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BRINGING CARE QUALITY TO LIFE: TOWARDS QUALITY INDICATOR-DRIVEN PATHWAY MODELLING FOR INTEGRATED CARE NETWORKS

Research in Progress

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Abstract

Integrated care is a promising approach to create connectivity, alignment, and collaboration in a network of health care providers, especially for people with long-term and complex conditions. It aims at improving care quality, but a common, standardised quality management approach for such networks is still missing. In this context, care pathways are recognised as important quality management tools. They define key goals of care and organise actions to achieve them. However, their utilisation in terms of quality management is lacking methodological support. The article provides the conceptual foundations as part of a design-oriented research project that aims to develop a method for the utilisation of care pathways for quality management purposes in integrated care settings. Therefore, the realm of process quality in integrated care is analysed and structured by means of a classification framework. Moreover, relevant concepts for the integration of quality indicators in care pathways are analysed and represented with a semi-formal domain ontology. These conceptualisations prepare the next steps in the project's research agenda. These comprise the development and evaluation of an indicator-driven care pathway modelling language and its application for quality management in integrated care. This approach could make quality of integrated care more transparent and manageable.

Keywords: care pathway, quality management, indicator modelling, health care network, design-oriented research.

1 Introduction

1.1 Background and objective

Integrated care holds the potential to ensure health care quality and patient satisfaction given today's challenging circumstances in Western countries. These challenges include demographic changes, skilled worker shortages, an increasing prevalence of chronic diseases, and high numbers of multimorbid patients (Antunes and Moreira, 2011; Nolte and Pitchforth, 2014). Integrated care is a concept creating connectivity, alignment, and collaboration with regard to resources, delivery, management, and organisation of health care services in a network of care providers, and this is especially important for patients with long-term and complex conditions (Gröne et al., 2001; Kodner and Kyriacou, 2000). The major aims of integrated care are to improve quality of care provision, patient satisfaction, and system efficiency (Kodner and Spreeuwenberg, 2002). While standardised quality management systems (QMS) exist for single health care institutions, e. g. the ISO 9001 norm or the European Foundation for Quality Management (EFQM), there is yet no common, broadly applied QMS for integrated care settings. Existing QMS show positive effects by helping health care organisations be more pro-active, improve operational efficiency and outcomes, increase patient safety and reduce errors (Sánchez et al., 2006; Stoimenova et al., 2014). In an effort to bring these same benefits to integrated care networks, Minkman (2016) took first steps and proposed a set of general quality management elements for integrated care.

In this context, multidisciplinary care pathways are recognised as an important quality management tool for integrated care (Minkman et al., 2013). However, there is no methodological support to utilise them for quality management purposes at this time. To address this gap, the article at hand aims to define the conceptual foundations for the development of a method to enable care pathway-based quality management in integrated care networks.

Care pathways improve patient outcomes, patient satisfaction and safety while at the same time optimising the use of resources (Vanhaecht, 2007). They define the key goals of care and the actions needed to achieve them. They are developed with regard to evidence-based recommendations from clinical practice guidelines (CPGs) and best practices. Care pathways facilitate communication between patients and a multidisciplinary team of care providers, coordinate roles, and document, monitor and evaluate variances in care provision (de Bleser et al., 2006; Vanhaecht, 2007). In contrast to clinical pathways being applied within single institutions (e. g. in a hospital), care pathways describe the intended interorganisational care process for a defined patient group (Schrijvers et al., 2012). Given these characteristics, care pathways seem to be a promising tool to address the quality management support for integrated care that is lacking today. In contrast to the healthcare domain, such a process-driven perspective on quality is already taken up in manufacturing and service industries (Knapper et al., 2012). In healthcare, a process-oriented view based on care pathways is suitable as well, since it is argued that for the vast majority of medical conditions, process quality measures should be used in order to assess the quality of care (Brook et al., 2000). This is because process interventions are the means to improve outcomes. Process indicators measure what a health care provider did for a patient and how well the service was done (Mainz, 2003). Quality goals and quality indicators are available, e. g. published in CPGs, and are used broadly to assess and compare quality of care. Still, the internal care-related processes of health care institutions, and correspondingly of entire care networks, remain unaffected by such quality specifications (Beckmann et al., 2016). There is no comprehensive quality management approach exploiting care pathways with regard to the definition, implementation, monitoring, and achievement of health care quality goals. In this context, Richter et al. (2016) discussed, how such an approach could support the monitoring of the quality of care, the quality assessment of integrated care networks, and the relation between medical research and clinical practice.

