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Operational antecedents of integrated patient planning in hospitals

Integrated
patient
planning in
hospitals

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Abstract

Purpose – Hospitals struggle to integrate the planning from different departments; resulting in unacceptable waiting times for patients. The literature mainly addresses general, organizational factors inhibiting or enabling integration and omits important factors stemming from the care delivery process. Therefore, the purpose of this paper is to uncover operational antecedents and to assess their effect on the integration of hospital planning.

Design/methodology/approach – The study is based on a three-hospital multi-case study. The main findings stem from over 40 in-depth interviews with specialists, nurses, planners, and managers of four specialties that are all involved in the orthopedic internal supply chain.

Findings – This study identifies five critical operational antecedents: performance management, shared resources, information technology, process visibility, and uncertainty/variability. The latter two are of specific importance in a healthcare context. Three distinctive roles are identified; initiating (performance management and process visibility), facilitating (information technology), and inhibiting (shared resources and uncertainty/variability).

Practical implications – The authors address how integration can be achieved, rather than merely prescribing integration as a means to improve performance. The identification of specific operational antecedents and their role help managers to find tangible ways to effectively integrate hospital planning which increases hospital performance.

Originality/value – First, the identified operational antecedents are essential supplementary factors to more common organizational and behavioral antecedents. Second, in contrast to earlier contributions the authors show the effects of antecedents on three different stages of integration, rather than on integration in general.

Keywords Case study, Hospital planning, Internal integration, Operational antecedents

Paper type Research paper

Introduction

Both patients and care providers seem to have accepted waiting as an inevitable part of healthcare provision. A large part of waiting results from poor coordination of consecutive appointments required to treat a patient. Integrating planning functions in hospitals helps addressing this problem (Vissers and Beech, 2005; Aronsson *et al.*, 2011). Despite proven benefits of integrated planning in manufacturing (e.g. Oliva and Watson, 2011), hospitals still lag behind (Cardoen *et al.*, 2010). The reasons for this lacking

integration, however, is unknown. Therefore, this paper aims to find antecedents which help or hinder integration of planning in hospitals.

Forced by a changing environment hospitals recognize the importance of organizing around the needs of care processes (and patients) rather than focussing solely on physician needs (Lega and DePietro, 2005). Initiatives such as a service line approach or care pathways consider the essential care steps and describe the expected medical progress of the patient (Vanhaecht *et al.*, 2012). However, planning aspects such as sequencing process steps over time and checking resource availability are mostly not explicitly addressed therein, as the main emphasis is on medical and procedural aspects.

So far, literature mentions general organizational and behavioral factors as likely causes for failed integration, such as organizational culture (Currie and Harvey, 2000), physician autonomy (Pearson *et al.*, 1995), top management support (Currie and Harvey, 2000), and politics (Vos *et al.*, 2009). Little attention has been given to antecedents directly related to specific characteristics of the process of care delivery and the management of resources. From other contexts the importance of such operational antecedents as layout (Pagell, 2004), performance measurement (Stank *et al.*, 2001), or shared resources (Van der Vaart and Van Donk, 2004) is well-known. However, they have not been explored in a healthcare setting yet.

We address the gap identified above by investigating integrative practices in hospitals as well as the associated operational antecedents that help or hinder the integration of planning. The main thrust of this paper is that a thorough understanding of the role and effects of operational antecedents can contribute to the integration of planning and consequently hospital performance. The main question is: how do operational antecedents enable or inhibit the integration of planning within hospitals? This question is explored in a multi-case study carried out in three hospitals in the Netherlands.

As the use of operations management practices is significantly influenced by context (Sousa and Voss, 2008), it is uncertain if integration research in manufacturing can be translated to a healthcare setting (Thrasher *et al.*, 2010). We add to earlier studies (e.g. Pagell, 2004) by exploring their findings on antecedents in a healthcare context. Although some antecedents are similar as in manufacturing we also uncover new antecedents and new roles. Further we add to the literature by adopting an operational perspective on integration of planning in the healthcare context. As this study provides a detailed, comprehensive understanding of the workings of integration in hospitals, the managerial contribution lies in addressing how integration can be achieved, rather than merely prescribing integration as a means to improve performance.

Theoretical background

Although integration and planning are used extensively, the literature provides no generally accepted definitions (e.g. Bertrand *et al.*, 1990; Pagell, 2004). That is why both concepts are defined first and positioned in the healthcare context. Next, antecedents of integration are discussed and linked to three stages of integration in order to build a conceptual model that will guide this study.

