Chapter 12
The Health Care Factory

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ABSTRACT

Nowadays healthcare systems tend to expand their diagnostic components while restricting their therapeutic counterpart to enable cost reduction and improvement of care giving processes. Diagnostic components will capillary distribute in the territory as distributed and specialized centers of various sizes, interconnected by a wired/wireless network. On the other side, as stated by Umberto Veronesi in a recent interview, therapeutic components and care giving centers tend to reduce in size and number (today 70% of operations belong to the one-day-surgery class). Recent advances in the development of healthcare testing devices is supporting and pushing to the extreme this revolution and will strongly impact corresponding IT management models.

In fact, the reduced size and advanced features of modern testing devices render such devices usable without the intervention of skilled personnel for carrying out most of the testing process. These devices can be used everywhere by everybody: in hospital wards, ambulances, or at the patient's home. The expected use of these devices will resemble the current frequent use of thermometers and sphygmomanometers which have, in the past, contributed to promote the role of patients as active managers of their diagnostic and treatment process. Today, more than 60% of medical tests could be provided at point-of-care, and this figure will approach the level of 80% in a few years (Felder, 1996).

New intelligent wearable and implantable devices are under development, and their use in advanced wireless networks will make diagnostic testing ubiquitous and continuous. Intelligent devices will be able to continuously monitor the patient state and to send alarms to central management systems through a wireless connection whenever some of the monitored values are exceeding a given security boundary.

Testing devices will become important actors of healthcare processes and will impact on the organization of patient management. Portable devices will be available to doctors and nurses and their use will be integrated into care giving processes instead of being managed by dedicated Laboratory Information Management Systems (LIMS) under the control of highly specialized technical staff. This capability will reduce the time spent between testing and care giving phases and will completely revolutionize the relationship between standard laboratory operations and patient management systems.

This capability will shift standard care-giving processes, centered on localized and specialized places of care (hospitals, out-patients' department clinics, etc.) that are managed with a cyclic, time-based, and statically defined workflow, to a virtually ubiquitous reactive (i.e., event-driven) approach typical of units specialized for emergency treatments. In fact, an intensive use of intelligent and mobile patient monitoring systems tends to unbalance the relationship among synchronous, i.e. pre-scheduled, and asynchronous, i.e. event-driven, healthcare organizations that will be more exactly modeled as a reactive system, i.e. systems maintaining a permanent interaction with their own environment and respecting the causality order of events and assuming the characteristics of a real-time distributed system when time constraints must be respected.

This approach has the capability of improving the healthcare delivery processes by linking patient data with more advanced and interactive clinical guidelines and protocols. The shorter time for the diagnostic process will introduce advanced process control techniques for implementing personalized plans of the cycle measure/treatment and in extreme cases to close the loop with automatic control algorithms (Robert, 2002, e.g., insulin infusion).

The Health Care Factory is the proposal of a highly integrated system designed with the aim of improving the overall healthcare process management and of obtaining a flexible and deeper understanding of the patient treatment mechanisms. The Health Care Factory is based on a software/hardware infrastructure designed for modeling the healthcare problem—including ubiquitous laboratory automation, miniaturized, and lab-on-a-chip devices management, local (i.e., in the hospital), and remote (telemedicine) patient health control—like an integrated large, real-time, ubiquitous, and distributed discrete plant automation problem.

INTRODUCTION

In the computing and automation age, the hospital organization still remains bureaucratic and paper-based. Certainly, many sectors, such as the operating-theater, have made formidable progress, but such progress is isolated. Many organizations still use paper documents to store the patient record and to analyze reports. This approach does not help hospitals to become more efficient, rather it hinders information sharing among units by introducing useless steps for document format conversions and interpretations. This problem has become more evident with the modern tendency for patient dehospitalization; in fact, paper archives are impractical when the patient and the monitoring devices are outside the hospital.

In the past, medicine was hospital oriented, nowadays, it focuses on dehospitalization[1]. Hospitals integrate human and instrumental resources that ensure high QoS. Hospitalization has three main drawbacks:

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