

m-HEALTH AND CLINICAL KNOWLEDGE MANAGEMENT

R. Summers, S. Price

Health Informatics Research Group, Department of Information Science,
Loughborough University, Loughborough, LE11 3TU, UK

Abstract – The interaction and development of electronic health records within the context of clinical knowledge management is explored. Particular attention is displayed towards electronic records management and ‘mobile-health’ solutions as a way to manage clinical decision making at the point of care. A framework is used to introduce the key drivers for change necessary to fully adopt the solutions offered. The impact and value of mobile-health solutions are indicated for the developed world, and a case study is used to investigate change within the United Kingdom. The role of the National Health Service Information Authority within the bounds of the change process required is described as crucial to the eventual success and roll-out of the electronic health record.

Keywords – mobile health, electronic health records, NHSIA.

I. INTRODUCTION

The aim of this paper is to provide a framework that allows the investigation of development of electronic and ‘m’ (mobile) -health initiatives within the context of clinical knowledge management. To achieve this aim requires an understanding of change management, including the economic, financial and political influences that pervade change processes in the health environment. A consistent example will be used to illustrate the developing framework: the introduction of the pervasive electronic health record (e-

HR) and electronic patient record (e-PR) in the United Kingdom.

Clinical knowledge management is the discipline concerned with the collection, processing, visualisation, storage, preservation and retrieval of health-related data and information, whether it be on an individual or collection of subjects. Looking at the evolution of clinical knowledge management, its roots are firmly entwined with records management, a topic known to librarians and other information professionals in particular as a core area of expertise. Library and information-related skills are further in evidence by the use of metadata to classify and encode the captured health data. It is clear that the use of such expertise will warrant closer examination of the collective competencies of teams brought together to further develop this emerging discipline.

II. CHANGE DRIVERS

The incorporation of m-health solutions into systems that manage and deliver healthcare requires change that goes beyond purely technical and organisational process development. To explore the interacting nature of the drivers for change, a PESTLE framework is adopted. The framework combines the well known PEST analysis (Political, Economic, Social, Technical) with Legal and Ethical issues. It is acknowledged that the analysis below is too simplistic for specific instantiations

in the developed and developing worlds, but this is redressed in the remaining part of the paper, which looks at the incorporation of m-health in the United Kingdom as an exemplar. Each issue is entered into the framework only once, even though it is clear that some issues or aspects of certain issues belong in more than one category. This is illustrative of the interaction between the drivers for change.

Political

- Political will for ‘electronic Government’ that includes healthcare needs
- Reduction in health costs brought about by the incorporation of m-health initiatives may lead to redistribution of the tax burden

Economic

- Cost savings as a consequence of optimised workflow processes
- Dramatic reduction in the cost of information storage
- Cost benefits in terms of reduction of risk

Social

- Consumer demand for connectivity, access, safety and quality of care
- Increase in patient compliance
- Point of care interaction
- Changing patient-clinician relationship

Technical

- ICT infrastructure availability
- Bandwidth – transmission speed
- Interference free transmissions
- Functionality of device – ease of use, processor speed, memory, screen size, battery life

- Platform free (seamless) connectivity, interoperability
- Electronic signatures

Legal

- Security – authentication, encryption, audit
- Regulatory compliance
- Reduction in medical errors and their relationship to medical defence insurance costs

Ethical

- Ownership of the virtual medical record
- Patient empowerment

The provision of support to enable electronic Government is a key goal of the European Union, and has received the Prime Minister’s endorsement in the United Kingdom. This level of political support is crucial to the success of the whole enterprise of which healthcare is an important cornerstone. The electronic provision of information to citizens, using an extensible mark-up language (XML) format for interoperability, is a stated Government target that is embraced by the medical record fraternity of the National Health Service Information Authority (NHSIA), as will be shown in Section III. Electronic provision of information also brings economic benefits in terms of a reduced management overhead, speedier service provision and reduction of risks associated with malpractice. The social aspects of change due to electronic provision of information has had a huge impact on citizens in terms of their awareness of what healthcare services are available and (sometimes imperfect) understanding of disease. The incorporation of m-Health into the change process allows for a point-of-

care interaction whether the patient is hospitalised, at home or elsewhere in the community. Social aspects of change are also more wide-ranging in the United Kingdom, as we move from clinician-centred to patient-centred care. The view of the hospital consultant as a demi-God guardian of the medical record to be revered by all is fast being replaced by the view that the patient 'owns' all personal data generated by the clinical encounter.

Technological change issues can be divided between those that relate to infrastructure requirements and those that relate to device requirements. The use of m-Health requires the necessary information and communication infrastructure to be in place. This is not a trivial matter, as wireless transmission needs a regulated frequency band in which to operate, but adherence to any international standards will be difficult. For instance, the transmission band given to medical activity in the United Kingdom corresponds to a band for military activity in the United States. Whereas this issue is not crucial for the consumer, it is important for medical device manufacturers who wish to enter the m-Health market. The functionality of any m-Health device will profit from an ergonomic study able to take a multiperspective view of its use in a healthcare setting. As examples of this, general functionality such as interoperability and specific functions such as the device's ability to offer electronic signatures are likely to enhance user acceptance.

Legal and ethical issues are dominated by security of the e-HR and e-PR. Security has many nuances: physical security of the device itself; virtual

security against 'hackers'; authentication of the users at each end of the wireless transmission; auditability of transactions and transmissions; as well as data encryption methods. However, there are other issues such as benefits of increased regulatory compliance and reduction in medical errors. The switch to patient-centred care in the United Kingdom means that patient empowerment has become a watch-word, leading to issues such as ownership of the virtual medical record moving away from central repositories within healthcare organisations to individual patient ownership.