Integration of planning in hospitals

Planning refers to the process of reconciling supply with demand (Slack *et al.*, 2001). On the operational level the planning function of healthcare processes relates to the day-to-day activities needed to facilitate patients (Vissers *et al.*, 2001). Here, the most important planning activities are patient scheduling, daily adjusting, and performance monitoring

(Peltokorpi, 2011). Also, cross-departmental coordination is necessary (Visser *et al.*, 2001) because proper planning should tie key activities in hospitals together (Rhyne and Jupp, 1988). A recent review of research aimed at planning (decision) optimization in hospitals (Hulshof *et al.*, 2012) reveals that little attention has been paid to integrating planning functions between departments. Although some papers consider the link between operating theater capacity and ward capacity (e.g. Beliën and Demeulemeester, 2007; McGowan *et al.*, 2007), most studies investigate planning of single-stages (White *et al.*, 2011).

As little theory building has been carried out with respect to integration in hospitals, we build on manufacturing-based research (e.g. Frohlich and Westbrook, 2001; Pagell, 2004; Zhao *et al.*, 2011). Since there is no generally accepted definition of integration (Mendes Primo, 2010), we position our research around the central idea of integration, that is, that distinct and interdependent organizational components should constitute a unified whole (Barki and Pinsonneault, 2005). In order to achieve such a unified whole, organizations should employ activities and practices that allow functions within an organization to coordinate and cooperate with one another (Braunscheidel *et al.*, 2010).

Pagell (2004) assumes that integration takes place in steps leading from no integration to complete integration. Often these stages are equated to an increasing extent of integration (i.e. the amount of actors or organizations involved in the integration) as described in Stevens (1989) and Frohlich and Westbrook (2001). For our purpose the content of integration rather than the extent of integration is important, as we are mainly interested in how hospitals integrate their planning. Van der Vaart and Van Donk (2004) propose three content-based stages of the integration of planning:

- (1) transparency stage: entities (departments, organizations) only share relevant planning information;
- (2) commitment and coordination stage: entities not only share relevant information, but also agree to some mutual commitments (e.g. capacity reservation); and
- (3) integrative planning stage: the planning of at least part of a supply chain is centralized.

This study employs these stages of integration to investigate their operational antecedents in hospitals.

Antecedents of integration

Most studies report a positive association between integration and organizational performance (e.g. Flynn *et al.*, 2010; Leuschner *et al.*, 2013), but ignore possible factors that help or hinder integration (Ho *et al.*, 2002). This section discusses such factors within and outside the healthcare context.

Stank *et al.* (2001) identify eight supply chain-related drivers of integration for best-in-class companies: internal support; proper measures; appropriate rewards; proper allocation processes; a long-term performance focus; consolidated product requirements; proper use of technology; and trust. Based on eleven manufacturing cases, Pagell (2004) found that internal integration is directly or indirectly influenced by communication, cross-functional teams and job rotation, performance measurement, plant layout, plant structure, and plant culture. Further, he proposes that both the use of information technology and support from top management could help internal integration. Barki and Pinsonneault (2005) believe six coordination mechanisms

(standardization of planning, work, outputs, skills and norms, direct supervision, and mutual adjustment) to enable organizational integration. However, specialization due to goal differences and conflicts stemming from power and political considerations hinder internal integration severely. Finally, Van der Vaart and Van Donk (2004) identify shared resources as an important barrier to the integration of planning.

To the best of our knowledge, the antecedents of integration in hospitals have not yet been addressed. However, there is some related work on integrative approaches in healthcare. A high-patient volume (Pearson *et al.*, 1995; Nevers, 2002; Hyer *et al.*, 2009) is one of the main prerequisites for service line management and clinical pathways to be viable. Physician involvement (Pearson *et al.*, 1995; Currie and Harvey, 2000; Nevers, 2002) is an important enabler for most integrative approaches, whereas physician autonomy is seen as a significant inhibitor (Pearson *et al.*, 1995; Vos *et al.*, 2009).

Four categories of antecedents can be identified: distinguishing between general (organizational and behavioral) and operational antecedents, and between antecedents specifically mentioned in a manufacturing or a healthcare context. Based upon the section above, it becomes apparent that little attention has so far been given to operational antecedents in hospitals. As a patient's care process is the main link between hospital departments, a lack of understanding about the antecedents that stem directly from this care process could explain why integrated planning functions are not yet realized in hospitals.

