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PROCESS BASED E-SERVICE LOGISTICS FOR CASE MANAGEMENT NETWORKS

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Abstract

An approach to advance coordination in case management networks is introduced. The overall aim is to improve quality and efficiency of care for patients with multiple morbidities and chronic diseases. The approach is based on a solution that handles coordination tasks by dynamic allocation of adequate e-services. The extended concept is focused on processes with more than one coordinator (decentralized coordination), supplier specific coordination (customized coordination,) and the coverage of multiple diseases. The patients social environment is particularly taken into account.

Keywords –process based coordination, complex care processes, homecare, e-services

1. Introduction

Beside deficient incentive systems the lack of integration between care sectors, insufficient coordination and transparency regarding decentralized service provision are considered to be responsible for the problems in the healthcare system [6]. The growing number of elderly people with multiple morbidities and chronic diseases is affected in particular because these are reliant on effective coordination throughout the care sectors [6,9]. "Servicezentrum Medizin und Pflege GmbH" organizes patient-centered care networks for this increasing group comprising ambulatory physicians, hospitals, home care services, rehabilitative care providers and other service providers.

Improvements regarding coordination between healthcare suppliers require effective information technology support. Whereas Electronic Health Records (EHR) focus on cross-enterprise interoperability and support exchange of information (e.g. IHE-XDS) the presented approach takes data centric e-services as given. There is no solution available that enables iterative process-oriented planning and execution of interorganizational care processes and provides adequate support for coordination between the network actors (e.g. agreement on care plans) [3,7]. The concept of process-based e-service logistics that was developed in cooperation with "QuE - Qualitäts- und Effizienzgemeinschaft", offers an approach to overcome deficits of existing solutions by adaptive identification and handling of coordination tasks based on e-services [4,7]. The first version of that concept was focused on gatekeeper systems including one coordinator per process instance. That concept was extended to meet the requirements of case management networks for people who are elder, multimorbid or chronically ill.

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2. Coordination in case management networks

2. 1. Networked care processes

Care processes in case management networks are highly individual based on specific patients needs. On a meta-level they comprise assignment, screening and assessment to identify patients' needs, planning of targets and services, provision of services, evaluation of results and returning information to the initiator [9]. Detailed characteristics and implications are listed in *Table 1*.

Table 1: Characteristics of patient-centered case management processes

Unique	Case management for the specified target group is highly individual to meet the needs of individual patient's course of disease.
Relevant and risky	Complex care processes lead to high costs and have a big impact on patient's health.
Long lasting	Care processes of people who are chronically ill span long periods of time.
Requiring in-depth knowledge	Knowledge in medical science increases rapidly which leads to a high degree of specialization. Because of the interdependencies between healthcare suppliers in-depth knowledge is also required for coordination processes [9].
Requiring intensive coordination	The medical knowledge necessary makes high demands on coordination of specialized healthcare suppliers in different sectors [8,9].
Decentralized organization	For comprehensive care services comprising different care sectors a centralized coordination approach is not adequate. Responsibility for coordination is split (e.g. non-medical services like diet consultancy are coordinated mainly by the case manager, whereas clinical services are coordinated by medical specialists). Coordination is conducted collaborative (e.g. family doctor and case manager plan case management processes together) and relative to organizational requirements regarding structures, processes and applications (e.g. hospitals use different applications for information exchange).
Agile	Patients' condition and the information on it change in the course of care. Hence care processes need to be adjusted frequently [7].

2. 2. Roles

In the project we distinguish between supplier roles (e.g. family doctor, case manager) and coordination roles (e.g. planning, monitoring). The roles listed in *Table 2* define coordinative responsibilities of actors related to case management services. Who can take on a coordination role is restricted by regulations (e.g. only a doctor can instantiate services like drug prescription) and network principles (e.g. only medical specialists can admit patients to hospital).