Existing methodological or technological support for care pathways is either incomplete or focusses on the application in a single health care institution instead of interorganisational, integrated care settings. For example, Braun et al. (2016) extended the Business Process Model and Notation (BPMN) to also represent specific aspects from the clinical pathway domain. Their approach comprises several perspectives, including quality indicators. They can be annotated to the pathway model, but neither do they guide its design nor is a methodological support for utilising annotated indicators in terms of quality management considered so far. Schriek et al. (2016) proposed a maturity model for care pathways in order to support the development of high-quality care pathways. In this context, the definition, use and evaluation of performance and quality metrics were identified as major enablers. However, the practical implementation described was not part of the study. In summary, there is the need for a change in perspective, i. e. to develop care pathways with a stronger focus on their usage for quality management tasks and to support integrated care delivery. As part of this, a quality perspective could be integrated in care pathways. Addressing this need, the article at hand aims at providing the conceptual foundations. Therefore, the following two research questions will be answered: (RQ1) How can process-relevant quality indicators for health care networks be identified and classified and (RQ2) what are the relevant concepts for the integration of quality indicators in care pathway process models?

1.2 Method and structure of the research

The conceptual foundations presented in this article are parts of the design and development phase in a design-oriented information systems research project (Österle et al., 2011; Peffers et al., 2007; Winter, 2008). In general, the focus of this design science research (DSR) genre lies on instructing the design and operation of information systems (IS) and of innovative concepts within IS (Peffers et al., 2018). In the presented case, this relates to the design of a quality indicator-based development and monitoring

method for care pathways in a health care network. The result of DSR is an artefact addressing important organisational problems (Hevner et al., 2004) which were described previously (see sec. 1.1) and are summarised in Figure 1 (see left part of Figure 1: environment). Since the intended artefact of the overall research project is a method, it is classified as a method engineering project (Brinkkemper, 1996; Henderson-Sellers, 2006). The overall DSR framework and how the work at hand is positioned is represented in Figure 1 by adopting the IS research framework described by Hevner et al. (2004). Thereby, the three cycles of design, rigor and relevance, as they are characteristic for DSR (Hevner, 2007), are addressed. The design activities are grounded in the knowledge base by analysing existing literature in the fields of health care quality, integrated care and the modelling of performance, pathways and indicators. Furthermore, the state-of-the-art of the application domain is an important knowledge base (see right part of Figure 1: knowledge base, rigor cycle). To identify previous work in these fields of interest, unsystematic database searches using PubMed, AISeL, Web of Science, and google scholar were conducted. Thus, the literature reviews cover representative and central work (Cooper, 1988). The practical need for developing the intended method originates from several discussions with experts in the application domain (relevance cycle), especially in the field of quality management for comprehensive cancer care (Beckmann et al., 2016).

