharing revolve around the bleeper, the whiteboard and the paper protocol sheets.

SHARING PATIENT INFORMATION
Paper use: Forms were seen as dynamic documents, with information added to them as it was discovered or generated. Paper was also seen as important in mobility (see also 3) – people could carry it around with them, jotting notes onto it as they carried out their tasks, and showing it to other people for comment.

Use of protocols: The protocol sheets were used as a resource in the performance of work, and they are examined here as a special subset of paper use. The formatting and use of these sheets is not common across all hospitals, but in this instance, they were introduced as a tool to structure the medical examination, ensuring that essential, treatment-critical patient details are gathered.

Common resources: Shared artefacts act as tools for collaboration and discussion. There exist, in A&E, a number of common resources and artefacts. These are shared over space and time by various people and their use and transformation affects treatment trajectories. The most mentioned resource in the literature is that of the medical record (in this case in the form of protocols) which has received considerable attention (e.g. 2). Another is that of the whiteboard [1] which is a common artefact of great moment-by-moment concern for sharing information and co-ordinating collaborative action. This board is divided into a grid with bed numbers down one side, the patient's name in another box and other details are added where necessary. It commonly acted as a talking point around which medics gathered to discuss details about their patients and the organisation of their time.

In the core study, the whiteboard was located centrally around the nurses' station and was one of the most

frequently looked at and amended sources of information. It acted as a resource for structuring work activity and informing members of the team of the status of the ward. It was not just an indicator of patient details, but also indicated how busy the unit was, how many patients had yet to be seen and how many patients were being dealt with. It recorded the 'allocation' of patients to particular members of the team and graphically represented the layout of the A&E 'majors' unit. As a modifiable resource that is also the focus of discussion, the whiteboard allows details to be added as they are uncovered.

MOBILITY (ISSUES OF)

The one feature of the medical setting that clearly stands out in the fieldwork is the mobility of workers and their required interaction with fixed informational resources that support co-operation and collaboration between all members of the team. In the past, CSCW has often overlooked systems to support mobile co-operation (but see 3) in favour of larger systems that require users to be confined to a very local space in order to communicate with others. In medical work, such situations are rare and mobility is a key issue. In many cases, as seen in studies of non-medical situations, 'travel' was used for information gathering, for staff to collect, or locate information, but also through 'collaring' people by taking advantage of other others 'travelling' into their own departments.

Mobile technology is interesting in its absence. Medics do carry bleepers (in-hospital pagers), but what is especially interesting about the use of these devices is that they enforce an 'always available' pattern of use. As a strategy for management of their time, the bleepers are often turned off, with inevitable consequences. Moreover, when the devices are on, they require the user to locate and use a fixed line telephone – thereby increasing their local mobility.

CONCLUSIONS

What the data from the field studies in the paper is intended to demonstrate is that medical work in the A&E department, although focussed around a local area, is detailed, complex, and involves actors from other more remote areas of the hospital. Mobility is a key issue if resources are to be accessed and fully utilised and this mobility allows for both planned and chance interaction that affects the work of the A&E staff. In the case of A&E, once the patient is discharged or admitted to the ward, their notes are scanned in and the paper copies destroyed and so at the end of the trajectory, *paper* is taken out of the system. However, paper still forms an integral part of the working practices and needs to be integrated in the system in a manageable fashion. As information systems are introduced to parts of the hospital work routines, so we have to find ways to incorporate the resultant media with current methods. These media, be they paper or electronic based, must interact to provide a coherent resource for locally situated activities. The importance of paper cannot be disregarded to continue to provide a level of flexibility that information systems cannot.

The common resources in use within the ward includes fixed technologies such as the paper protocols that 'fly around' acting as representations of the patient [2]. They also include the whiteboard, the stand-alone computer and the telephone, and personnel interact with these on a regular basis, thus increasing the need for them to be mobile. These fixed common resources bring a presence to the environment and physical space that influences its organisation and the working routines of all of the collaborating personnel. As the field work suggests, the mere fact of 'going to see' people, places and things led to chance encounters that later reduced the need to go and find someone, and the physical presence of people in the department meant the tasks, such as getting approval for an x-ray, were simpler. This is extremely hard to reproduce within an electronic system, and making use of people's inherent flexibility of action to deal with novel situations may be the most appropriate solution – these processes should only be systematised with extreme caution.

The fieldwork demonstrates how the medical personnel in the A&E department adapted to the quirks and failures of the systems in place and structured their work accordingly, overriding the system where necessary. We argue that the social interactions that exist around the work of treating the patient are crucially important to acknowledge before the design or redesign of any technology intended to support the functional aspects of medical work within the A&E ward. Some may argue that there is no need for this kind of technology, yet there is a widespread demand for its introduction to provide a more structured and standardised method of work from hospital managers and consultants, both for quality assurance and valid diagnostic reasons.

What we have attempted to do is understand the work to see how a variety of shared informational resources (including technology and paper) are integrated into the system and how they interact with one another. There are implications for the design and introduction of CSCW systems here. It may appear that a widespread integrated collaborative information system would eliminate the need for people to travel to radiology or other departments to request tests, yet such systems take away the social interactions that make the work practices effective and efficient. Instead, what we need to concentrate on is the means by which we can mobilise the information held within fixed resources and make them more accessible to the users.

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