Table 2: Coordination roles

Planning	Assessment of needs, agreement on planned services with other actors involved
Instantiation	Completion of relevant preconditions related to the service (e.g. formal assignment)
Treatment	Provision of all services and sub services; documentation and communication of results
Monitoring	Observing progress and results of planned services
Evaluation	Qualitative and quantitative analyses based on results and initial targets

2. 3. Coordination situations

Coordination situations occur when decentralized information or decisions need to be aligned. There are sequential and simultaneous coordination situations [2]. While sequential coordination is subject to previous made decisions, simultaneous coordination produces collective results. *Figure 1* shows an example with several coordination situations. Two services (hospital treatment and short term care) for two different patients have to be scheduled because a cardiac patient is not able to

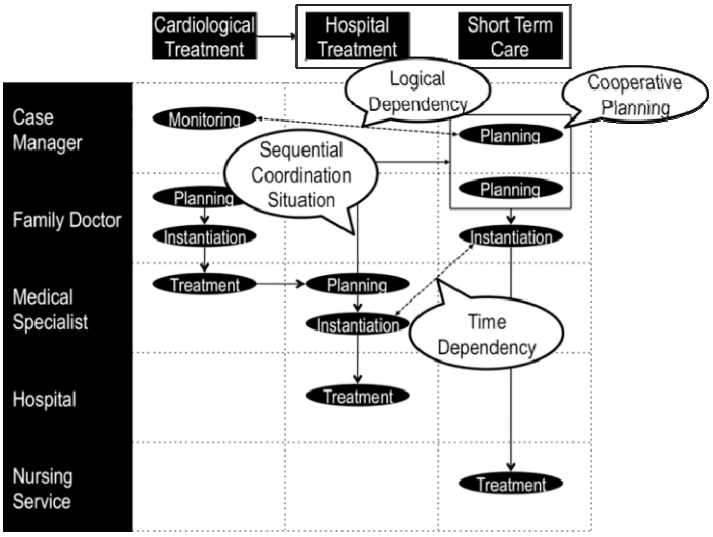

Figure 1: Example with several coordination situations

care for his wife during his hospitalization. On one hand there is a sequential coordination situation since the medical specialist already decided to hospitalize the cardiac patient. So the short term care for the patient's wife has to be initiated not later than the instantiation for hospital treatment (time dependency). For an adequate planning of short term care the case manager takes on a monitoring role for the previous service (logical dependency). On the other hand there is a simultaneous coordination situation. Case manager and family doctor mutually arrange targets and detailed services for short-term care.

3. Process based E-Service Logistics

3. 1. Approach

The concept of process-based e-service logistics (PEL) aims to support coordination of networked care processes by providing a customized set of e-services for patients and healthcare suppliers (especially for coordinators). *Figure 2* depicts the cybernetic model of PEL where context is used to produce proposals for care processes and e-service support [7].