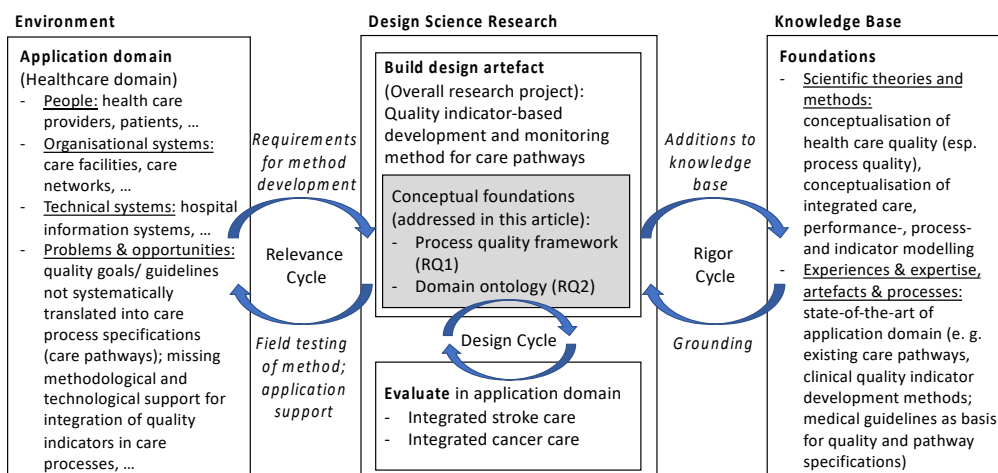


Figure 1. Research framework of the overall research project and positioning of the presented artefacts (highlighted in grey) according to the DSR framework described by Hevner et al. (2004) and Hevner (2007)

The remainder of the paper is structured as follows. Research question RQ1 is addressed in section 2 with the proposal of a classification framework for process-related quality indicators in the realm of integrated health care networks. Research question RQ2 is addressed in section 3 with the analysis of relevant concepts for the integration of quality indicators in care pathway models. Therefore, a domain ontology is developed. The next steps in the overall research agenda, including the further use of the presented work, are outlined in section 4. The article closes with a summary and potential contributions in section 5.

2 Process quality classification framework for integrated care networks

In order to design the intended method to enable the utilisation of care pathways for quality management purposes in integrated care, it is initially necessary to structure the domain of health care quality. The traditional classification of care quality goes back to Donabedian's differentiation between the quality of structures (e. g. infrastructure, environment, employee qualification), processes (e. g. interventions, diagnosis activities) and outcomes (e. g. patient's health status, patient satisfaction) (Donabedian, 1988; Vanhaecht, 2007). Accordingly, this became a common approach to classify quality indicators as well. It is sufficient for an initial differentiation. However, the overall research objective requires a more

detailed specification, especially of process- and care network-related indicators, in order to identify and classify relevant process quality characteristics and thus, requirements for the method. Therefore, literature conceptualising both the quality of health care on a general level and the quality of integrated care was analysed. Since the aim is to identify and classify process-related quality indicators (see RQ1), the inclusion of health care performance-related literature in the analysis is appropriate as well (McLellan et al., 2007). This approach was complemented by a bottom-up approach, i. e. by analysing disease-specific quality indicator sets (e. g. Grube et al. (2012); Ludt et al. (2013); Wesselmann et al. (2014)) to identify common characteristics of quality indicators and to compare conceptual findings with practice.

Based on the conducted literature analysis, a classification framework for process-related quality measures in network-based, integrated health care settings was developed (see Figure 2). The representation of the phases in health care (dimension 1) and the quality concepts (dimension 2) in the form of a matrix is borrowed from the conceptual framework proposed by Arah et al. (2006), outlining the main concepts and domains of performance. This matrix was modified according to the research objectives by adapting the process quality dimension and by enhancing the framework by a third dimension, the levels of analysis. The three dimensions are described in the following.

