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### The Clinical Workstation: a GPS for the Medical User

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Benefits for the Healthcare User Most hospital systems have traditionally been "silo-based", expensive to maintain and inflexible. In contrast, all patient and hospital related information and processes are streamlined and integrated into one single clinical holistic system improving the quality of data. The focus of our approach was: Uniformity for the healthcare user by re-use hence minimising training, optimising navigation by avoiding the user having to spend a disproportionate amount of time switching from one application to another.

#### Originality

It was apparent, as the healthcare environment will become even more complex and more difficult to run, that a new state-of-the-art system was needed. We decided to move from a client server to a component-based, multi-tier J2EE architecture providing a clean separation between business and presentation logic. The application server embeds in the back-end the complex business logic of the medical environment. The CWS provides real-time holistic insight through five healthcare related core components:

**1. patient identification:** Used to issue and manage each patient's identification and location data.

**2. patient activities:** This manages the collaborative activity between different groups in the hospital and includes all kind of orders and prescriptions. It is one of the most important components to achieve integration within the patient's healthcare process. This component reflects and supports the medical organisation as a whole. The act component together with the workflow component governs the workflow (and information) between various healthcare actors based on output of the scheduling engine (as part of the resource component). The act component is the basis for CPOE (Computerised Physician Order Entry). The most important long-term benefit of CPOE results from the integration of clinical decision support systems into the order-entry process coupled with a hospital-wide resource scheduling system and with the EMR (Electronic Medical Record), so that orders can be tracked as part of a patient's EMR. The impact of clinical evidence on clinical practice by means of the creation of clinical protocols represents a major technical challenge and a promising opportunity in the field of medical informatics. Therefore the act component is an important fundament. Protocols are extensively used in the hospital's radiotherapy department of nowadays integrated with the CPOE and scheduling system.

**3. medical record:** A deletion-less central repository contains multimedia medical patient data (e.g. still images, video, alphanumeric data...) and incorporates all medical images collated from the various departments, including digitised scans, biopsies, and ultrasounds. These can be viewed in a clustered, aggregated environment, dependent upon the patient's needs. Data is gathered from various departmental/ satellite feeder systems. Each year, the available medical data in the hospital explodes. Currently, UZ Brussels sits on 1.5 petabytes of data, with a yearly increase of 150 terabytes. The medical server provides tools for clustering and presenting medical data, aggregated in different structures according to user needs.

**4. Scheduling:** One of the main distinguishing features of the CWS is that the broad application of CPOE is integrated with a sophisticated appointment planning and activity scheduling system. This system is deployed hospital-wide, without loss of continuity across services and departments. This system also includes a care programme scheduling facility to execute and manage the planning of an ordered sequence of clinical activities that make up such a programme. It takes into account the set of temporal and physical constraints between the activities defined in the programme and merges those with the agenda preferences of the patient. Incremental versions of this system have been operational for more than 10 years now. For example, the radiotherapy and oncology departments manage the complexity of cancer treatments using 300 different care programmes. The goal of this development was to extend this powerful automated care programme scheduling with an ICT infrastructure supporting clinical pathways (CP) while maintaining a tight integration within the hospital-based EPR system. This application supports the hospital's scheduling and appointment planning activities and includes OR management as well.

**5. Knowledge Component:** This can be regarded as a repository of business rules for concepts or acts and forms the underlying basis for medical decision support systems. As part of this service we have developed a terminology server with already more than 40,000 medical concepts that bring structure to the data. Examples:

- Does a drug interfere with other drugs?
- Is this act compatible with the patient's sex, age or condition?
- Are staff, equipment, etc. available to perform this act?
- Scheduling an act without fulfilling medical preconditions.
- Ordering tests that have already been ordered.
- Patient authorisation: Provides a unified system to manage secure access rights of individuals according to the hospital's, legal, medical, and organisational requirements.

#### Success

Physicians use the CWS for almost all their activities, including order entry, scheduling (radiology, pathology, surgical and other activities), reporting, medication, and admission. Physicians have a complete picture of the patient's medical history at their fingertips. We seamlessly integrate hospital applications, re-use many components, and effectively manage change more efficiently. On a daily basis physicians and nurses access patient records 25,000 times a day, schedule 4,000 appointments, capture >5,000 medical reports, process over 9,500 medical orders. 90 percent of interactions are completed in less than one second.

#### E-Health

This architecture paves the way for the future. Extended relationships means that GPs and patients effectively become part of the hospital

network by a secure GP portal providing referral physicians access to their patients' records. They are able to follow the course of each patient's health status. A patient portal provides secure access to self-administer their profile, request appointments, and provide feedback.

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