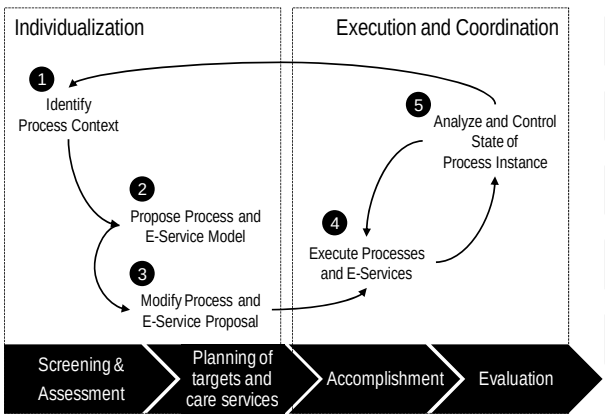

Figure 2: Cybernetic model

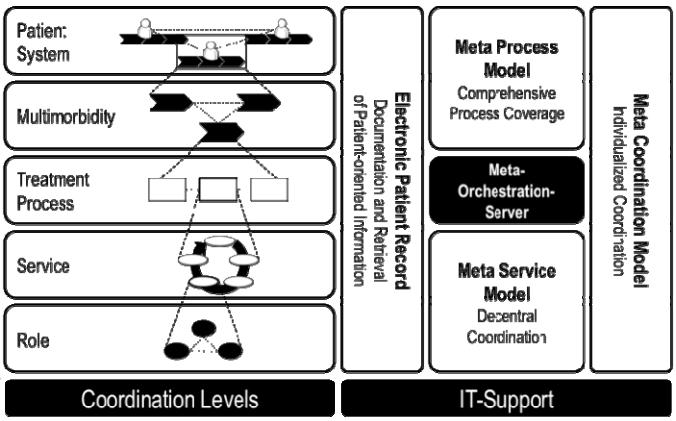

Figure 3: Extended approach

The extended approach is based on the specific requirements in case management networks. It enables the existing solution to handle coordination tasks that emerge decentralized from several coordination levels. Each level is represented by specific components that extend the existing solution. *Figure 3* pictures the mapping of coordination levels and IT Support.
The system architecture illustrated in *Figure 4* comprises the following layers:

- Data Integration: With cross-sectional care covering complex treatment cases comprehensive information demand is exigent. The integration of an EHR for documentation and retrieval of patient-related data enables transparent and context-sensitive information logistics. The EHR possesses interfaces to various operational information systems, e.g. practice management systems (PMS), clinical information system (CIS) and case management software (CMS).
- Process Control and Application Integration: The meta-orchestration server (MOS) comprises a flexible coordination model that supports decentralized healthcare service provision. It enables process customization, detects and handles coordination tasks in services and provides appropriate e-service support for healthcare suppliers and patients (e.g. e-service for cooperative care planning).
- Synchronization: The interface between MOS and EHR exchanges administrative and process-relevant information in order to identify patients, service providers and services and to enable process-oriented retrieval and analysis of patient- and care-relevant data and services.
- Presentation: Patients, service providers and health network managers use individual user interfaces for care information, configuration, coordination, monitoring and evaluation.

3. 2. Decentralized coordination

The "Meta Service Model" (MSM) enables coordination of service providers and patients within and between coordination roles. It supports simultaneous and sequential coordination situations. At runtime the need of coordination is scanned continuously. When the current configuration of actors and coordination roles matches a stored definition of a coordination pattern the system creates appropriate coordination tasks and assigns them to relevant service providers or patients. There are one-dimensional, two-dimensional and multidimensional coordination needs. The number of dimensions represents the number of different coordination roles that participate in the coordination task.