The issues addressed in this framework have been taken into consideration, albeit with various weightings, upon the planning for the incorporation of e-HR and e-PR solutions into the National Health Service of the United Kingdom.

III. e-HR IMPLEMENTATIONS IN THE UNITED KINGDOM

Currently, clinical documents do not always contain the information that recipients require to support clinical practice. The 'Information for Health' report [1] recognised the need for improved information management within clinical documentation. The National Health Service in the United Kingdom has produced a planning document, 'The NHS Plan' [2] that reinforces this viewpoint. It sets targets for 75% of hospitals and 50% of primary and community trusts to have implemented an electronic patient record system by 2004 to an agreed level of support that includes electronic prescribing, integrated care pathways, order communications and results reporting. This commitment to creating

an information and communications infrastructure will ensure that patients as well as clinicians will have access to documents relating to their treatment and planned care.

The development of a nationally implemented e-HR and e-PR will facilitate patient-centred care as envisaged in the NHS Plan. Patients will not only have access to the information held in their healthcare records but also will be able to control and monitor access by clinicians. A recognised benefit will be the development of an infrastructure to support communication across organisational boundaries. Traditionally, communication between primary and secondary care has been predominately paper based. Recipients complain that they cannot read handwriting, the information contained in documents is not appropriate to the clinical need at that moment in time, and that too large a percentage of documents, especially discharge letters, do not reach the intended recipient. It is envisaged that the e-HR and e-PR will provide a solution to all of these reported issues.

The UK situation, prior to implementation of the e-HR and e-PR, indicates a fragmented approach to system development and implementation from both primary and secondary care perspectives. The need for national standards is evident that will feed into an appropriate international standard for electronic records management.

The representation of clinical terminology is crucial to the success of the e-HR and e-PR and although many representations have been attempted in the past, most have not stood the test of time. Rector provides a compelling

litany of the difficulties in representing clinical terminology, which stems from the often conflicting needs and goals of clinical linguistics, clinical pragmatics and logical concept representation. He concludes that the successful representation will be recognised when “clinical terminologies are used and re-used... ..and when multiple *independently developed* [his italics] medical records... ..sharing the same terminology are in routine use.” [3]. This degree of uncertainty serves as a reminder that m-health applications are being developed at a time when the health systems in which they will sit are far from certain. However, the NHSIA in the United Kingdom has pressed ahead with Government inspired targets of achieving the e-PR in all hospitals by 2008. For the purpose of this paper, this target is perceived as an intermediate goal, to be superseded when home-based and General Practitioner patient records are included to form the e-HR.

The Government of the United Kingdom has given assent for the use XML as the standard for e-Government interoperability, the next Section investigates a specific application of XML in a healthcare setting.

IV. XML IN m-HEALTH

The use of XML facilitates electronic document management and workflow. XML technologies have the capability to transform electronic documents into multimedia information resources containing compound, reusable information objects. The management of workflow processes enables complete control and auditability of complex processes that may originate from distributed information sources.

Workflow management provides the sequence of tasks to be distributed among multi-professional clinical personnel, allowing the scheduling of interdependencies between the personnel to be optimised for the benefit of care of the patient.

Using these concepts Winchester and Eastleigh NHS Trust, a fully integrated health organisation comprising Acute, Community, Mental Health and Learning Disability Services that serves a population of 220,000 people across central Hampshire, registered a tender for an 'Electronic Case Notes Folder'. In response, an XML-enabled web-based virtual document system was produced that gave clinicians quick and easy access to a wealth of patient information. Having each patient's medical history at hand at the point of care aided clinical decision making. This was facilitated by provision of a local repository of all clinical letters and supporting documentation together with a browsing functionality. To ensure a high impact and value rating, the suppliers also included extracts from the Hospital Information System (for example, patient demographics) and incorporated existing workflow systems. In this way information in virtual space provided a powerful method for system integration that could be augmented with distributed data from m-health applications.

Crucially, XML-based solutions for integration of information are based on the concept of 'middleware', an interface (or more likely, a set of interfaces) between the existing legacy Hospital Information System and the standard web browser that clinicians use to interact with the system. The system architecture developed was able to

support both high and low specification web browsers as well as being primed for the introduction of a native XML processing capability that will further extend the scope of user interaction.

The 'Electronic Case Notes Folder' allowed clinicians to view directly from the screen:

- Patient demographics
- Episode of care details
- Alerts and allergies
- Laboratory reports
- Radiology reports
- GP referral letters
- Medical procedures undertaken
- Discharge letters.

Since the successful incorporation of this solution into the working practices of the Winchester and Eastleigh NHS Trust, the concept has been further developed into a more generic product that is receiving critical acclaim from Hospital Managers throughout the United Kingdom.

V. CONCLUSIONS

A PESTLE framework has been developed to investigate the change drivers and issues surrounding the introduction of the e-HR and e-PR into clinical practice. The role of m-Health is viewed as an instantiation of electronic records management that facilitates point-of-care clinical episodes in particular. NHSIA initiatives in the United Kingdom are seen as showing the way for successful m-Health solutions elsewhere in the world. The telecommunication markets in the UK and Europe are more focused and standardised than those found in the rest of the world, which may constitute a competitive advantage when roll-out of

enabled m-Health devices takes place. Perhaps the biggest market for m-Health solutions is also the least understood, that of the healthcare needs in the developing world. It is not hard to understand why this market is unattractive to manufacturers – rate of return on investment (as just one measure) is bound to be too low for market entry. To stimulate this market to a level where it becomes attractive needs more attention. Perhaps this is an area in which trans-national non-Governmental organisations have a stake in the continued development of citizens from less privileged regions of the world.

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