Connecting operational antecedents to the stages of integration

The literature provides some guidance when it comes to operational antecedents of integration. Although antecedents, as well as integration stages, have not been explicitly researched in a healthcare context, theorizing from the above we constructed an initial conceptual model (see Figure 1) as the starting point for our empirical exploration. We briefly elaborate upon the relations in Figure 1.

Integration requires incorporating and communicating the performance requirements of other links in the chain (Stank *et al.*, 2001). However, in most hospitals, performance management is fragmented with individual departments focussing on their own targets. Often, the main objective of a hospital department is optimal capacity utilization (Visser and Beech, 2005). As such, it seems that current hospital performance management largely discourages the final two integration stages as these both require departments to relinquish responsibility for their own capacity utilization.

Shared resources form a barrier to both the commitment and coordination stage and the integrated planning stage. In the transparency stage of integration, internal rules for efficient use of resources can be employed. This is not the case in the subsequent stages, where external parties might determine the allocation of capacity to a large extent (Van der Vaart and Van Donk, 2004).

Figure 1.
Operational
antecedents of the
integration of
planning in hospitals
based on literature

Volume is widely seen as a prerequisite for effective integration. Especially for “focused factories” in healthcare (independent medical centers with a confined range of service offerings), a sufficient volume is required to enable efficient processes (Hyer *et al.*, 2009). Similarly, it is only possible to create critical pathways for high-volume, low-variety patient groups, such as patients needing a total hip replacement. Having high-volume patient groups which are predictable in their routing (i.e. highly standardized treatment) simplifies capacity allocation as there are always patients to fill the capacity, and it is easy to predict the next step in their routing. As such, volume and associated standardization would seem to enable the last two stages, whereas low-volume and high-variety patient groups will make it hard to achieve these stages.

The uncertainty surrounding many patient groups requires flawless information integration to enable efficient and timely decision-making (Shih *et al.*, 2009). Van Merode *et al.* (2004) state that “integrated hospitals need a central planning system to plan patients’ processes and the required capacity.” Most contemporary hospital information systems do allow information exchange and capacity allocation (Haas and Kuhn, 2012), and therefore, it appears that hospitals have the information technology needed to enable all three stages of integration. However, using such technology proves to be challenging for many hospitals amongst others due to a lack of trust in IT (e.g. data quality) or the impact of IT on medical practice (Lluch, 2011).

Pagell (2004) reasons that layouts that allow different managers to communicate informally increases integration, which suggest layout to be an enabler of the transparency stage. However, hospitals generally use a highly functional layout (Butler *et al.*, 1992), thus allowing little informal information sharing. The literature provides little insight into how a hospital’s layout might influence the two other integration stages.

Methodology

As previously argued, how integration can be achieved and what operational antecedents help or hinder the integration of planning functions in hospitals, is under-researched. As we want to expand our understanding of integration by focussing on operational antecedents which have little foundation in the healthcare literature, we believe that a theory building case study approach is appropriate. Given the above research question using quantitative data are hard to justify, while relying on qualitative data to seek insight into complex social processes in a complex context fits our aim (Eisenhardt and Graebner, 2007; Stuart *et al.*, 2002). The chosen multi-case study approach tends to produce more compelling evidence than single cases (Yin, 2003) and increases the external validity of the research (Voss *et al.*, 2002).

Case selection

This study is conducted within three general hospitals (offering a full range of healthcare specialties) in the Netherlands. In terms of case classification (Miles and Huberman 1994) we selected an extreme case and two typical cases in order to ensure theoretical replication (comparing the extreme case with the two typical cases) and literal replication (comparing between the two typical cases) (Yin, 2003). Hospital 1 can be seen as a best-in-class case, as it has ranked as one of the top hospitals in the Netherlands, Hospitals 2 and 3 are regarded as hospitals not in the top nor at the bottom of this ranking. All three hospitals are viewed as performing well both financially and in terms of care quality, as can be derived from publicly available sources. We deliberately excluded university hospitals from our sample as they often function as teaching hospitals and daily practices could be distorted to accommodate teaching obligations.