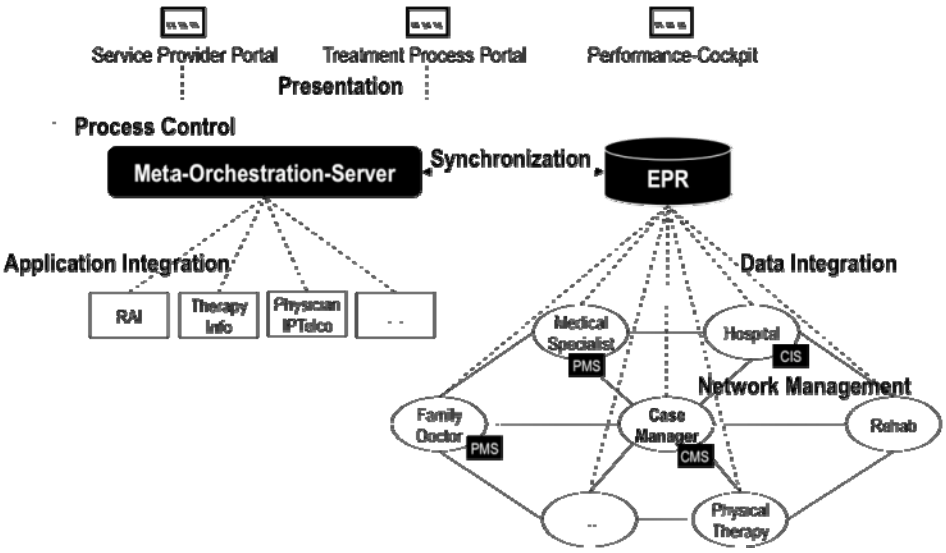

Figure 4: System architecture

One-dimensional coordination tasks emerge from actors that take on the same coordination role (e.g. planning, see chapter 2. 3) for a process element. They are either to be fulfilled cooperatively or separately. While cooperative fulfillment leads to one coordination task for all actors and produces collective result (e.g. case manager and family doctor create a care plan together), separate fulfillment implicates that each actor has to complete a respective task on his own (e.g. the actors create separate plans that are combined). Two-dimensional coordination tasks (e.g. transfer of care plans) emerge from actors that participate in two different coordination roles for a process element like care planning (planning) and service provision (treatment). Multidimensional coordination needs are spanning any number of coordination roles and enable the assignment of coordination tasks to actors participating in different coordination roles and process elements.

3. 3. Process coverage

The "Meta Process Model" (MPM) enables wholistic process support through setting-up associations between process elements with respect to logic, time and medical issues in order to identify and balance interdependencies. Objective of the MPM is to bring together distributed processes of different indications and persons. There are two ways to coordinate several processes such as it is needed in case management due to multimorbidity and the representation of patient systems with more than one person.

In order to manage distributed processes directly the MPM extends the MSM so that coordination tasks can be defined regarding two or more service and process instances. However, in some cases separate coordination tasks need to be aligned. Although each coordination task has to be completed separately, it can be important to align the coordination results (e.g. start dates of short-term care and of hospitalization, see chapter 2. 3). Therefore the coordination broker handles dependencies between the coordination results and requires a dominant (make appointment for hospitalization) and a subordinated coordination task (make appointment for short time care) and a relational operator (less or equal) as parameters. The broker continuously monitors the result of the dominant coordination task (start date of hospitalization). Whenever the dominant coordination result changes the condition of the subordinated coordination task will be refreshed. The resultant condition is an expression consisting of the relational operator and the dominant coordination result. This mechanism supports sequential coordination situations since changes of the dominant coordination result implicate new conditions for the dependant coordination result.

3. 4. Customized coordination

The "Meta Coordination Model" (MCM) enables the management of various requirements regarding design and execution of coordination tasks according to heterogeneous organizational needs by providing the users with the modification of both static (e.g. need, priority and due date) and dynamic parameters (e.g. patient role, e-service support, interactional settings) of the coordination tasks. In some cases, however, the value margins of the parameters are possibly constricted (e.g. "at latest three days before treatment starts" vs. "at the earliest after anamnesis"). The MCM tries to solve these conflicts by applying different levels of synchronization mechanisms that aim to consolidate individual parameters and produce a common coordination result that is as satisfying as possible for all participants.

Parameter level: In each case the configuration having the most extreme value dominates so that the rest of the conditions can be fulfilled as well. This mechanism is only executable if all values are qualitatively comparable rather can be mapped onto an ordinal scale.

Role level: The dominant parameter value depends on the particular role of participating actors. Service providers take priority over service initiators and service initiators dominate service observers. Within these roles additionally responsible and expectant roles are distinguished. As the expectant actor is dependent on the coordination result, in case of synchronization conflicts the responsible actor has to accept the customized parameter value of the expectant.

Organization level: Size, degree of standardization or automation, application integration and legal requirements build criterions for the decision which parameter value is to be favored.

4. Conclusion

The described approach manages complex and distributed coordination issues flexibly. It is customizable for different types of healthcare networks and enables support for organization specific coordination requirements. Existing applications can be invoked dynamically as e-services. The EHR interface enables automated data supply. The feasibility of the approach that meets specific requirements in case management networks has been proved. As a next step the coordination broker of the MPM will be extended to enable more complex conditions and constraints. The real-time process data will be analyzed and presented in a performance cockpit in order to satisfy information needs of network management and health insurance funds.

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