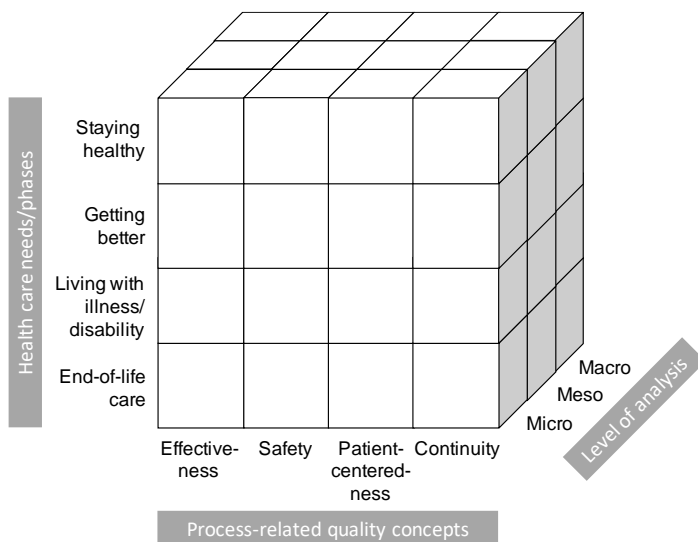


Figure 2. Classification framework for process quality in integrated care settings

2.1 Dimension 1: phases in the care process based on health care needs

Since the patient's perspective and individual health care needs are in the centre of all services provided by integrated care initiatives (Lloyd and Wait, 2006), they are represented in a separate dimension in the classification framework. The US national health care quality framework describes the typical phases of a person in relation to the individual health status, i. e. the reasons for seeking care, which are staying healthy, getting better, living with illness or disability, or coping with end-of-life (Institute of Medicine (US) Committee on the National Quality Report on Health Care Delivery, 2001). These go along with the typical phases of the continuum of care to be coordinated across different health care providers in integrated care settings – from health promotion, health protection and disease prevention (staying healthy), to diagnosis, treatment, rehabilitation (getting better) as well as long-term care (living with illness/disability) and palliative care (end-of-life-care) (Kluge, 2013; World Health Organization, 2016). In order to enable comprehensive and longitudinal quality management in integrated care networks, quality measures for all of these phases are of potential interest.

2.2 Dimension 2: process-related quality goals

The process-related quality of health care can be classified into four major concepts. These are effectiveness, safety, patient-centredness, and continuity. The description of, and examples for, each concept are summarised in Table 1. Effectiveness and safety were identified as core elements of health care quality relevant for a process-based quality assessment, whereas patient-centredness and continuity are especially relevant in integrated care settings (Bautista et al., 2016; Minkman et al., 2009; Suter et al., 2008). Other traditional health care quality domains such as efficiency and equity (Arah et al., 2006; Institute of Medicine (US) Committee on Quality of Health Care in America, 2001) are not included in the classification framework. They represent wider, economic and social objectives of health policy (Arah et al., 2006) and are rather outcome oriented and thus, not relevant indicators in the context of care pathways. Similar reasoning applies to patient satisfaction, which is a typical client-oriented outcome indicator. However, effectiveness, safety, patient-centredness, and continuity of processes influence outcome quality such as patient satisfaction.

Concept	Description	Operationalisation examples
Effectiveness	Effectiveness of health care services is “the extent to which attainable improvement are, in fact, attained” (Arah et al., 2006). The provision of evidence-based and appropriate services is essential for effective care processes.	Diagnostic based on medical guideline recommendations; pre-therapeutic assessment of patients by multidisciplinary teams (Ludt et al., 2013)
Safety	Health care services are rendered in ways that prevent or reduce harm to users (patients), care providers, and the environment (Arah et al., 2006).	Obtaining confirmatory diagnosis; compliance with hygiene standards; appropriate use of prophylaxis (Mitchell, 2008); documentation
Patient-centred-ness	Health care services are responsive to individual patient preference and needs. This also includes their non-health expectations, e. g. lifestyle, personal resources, social-economic conditions. Patient-centredness comprises other concepts such as responsiveness, acceptability, or timeliness of care services (Arah et al., 2006; Institute of Medicine (US) Committee on Quality of Health Care in America, 2001; Mosadeghrad, 2012).	Providing understandable information; harmonising self-management support methods (Minkman et al., 2009); sharing decision with patient regarding therapeutic procedures; opportunities for patient to ask specialists questions (Ludt et al., 2013); short waiting times
Continuity	Health care services are smoothly organised and coordinated not only within but also across health care providers. Continuity comprises client logistics and streamlining of care processes when it comes to transitions (Arah et al., 2006; Minkman et al., 2009).	Exchange of patient information among care providers; agreement among care providers for inclusion and throughput of patients (Minkman et al., 2009)