The unit of analysis in this study is the orthopedics supply chain in which we focus on patient flows within elective care processes. More specifically, we focus on total hip replacements, total knee replacements, and meniscus lesions. These patient groups show highly similar care processes as can be seen in Figure 2. We selected our unit of analysis on theoretical criteria (Eisenhardt, 1989; Yin, 2003), expecting internal supply chains with a relatively high-patient volume and both relatively low variety and uncertainty would be most likely to have adopted integrative practices. Further, waiting times for orthopedic elective surgery are lowest in the Netherlands compared to other European countries (OECD/European Union, 2014). Thus, the orthopedics supply chain was selected based on its relatively stable nature, relatively high-patient volume, and relatively high performance. Each of the orthopedic supply chains studied consists of four key departments that all execute activities linked to the patient's care process. These departments are orthopedics, radiology, anesthesiology, and the operating room (OR).

Data sources

Our study is built on four data sources: structured interviews with subjects from each department in the orthopedic supply chain, archival data such as annual reports, quantitative data from the hospital information system, and observational data. Data were collected between July 2010 and December 2010, with several visits to each of the hospitals. By triangulating multiple data sources, a stronger foundation is created for the findings (Eisenhardt, 1989; Yin, 2003). Each of the data sources is now discussed briefly.

The intention of the interviews was to understand the role of each of the subjects in the internal supply chain and to document their perspectives on factors that helped to achieve the current level of integration, or hindered further integration of planning functions. All interviews followed an interview protocol consisting of 29 questions (see the Appendix) concerning integration in general, the cross-departmental relationships, information flows, patient planning, and performance measurement. The protocol was adapted from existing questionnaires and constructs concerning internal integration (Lawrence and Hottenstein, 1995; Ahmad and Schroeder, 2001; Pagell, 2004; Prahinski and Benton, 2004; Benton and Maloni, 2005) to fit the healthcare setting. In total, 41 subjects were interviewed. These subjects were selected by each hospital's key informant based on the subject's knowledge on and involvement in the planning and execution of the care process. As the answers of the subjects converged, the researchers felt confident that data saturation was reached. All interviews were audio recorded and had an average duration of one hour. In order to ensure a multifaceted view on integration we interviewed at least one person from each department responsible for planning (i.e. planner or secretary), daily management (i.e. manager or head nurse), and executing patient-related activities (i.e. physician, technician, or nurse). Several subjects had multiple responsibility areas. We used the contents of annual reports, planning sheets, and performance agreements to

Figure 2.
Orthopedic supply
chain and the steps
in elective care
processes

corroborate the data gathered from our interviews. During the hospital visits, interactions and communications among different functional departments were observed and used to contextualize and understand the planning and execution of the care processes.

Data analysis

Both within-case and cross-case analyses of the data were employed. The within-case analysis was used to establish the degree of integration present at each hospital by classifying the observed integrative practices in terms of the three consecutive integration stages. Interview questions 3, 4, 5, 18, and 20 provided information enabling this classification.

We constructed visual maps to gain a clear overview of the degree of integration per hospital. We started mapping patient flows based on quantitative case-mix data. These flow-maps were discussed with the corresponding hospital and adapted if necessary. Then, the maps were complemented with all identified integrative practices to illustrate which processes were connected through one or more integrative stages. The results were reviewed in a round of presentations and adaptations.

In the cross-case analysis, the insights from the within-case analysis were extended by determining which operational antecedents lead to a specific stage of integration, and which hinder further integration. Here, we mainly relied on answers to interview questions 6, 7, 8, 9, 19, and 21. A common way of exploratory data reduction is the use of an explanatory effects matrix (EEM) as it helps to trace back emerging trends of causality (Miles and Huberman, 1994). All recorded interviews were transcribed into such an EEM. This allowed us to create an overview of which antecedents were deemed important and whenever possible, to relate these antecedents to stages of integration. Through EEM we identified eight frequently mentioned antecedents and their roles: three of the antecedents were classified as non-operational (physician autonomy, culture, and communication). The other five antecedents will be discussed in the cross-case analysis.

Integrative practices: a within-case analysis

First, we briefly describe each case and assess the degree of integration by classifying the observed integrative practices based on the stages defined by Van der Vaart and Van Donk (2004).

Case Hospital 1

Hospital 1 is a relatively small hospital with a catchment area containing approximately 110,000 potential patients. The four orthopedic surgeons treat approximately 7,200 (surgical and non-invasive) patients annually.

In this hospital's orthopedic supply chain, we found seven integrative practices: three forms of transparency; two forms of commitment and coordination; and two manifestations of integrated planning. Integration in Hospital 1 is mainly dyadic (see Table I), while a planning function that monitors the complete internal supply chain is absent.

