A TELEMATIC SYSTEM FOR ONCOLOGY BASED ON ELECTRONIC HEALTH AND PATIENT RECORDS

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In September 1998 a new National Health Service (NHS) strategy was launched in the UK [1]. A key goal is to create electronic health records by 2005. The realisation of the strategy will have a number of advantages such as
improving patient booking and appointment systems and providing speedier diagnosis, test results, on-line advice and information to patients and carers. The NHS executive is aware that realising the strategy is a major challenge. Although IT progress has been made in some sectors of the health service (90% of General Practitioner (GP) practices are computerised and certain NHS Trusts have internationally leading edge clinical systems in place), most of the NHS is at the rear of the information technology movement [2]. Most NHS hospitals have not invested in advanced clinical systems. GP practices and hospitals have not collaborated to develop integrated systems, partly because of a lack of financial incentive to do so. An additional development is the establishment of a telematic system that captures and supports the clinical and administrative procedures involved in oncology. Such a system will enhance the integrity of the operational processes, record keeping and security of information as well as easing the workload of the professionals involved through the provision of automated support. One of the challenges in developing a telematic system for process support is properly capturing and supporting the processes and the interactions between the various parties involved. This challenge has been addressed by using a framework called Ariadne that supports the specification of co-operative work patterns [3]. Previous papers have addressed the structure and development of the multimedia workstation for oncology. Figure 1 shows the proposed architecture for the workstation [4,5]. An Electronic Health Record (EHR) and Electronic Patient Record (EPR), will remain on the server for as long as the care episode is current, i.e., from date of admission to date of discharge. It would then be archived. Summary information from each episode, represented as a discharge summary on the EPR, would be designated to form part of the patient's EHR.

Regarding the EHR, a centralised national directory would need to be in place to show locations of individual EPRs relating to a patient. This directory could be distributed, each entry residing with the GP practice at which the patient is registered. In this case the completion of a care episode would trigger the transfer of the discharge summary from the EPR to the EHR. The EPR could be called if needed. Thus a combination of push and pull would be used.
The use of a data warehouse approach has the added advantage of capturing summary information in a form that is suitable for statistical data analysis. Data mining techniques can be used to find patterns that can have implications for future healthcare requirements and recommendations. It is on the basis of this architecture that the telematic system for oncology has been developed.

Telemedicine can be seen as covering four main areas. The first and most widespread is its use for remote consultations, diagnoses and education [6-9]. Techniques such as audio and video conferencing are very important in this area as are techniques of image capture and transfer, a teleconferencing subsystem, a communication subsystem, and a database management subsystem [10]. The growth of communications technology, the Internet and the World Wide Web has made rapid advances possible in this area. A second area in which telemedicine is making a rapid advance is that of the emergency services [11,12]. A third area of growing importance is that of home-based care using sensors to monitor a patient's well being [13,14]. A fourth area that telemedicine covers but which perhaps has so far attracted less attention is that of integrated record-keeping and automatic transfer of routine information. Information management is a constant problem in healthcare as inaccurate or incomplete records and unavailable or unlocatable information are frequent difficulties. The development of the Electronic Health Record (EHR) and Electronic Patient Record (EPR), which is now the subject of much interest falls into this area [1,7,15].

The NHS recognises six levels of IT adoption in healthcare systems [1] (Table 1). Most current healthcare systems are at Level 1 with some notable specialised exceptions. The telematic system for oncology is at Level 6.
Table 1. Levels of IT Adoption as Seen by the UK NHS Executive (from [1])

<table>
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<th>Level</th>
<th>Description</th>
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<tr>
<td>Level 6</td>
<td>Advanced multimedia and telematics (Level 5 plus telemedicine and other multimedia applications e.g. picture archiving and communications systems)</td>
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<td>Level 5</td>
<td>Speciality-specific support (Level 4 plus special clinical modules, document imaging)</td>
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<tr>
<td>Level 4</td>
<td>Clinical knowledge and decision support (Level 3 plus electronic access to knowledge bases, embedded guidelines, rules, electronic alerts, expert system support)</td>
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<td>Level 3</td>
<td>Clinical activity support (Level 2 plus electronic clinical orders, results reporting, prescribing, multi-professional care packages)</td>
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<td>Level 2</td>
<td>Integrated clinical diagnosis and treatment support (Level 1 plus integrated master patient index and departmental systems)</td>
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<td>Level 1</td>
<td>Clinical administrative data (Patient administrative and independent departmental systems)</td>
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Oncology is a particularly complicated area as it draws on most of the other diagnostic systems and also has a number of different treatment regimes each of which may have their own system e.g. surgery, chemotherapy and radiotherapy. Relevant information will be extracted from the underlying systems on a regular basis and stored on a server that can be accessed by various parties. Regarding the EHR, a centralised national directory would need to be in place to show locations of individual EPRs relating to a patient.

In order to clearly capture and specify the requirements of the telematic system for oncology, it was decided that a framework, based on Ariadne, especially designed for describing computer supported cooperative work (CSCW) should be used (Table 2). The use of such a framework captures the workflow showing clearly the tasks of each actor within the processes as well as resources needed by each actor.

Table 2: The Ariadne Framework

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<tr>
<th>Level Three</th>
<th>Description</th>
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<td></td>
<td>The Computer Supported Co-operative Work (CSCW) system comprising of a number of interacting Computational Co-ordination Mechanisms (C2M)</td>
</tr>
<tr>
<td>Level Two</td>
<td>Active Artefacts (AAs) and Proctors comprising the Computational Co-ordination Mechanisms (C2Ms)</td>
</tr>
<tr>
<td>Level One</td>
<td>Objects of Articulation Work (e.g. roles, actors, tasks, activities, actions, resources)</td>
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The Ariadne framework was developed as part of a European *Esprit* research project which studied computational notations for representing computer supported cooperative work [3]. Ariadne can be considered as a notation for defining multi-agent architecture for supporting articulation work among co-operating actors.

Let us consider a simplified typical procedure in the field of oncology patient care and see how this can be represented in a telematic system for oncology. A patient presents symptoms to his/her GP. The GP refers the patient to the oncologist. The oncologist assesses the patient and requests pathology and radiology tests. On the basis of the test results the oncologist makes a diagnosis and decides whether to discharge or treat the patient. If the patient is to be treated, various options are considered and a course of treatment or surgical intervention is determined. This is then carried out. At the end of the period of treatment, the patient is reassessed, diagnostic tests may be performed again and then the oncologist decides whether to discharge the patient or administer further treatment. This cycle repeats until the patient is discharged or no further treatment is considered viable. The GP is informed of outcomes at various stages of the oncology treatment process.

This architecture is in line with a recently published UK NHS information strategy. The framework appears to be suitable for defining the telematic oncology system, and the advantage of such a framework is that requirements capture and specification become more reliable and communicable. It also provides a basis for implementation and security management. The work described is part of a project being carried out at Coventry University in association with regional healthcare institutions.

**References**