Table 1. Description and operationalisation examples of process-related quality concepts

2.3 Dimension 3: level of analysis

Quality indicators can be distinguished regarding their level of analysis. This is important because the level of measurement depends on the level of analysis (Hitt et al., 2007). For this reason, the classification framework distinguishes between quality indicators on the micro-, meso-, and macro-levels. This differentiation is also used by Valentijn et al. (2013) to describe the levels of care integration. The micro-level refers to person-focussed measures describing individual, human behaviour and capturing interactions between individuals such as patient-doctor interaction (person-based quality measures). The meso-level refers to quality measures addressing organisational units such as hospitals. The macro-level refers to measures describing interorganisational health care networks and the relations between the participants in such a network. Both measures on the meso- and macro-level, are population-based (Bautista et al., 2016).

3 Bringing it together: preparation of integrating a quality perspective in care pathway models

Aiming at the overall research goal to methodologically support the utilisation of care pathways for quality management in integrated care settings, the semi-formal domain ontology depicted in Figure 3 was developed in order to gain a comprehensive understanding of the domain and its relevant concepts and attributes (Happel and Seedorf, 2006; Uschold, 1996). The ontology is based on the findings of the previous process quality analysis (referring to section 2) and on the analysis of literature in the fields of pathway-, indicator- and performance-modelling. In order to integrate a quality perspective in care pathways, it is necessary to specify the key concepts of a pathway model and of process-related quality aspects, i. e. goals, indicators, and measurement-related concepts. Since the application focus is on integrated care scenarios, in which patient-centred care is of high importance, the domain ontology also covers patient- and network-related concepts. Therefore, the identified concepts were structured into the four areas of interest, i. e. concepts relating to the patient, the care provider, the care pathway, and to process quality. The concepts based on the three dimensions of the proposed classification framework (see Figure 2) are highlighted in darker grey. In summary, the ontology shows the relations between the concepts of care pathways and process quality indicators in the context of integrated care.

