Chapter 17
Towards Process-of-Care Aware Emergency Department Information Systems:
A Clustering Approach to Activity Views Elicitation

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ABSTRACT

The critical role of emergency departments (EDs) as the first point of contact for ill and injured patients has presented significant challenges for the elicitation of detailed process models. Patient complexity has limited the ability of ED information systems (EDIS) in prediction of patient treatment and patient movement. This article formulates a novel approach to building EDIS Activity Views that paves the way for EDIS that can predict patient workflow. The resulting Activity View pertains to "what is being done," rather than "what experts think is being done." The approach is based on analysis of data that is routinely recorded during patient treatment. The practical significance of the proposed approach is clinically acceptable, verifiable, and statistically valid process-oriented clusters of ED activities that can be used for targeted process elicitation, thus informing the design of EDIS. Its theoretical significance is in providing the new "middle ground" between existing "soft" and "computational" process elicitation methods.

INTRODUCTION

Information system (IS) design principles call for requirements definition as an intermediate stage in the design and development of IS (Mertins, Bernus, & Schmidt, 1998). The requirements definition is a document that outlines all the needs that users require of the prospective system. The requirements

definition is designed to allow for the translation of the physical needs of a process into an automated environment. Programmers should be able to work from this document without going back to the users for clarification. The requirements definition can thus "be compared to a schematic of a plan or a diagram of how a technical device works" (Langer, 2008).

The requirements definition commonly takes the organisation from a functional view of activities (who, in which department, does what) to a process-oriented view of operations (what happens, when, and where). This shift from functional data structuring to process event recording is best described in process models. Process models are formalised representations of the activities enacted by a human or a machine that are considered important to the achievement of the objective of the process (Dumas, van der Aalst, & ter Hofstede, 2005). The process models provide a structured framework for IS specification and design, one example is ARIS, a widely used reference architecture and methodology (Scheer, 1999), and allow configuration of the IS to support or control the flow of work in the operational process (Rozinat & van der Aalst, 2008). Comprehensive process models combine different views (Poulymenopoulou, Malamateniou, & Vassilacopoulos, 2003; Seltsikas, 2001) that describe:
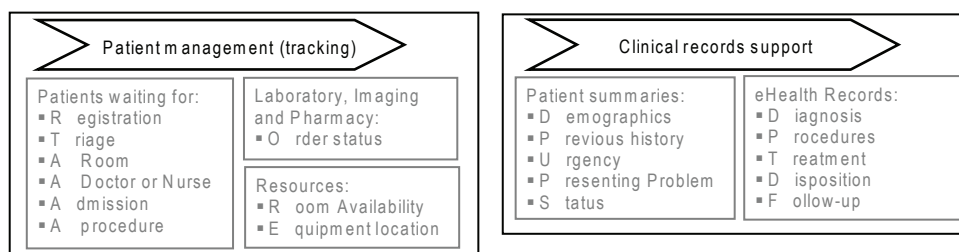
1. what activities are being performed within a process and their interactions (an activity view);

2. what data are relevant as inputs to, or outputs from these activities (data and output views);
3. who performs each activity and where it is performed (an organisational or resource view); and
4. when and how the process activities are being performed (a control view).

Information systems designed for hospital emergency departments (ED), also known as emergency rooms (ER) or accident and emergency departments (A&E), are commonly called emergency department information systems (EDIS). EDIS as they exist today mainly address two aspects of ED operations: (i) providing for tracking of patients and (ii) making patient information available to clinicians and administrators (Figure 1).

The first function, having patient information available online, promotes efficiency of operations through enhanced data entry capabilities, transferability between hospital departments and locations, and potential for bedside update of patient records. Electronic health records have wide reaching implications for EDIS design that are being addressed through various electronic health record initiatives (e.g., OpenEHR in Australia; GEHR in Europe; and HL7 in the USA).

The second function of existing EDIS relates to patient flow management. Most systems provide a list of patients awaiting treatment along with presenting problem, urgency, and disposition. This

Figure 1. Current EDIS deal with patient management retrospectively. There is an absence of information about the pathways future treatment might take and likelihood of patient admission.

Patient management (tracking)	
Patients waiting for: ▪ R egistration ▪ T riage ▪ A Room ▪ A Doctor or Nurse ▪ A dmission ▪ A procedure	Laboratory, Imaging and Pharmacy: ▪ O rder status Resources: ▪ R oom Availability ▪ E quipment location

Clinical records support	
Patient summaries: ▪ D emographics ▪ P revious history ▪ U rgency ▪ P resenting Problem ▪ S tatus	eHealth Records: ▪ D iagnosis ▪ P rocedures ▪ T reatment ▪ D isposition ▪ F ollow-up

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