Case Hospital 2

Hospital 2 is a medium-sized hospital providing care to a large regional area. The hospital has 31 responsibility centers that are mainly based on specialization. Six orthopedic surgeons work within the orthopedics department and treat approximately 8,500 (surgical and non-invasive) patients annually.

Table I.
Degree of integration

Integrative practice	Type	Stage	Informant's quote	Informant (department)
<i>Hospital 1</i> Planned MRI date is shared with orthopedics so the appointment to discuss the results can be planned near to the planned MRI date Pre-assessment waiting list time is shared with orthopedics The leading role of the OR master plan is communicated throughout the supply chain	Sharing of information	Transparency	We send the letter with the planned MRI data to orthopedics and they add an appointment to discuss the results to this letter	Technician (radiology)
	Sharing of information	Transparency	Officially we do not plan a patient for the OR without pre-assessment; however this often takes too long, therefore we do. In doing so we take the waiting list of the pre-assessment into account	Planner (orthopedics)
	Sharing of information	Transparency	It's designed in such a way that everyone is "forced" to make it happen, everyone has to participate, it's a team effort	Planner (OR planning)
			The OR is situated in the center of the network [...] this is the spot where the money is made [...] that's why we communicate the OR is leading The pre-assessment template is completely based on the OR master plan	Manager (OR planning) Planner (anesthesiology)
Orthopedics schedules pre-assessment appointment	Cross-departmental scheduling	Commitment and coordination	By sequencing the different orthopedic patients in a specific way for the pre-assessment, the case-mix ready for OR can be influenced	Logistics (manager)
Orthopedics schedules OR	Cross-departmental scheduling	Commitment and coordination	The OR releases the template for a specific month and orthopedics can fill this template with patients	Planner (orthopedics)
Orthopedic and anesthesiologic part of the pre-assessment are combined	Combining appointments	Integrative planning	We've combined the Orthopedic and Anesthesiologic part of the pre-assessment so that patients have to visit the hospital only once for two appointments	Nurse practitioner (orthopedics)
Patients can walk in the X-ray just before their appointment with orthopedics	Combining appointments	Integrative planning	We tell the patients to visit X-ray 30 minutes before their appointment with Orthopedics	Secretary (orthopedics)
				(continued)

Integrative practice	Type	Stage	Informant's quote	Informant (department)
<i>Hospital 2</i>				
Orthopedics shares main planning information with dependent departments	Sharing information	Transparency	I share important planning information with the other department; however, I very much doubt if anyone is using this information and I get no information in return	Planner (orthopedics)
Orthopedics schedules X-ray appointments just before a patient's appointment with orthopedics	Cross-departmental scheduling	Commitment and coordination	We can schedule all our required x-rays ourselves [...] if we couldn't plan ourselves, it would be much more difficult for us, we would be too much dependent on the schedule of Radiology [...] This saves time and the patients like it	Secretary (orthopedics)
For a small distinct group a 3 week lead-time guarantee is provided	Combined appointments	Integrative Planning	We've got some preferred care paths in which we made a performance commitment to an insurance company. In this path several appointments are combined and the patient has to be operated within three weeks	Surgeon (orthopedics)
<i>Hospital 3</i>				
MRI waiting list information is shared so orthopedics can anticipate on this in planning the appointment to discuss the results	Sharing information	Transparency	We request an MRI and simultaneously we schedule an appointment for discussing the results. This appointment is scheduled 3 to 4 weeks from now, depending on the waiting list for the MRI	Planner (orthopedics)
Pre-assessment planned date is shared with orthopedics	Sharing information	Transparency	We find out when the patient is scheduled for pre-assessment and we schedule an OR appointment at the first open slot after the pre-assessment	Planner (orthopedics)
Orthopedics schedules OR	Cross-departmental scheduling	Commitment and coordination	Orthopedics schedules the OR itself	Planner (pre-assessment)
Orthopedics schedules pre-assessment appointment	Combining appointments	Integrative planning	OR provides a template every six weeks for the OR to schedule in	Manager (OR planning)
Orthopedic and anesthesiologic part of the pre-assessment are combined	Combining appointments	Integrative planning	Orthopedics schedules the pre-assessment itself [...] we've reserved slots for Orthopedics To accommodate patients we let them come only once to the hospital [...] it used to be up to six times	Planner (pre-assessment) Nurse (orthopedics)

Table I.