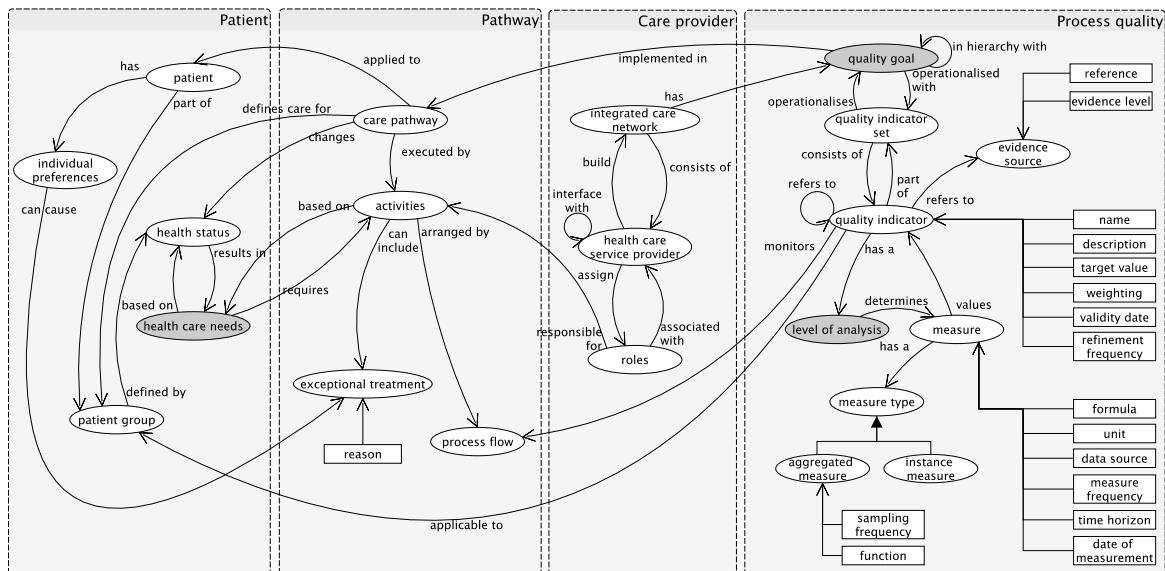


Figure 3. Basic OWL Lite domain ontology (W3C, 2012) integrating concepts concerning quality indicator-driven care pathway modelling and utilisation

As basis for the pathway-related concepts functions the ontology of clinical pathways proposed by Braun et al. (2016). A *care pathway*, such as a clinical pathway, consists of several *activities* which are organised and arranged in a *process flow*. A care pathway provides care to a *patient* who is part of a defined *patient group* (population). Since integrated care not only includes the treatment of diseases but also preventative activities, the term patient includes healthy people seeking preventative care in this context as well. Based on the characteristics of the patient group, which are determined by a shared *health status* (e. g. described by symptoms or current status in comparison to individual health objectives) and corresponding *health care needs* (referring to section 2.1), the care pathway and corresponding actions are defined. The aim of the care pathway is to change the health status of the related patient group and thus of the individual patients the pathway is being applied to. Since patient-centredness is a major characteristic of integrated health care services, the tailoring of care to individual *preferences* of patients is necessary (Berntsen et al., 2015; Minkman et al., 2009). Thereby, *exceptional treatments* can occur. In addition to individual patient preferences, there may be other reasons for deviations from the predefined care pathway such as the expertise of the care provider or the clinical state and circumstances (Haynes et al., 2002). Defined organisational roles (e. g. general practitioner,

nurse, radiologist), associated with particular *health service providers*, are responsible to perform the actions specified for a care pathway. The *integrated care network*, consisting of several health service providers, specifies network- and care-related goals to be achieved. The goals for particular patient groups are implemented in the form of a care pathway. These pathway-related *quality goals* (referring to section 2.2) are operationalised by means of a *quality indicator set*, consisting of several related *quality indicators* (referring to the enterprise monitoring ontology proposed by Silva and Weigand (2011)). They monitor the quality of the process flow based on care pathways (analogous to Jussupova-Mariethoz and Probst (2007) and Amor and Ghannouchi (2017)). Such indicators are linked to an *evidence source* in order to ensure effective care provision. Such sources are mostly CPGs, which bundle the current evidence from clinical studies regarding the care for particular patient groups (Woolf et al., 1999). Mature CPGs already describe quality indicators with this regard. Otherwise, methods to derive quality indicators from CPGs can be used (Follmann et al., 2012). Indicators are defined by several attributes, which are represented in the ontology based on attributes as specified in existing indicator-related meta models proposed in performance measurement literature (referring to Frank et al. (2008) and Strecker et al. (2012)). Depending on the *level of analysis* (referring to section 2.3) of a quality indicator, an appropriate *measure* to determine its value is chosen. A measure has a *measure type*, which is either an *aggregated* or an *instance measure* (del-Río-Ortega et al., 2010). The former has an aggregation function (e. g. minimum, maximum, average) and a sampling frequency. For all measures, the formula, unit, source of data, measurement frequency, covered time horizon, and the date of each measurement are characterising attributes (del-Río-Ortega et al., 2010; Strecker et al., 2012).

4 Next steps in the research agenda

The overall research project, to develop a method for the utilisation of care pathways for quality management purposes in integrated care networks, can be divided into three components building on each other. These components go back to basic requirements arising from the environment and the knowledge base, which the intended method should meet (referring back to Figure 1, especially relating to the rigor and relevance cycles constituting the grounding and requirements for the method development).