Three integrative practices were found in Hospital 2, each representing a different stage of integration (see Table I). Two of the three integrative practices span more than two departments. Information sharing in Hospital 2 is mostly unidirectional: orthopedics provides information, but doubts if others use it and they receive little information in return. Cross-departmental planning was found in one instance where appointments were combined throughout the care process for a specific group of meniscus patients.

Case Hospital 3

Hospital 3 is the largest of the three hospitals. Care in Hospital 3 is organized in 12 centers. Each center focusses on a specific category of patient. The centers are chaired by a center manager and a mandated specialist. A center combines both the inpatient and the outpatient clinics. Six orthopedic surgeons treat annually approximately 9,600 (surgical and non-invasive) patients.

All five observed integrative practices in Hospital 3 were dyadic (see Table I); two information sharing practices, one cross-departmental planning, and two combining appointments.

We found evidence of integrative practices relating to all three stages of integration. The transparency stage is apparent in the sharing of planning information between departments and the sharing of waiting list information between departments. The commitment and coordination stage is visible through cross-departmental scheduling while the integrative planning stage manifests itself in combined appointments. The antecedents of integration will be discussed next.

Antecedents of integration: a cross-case analysis

Five critical antecedents were identified: performance management, information technology, process visibility, uncertainty/variability, and shared resources. Each antecedent and its impact on integration are justified by multiple subject quotes (the subject's function is given with the case number and subject letter in brackets).

Performance management

The results show that departments are responsible for their own performance and mainly ignore the performance of other departments, or of the hospital as a whole. Terms as "internally focused" and "silo-mentality" used by our subjects reflect how such a compartmentalized approach to performance management hinders integration:

Hospital Manager (1E): The hospital is divided in pillars, and each pillar is responsible for its own results. Departments should focus on total performance rather than local.

Manager Orthopedics (2D): I've noticed that we're internally focused.

Team Manager Radiology (3J): You try to run your own department as efficiently as possible and finding the link with other departments has never been stimulated.

A symptom of the compartmentalized approach is the absence of measures for lead times. None of the hospitals monitored the lead times along an entire care process. Subjects in both Hospitals 1 and 2 acknowledged that performance management lacks common goals, feedback loops, and proper measures concerning patient lead-time performance:

Manager OR (1K): There's no intentional control of lead times.

Manager Anesthesiology (3N): I don't receive feedback in the form of lead-time-related performance information.

Manager Orthopedics (2D): We do have a norm (for lead times), but we lack proper measurement or measures.

Compartmentalized performance management is rooted in a culture which is patient focussed, rather than process focussed, resulting in departments focussing mainly on their own part of the patient's care process:

Staff Officer (3K): The caregiver is very focused on that one patient. The greater good is thus ignored.

Team Manager (2G): People in healthcare focus on a patient in specific, rather than the patient in general.

In all three hospitals, an orchestrator that monitors and manages a patient's progress throughout the care process was suggested to stimulate integrated performance management. Our subjects suggest orthopedics, as the gateway specialty, as a likely suitable candidate for such an orchestrating role:

Planner Orthopedics (2B): If orthopedics could plan its own patients for the other departments, we could have much more patient-friendly planning.

Anesthesiologist (1I): What we miss is a coordinator for the entire perioperative process.

Manager Anesthesiology (3N): As long as no one is responsible for care paths, their performance will not be monitored.

The data reveal that implementing integrative practices drives improvements in patient waiting time or help to comply with the lead-time requirements imposed by insurers or the government:

Nurse Practitioner (1A): We've combined the orthopedic and anesthesiology parts of the pre-assessment so that patients only have to visit the hospital once for two appointments.

Orthopedic Surgeon (2A): We've some preferred care paths where we have made a performance commitment to an insurance company. In this path, several appointments are combined and the patient has to be in surgery within three weeks.

Nurse (3L): Patients only visit the hospital once [...] it used to be up to six times.

Information technology

Most integrative practices and all three integration stages seem to be facilitated by the hospital information system. It helps in accessing planning information and waiting list information from other departments, it provides access to the planning templates of other departments, and it helps in scheduling combined appointments with as little time as possible between the appointments:

Hospital Manager (1E): The information system is a facilitating factor in the cooperation between the different departments.

Manager Radiology (2F): The information system helps to plan time slots for patients in multiple departments.

Planner Pre-assessment (3M): In the event of combined appointments, the system shows us all the scheduled appointments.

Hospital 3 perceived information technology as a limitation for integration because their outdated planning system allows little digital interaction between departments in

several stages of the internal supply chain. Moreover, even though orthopedics in Hospital 3 can access the planning of radiology, the complex coding of procedures and the non-graphical interface make integrative efforts difficult:

Orthopedic Surgeon (3A): We don't have an automated waiting list, most lists are generated manually.

Technologist (3E): We've got a very rigid planning system; a new system should create much greater transparency.

Team Manager Radiology (3J): Others cannot plan within our system due to the complex coding of requests in our system.

Our data suggest that the role of the hospital information system is critical for integrative practices: outdated systems hinder while modern ones facilitate effective integration in each stage and help to shift from isolated silos to integrated processes.

Process visibility

Work in hospitals is often functionally divided and spatially separated. Moreover, most process steps in hospitals inherently take place behind closed doors. Therefore, contrary to many manufacturing processes, there is no visible flow of patients, and the actual process is difficult to deduce from all the separate process steps. Our data reveal that process visibility is very low in all three hospitals. Typically, the subjects lack knowledge of the overall process and the contributions each department makes to this overall process:

Technologist (1F): There is a lack of understanding, not everyone is aware of the procedures of others'.

Unit Manager Pre-assessment (2I): Each (actor) contributes to their part (of the process) and is unfamiliar with the contributions of others.

Unit Manager Orthopedics (3I): Currently, the process is unclear for most of the people involved.

Such lack of process visibility is recognized as problematic. In all three hospitals, informants stated a desire to increase process visibility. Increased process visibility is said to result in a better understanding of patient flow and thus a better understanding of which information to share:

Planner OR (1L): It would be nice to discuss with other departments why things work the way they do in our department.

Orthopedic Surgeon (2A): We should all explain our processes and elaborate on why they work the way they do.

Planner Pre-assessment (3M): I think it is of major importance that we know what's going on in other departments.

Low-process visibility is accompanied by limited knowledge regarding the consequences of decisions for other departments. Lack of awareness, rather than unwillingness to share relevant planning information, seems a barrier to achieving the transparency stage of integration. One simply does not know which information is relevant to share and/or available to receive:

Manager Radiology (1H): I would like to sit down with everyone to discuss the patients' routings and to identify bottlenecks in the process.

Planner OR (2K): One has very little knowledge and insight into the inner workings of other departments, especially concerning the criteria they use in their planning.

The above shows that low-process visibility is a severe barrier to internal integration, as it limits the possibility to take other departments' processes into account, including sources of delay and/or sources of variability that stem from other departments.

Uncertainty/variability

Uncertainty found in the case hospitals mainly relates to the routing of patients being dependent on the outcome of previous process steps. Specifically, the diagnosis determines the course of the care process. Consequently, process steps up until the diagnosis are decoupled from the remaining steps. Informants stated that such uncertainty is a barrier to cross-departmental planning and especially to combining appointments:

Secretary Radiology (1C): At the beginning of a care process, we cannot by default plan a pre-assessment for every patient as we do not know whether they're going to need one.

Manager Orthopedics (2D): Uncertainty is a barrier to integration; the way a care path continues depends completely on the diagnosis part of the care process.

Anesthesiologist (2H): The course of a care process is not very predictable.

Similarly, demand variability (either internally or externally) is a barrier to both cross-departmental planning and combined appointments:

Manager OR (1K): You cannot control your input. One day, four patients need surgery, the next day fourteen. It's impossible to design a one-stop shop for this.

Technologist (3F): One day, ten out of thirty patients require an x-ray, the next day every patient.

Although routing uncertainty and demand variability are relatively low in the orthopedics department, our data still suggest that they both form barriers to adopting the final two integration stages as it is very difficult to commit capacity. There is no evidence that these aspects form a barrier to achieving the transparency stage.

Shared resources

The orthopedics supply chain shares several resources (including diagnostic equipment in the radiology department, the anesthesiologists, and the OR) with other supply chains or other groups of patients. For departments requesting shared resources, a set amount of allocated capacity would enable them to integrate planning. However, for the supplying department, capacity allocation decisions can become more complex, especially when high-resource utilization is required:

Manager Radiology (2F): One has to consider which paths cross in our (radiology) planning. Allowing dedicated time slots in the MRI planning for specific specialties would create very rigid planning.

Manager Orthopedics (3L): Shared resources often form a bottleneck. X-ray, for example, crosses each silo. With those kinds of departments, we have to make different agreements than we do with the silos.