First, the method needs to specify the quality indicator system to be implemented with care pathways. Such an indicator system shall be described by the quality indicator set, its relation to the quality goals as well as by the corresponding measures (as depicted in Figure 3). The two design artefacts described in the article at hand, i. e. the classification framework and the domain ontology, are major parts of this method component because they describe the foundational concepts, their relations and attributes to be considered.

Second, the method needs to specify how care pathways in integrated care networks can be enhanced with a quality indicator view, integrating the developed quality indicator system. Therefore, distinct types of process quality indicators, their integration and representation in care pathway models will be defined and a meta-model for quality-indicator-based care pathways will be developed. The proposed domain ontology provides the starting point for this. With this regard, the domain-specific BPMN extension, called BPMN4CP (BPMN for clinical pathways), proposed by Braun et al. (2016) will be revised by including a quality perspective and checking its applicability on the network level. This approach is reasonable because the extension of an existing language with domain-specific concepts is expected to be less expensive than the invention of a new modelling language (Mernik et al., 2005).

Third, the method needs to provide a quality monitoring approach in order to utilise the prepared care pathways for quality management purposes in integrated health care networks (Richter et al., 2016). This includes tasks such as the evaluation of quality indicators and correspondingly, the assessment of goal achievement as well as the monitoring of pathway compliance, i. e. the extent to which the practical application of the pathways matches the pre-defined care pathway quality specifications. In the latter context, the research will draw on existing approaches in the field of process compliance management (e. g. El Kharbili (2012), Ly et al. (2013)) and adapt them according to the domain specifics.

As the continuous evaluation of design artefacts is part of the design cycle in design-oriented research projects (referring back to Figure 1), the research process will include the continuous evaluation of the method and its components in context of the application domain. Therefore, available research access to two integrated care networks covering acute care, rehabilitation and domestic aftercare (one for stroke and one for cancer patients) will be used for method application and evaluation. First, the applicability of the proposed artefacts in the article at hand will be tested and demonstrated by instantiating them in context of the two application scenarios (Peffer et al., 2007). Although the outline of the evaluation process is currently being developed, it is likely to carry out the evaluation in terms of a demonstration or case study in the application scenarios (Offermann et al., 2009).

5 Conclusion

The article presented the conceptual foundations of an ongoing research project aiming at the development of a method to support the utilisation of care pathways for quality management purposes in integrated care networks. Therefore, the integration of a quality perspective in care pathway models is intended. In order to prepare the integration of process-related quality indicators in care pathways, the article at hand answered two research questions. First, the realm of process quality in integrated care settings was analysed and a classification framework was proposed (addressing RQ1). The framework consists of three dimensions covering the phases in a care process based on a patient's health care needs, the concepts of process-related quality goals, and the level of quality analysis. Second, relevant concepts for the integration of quality indicators in care pathway process models were analysed (addressing RQ2). The concepts, relations and attributes were represented in the form of a semi-formal domain ontology. It integrates concepts relating to patients, the care pathway, care provider, and quality indicators. The next steps in the research agenda comprise the development of a domain-specific, indicator-driven care pathway modelling language, the provision of a corresponding monitoring approach and the evaluation of the design artefacts.

It is important to state that quality of care should not be evaluated using process quality indicators only. They complement structural and outcome quality indicators. However, a methodological and technological support for the representation and utilisation of process indicators in care pathways could improve the achievement of quality goals. A more process-oriented quality assessment could make the practice of integrated care delivery more transparent and manageable (Richter et al., 2016). This is desirable because process quality has a strong effect on outcome quality (Mainz, 2003). Furthermore, the presented conceptualisations in the paper at hand may function as groundwork for the identification of constructs in the context of theory development in order to explain, observe, and predict the impact of quality indicator-driven care pathways in comparison to current approaches.

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