Secretary Radiology (3G): With too many well-defined care paths, we (Radiology) would be put on the spot. We would have to adapt to all those paths' requirements, which will be a difficult planning puzzle.

Hospital 2 has experience of using the “focussed factory” concept for specific types of orthopedic procedure. Focussed factories do not share resources:

Orthopedic Surgeon (2A): Preferably, one wants to work with dedicated personnel but we have to share facilitating departments with many others. A focused factory might be the solution.

Manager Orthopedics (2D): A dedicated pre-assessment for orthopedics is preferable. [...] We have a separate clinic in which we only work with dedicated resources, this makes planning a lot more efficient.

The supplying department, responsible for a shared resource, is predominantly held accountable for resource utilization. The requesting department desires quick access, which might well conflict with the objective of the supplying department. Therefore, shared resources, especially in an environment which emphasizes local performance as often is the case in elective surgery, hinder integrative practices which involve relinquishing control over capacity (and thus control over performance) to other departments. As a consequence, shared resources hinder both the commitment and coordination stage and the integrative planning stage.

Discussion

Overall, our findings are consistent with the relationships found in the literature. However, we also came across some notable deviations. New antecedents of integration were detected, in contrast with some antecedents from our initial model which did not appear to play a role. Further, we found a three-way split in the roles of operational antecedents, an aspect that is not clearly distinguished in the literature. We illustrate each category in this split. Based on our empirical investigation the original model is adapted (see Figure 3).

First, in contrast to earlier studies the volume construct does not seem to be an antecedent for integration. This can be understood by the focus of those studies on creating a separate service line for a specific group of patients. Then, volume is a prerequisite for the viability of physically separating resources, but apparently not for planning integration.

Second, standardization is excluded from the revised model. We chose to include the cause (uncertainty/variability) in our model, rather than a specific solution

Figure 3.
Revised model

(standardization), as there are many strategies to cope with uncertainty/variability (Jack and Powers, 2004). Our data firmly support the inclusion of uncertainty/variability to the model.

The final construct excluded from the model is layout. None of the subjects mentioned it as relevant. However, the often mentioned lack of process visibility might result from the current layout.

Process visibility is included as a new antecedent in our model, as it plays a major role in the integration of planning in hospitals. Our study shows that low-process visibility results in staff being unaware of planning information relevant for other process steps or planning information available in other departments. In line with Buchanan (1998) it appears to be uncommon for hospital staff to communicate relevant information to staff involved in preceding or subsequent process steps. Reversely, Barratt and Oke (2007) suggest that information sharing leads to visibility. With both being true a vicious cycle can emerge where not sharing information reinforces low visibility, resulting in even lower sharing information. Process mapping will be a first step in breaking this vicious cycle. It would provide insight into the relationships between the different functions involved. We argue that understanding at least the basic processes of adjacent departments in the care process would help staff to appreciate the information required for planning the flow of patients between departments.

Operational antecedents: a three-way split

Our empirical findings suggest a clear three-way split in the role of operational antecedents. Distinguishing such roles and logically classifying them is an addition to literature.

First, we distinguish initiating antecedents, which should be encouraged in practice. Process visibility is a clear initiating factor for integration. Understanding the total care process and the separate steps involved is a prerequisite for knowing how to integrate. Another initiating antecedent is integral performance management. A shift from local performance management to integral performance management provides opportunities and incentives for integration. This is in line with the manufacturing literature (Stank *et al.*, 2001) and with the findings of Elg *et al.* (2013). Clinical pathways prove useful in integrating several disciplines in a common process (Vanhaecht *et al.*, 2012). However, the literature is still lacking clear performance measures and auditing tools for such pathways (Vanhaecht *et al.*, 2006). The integrative practices we found did stem from an emphasis on overall lead-time performance. Although overall lead-time performance management is promoted by the literature, most hospitals still employ departmental performance management, hindering all stages of integration. These findings reflect the traditional emphasis in hospitals on resource utilization (Vissers and Beech, 2005). Although some studies take other performance measures into consideration, such as length of stay (e.g. McDermott and Stock, 2007; Devaraj *et al.*, 2013) and waiting times (e.g. Siciliani and Hurst, 2005; White *et al.*, 2011), it seems that both in academia and in practice few measures exist that can monitor a care process from first contact to discharge.

Second, uncertainty/variability and shared resources clearly inhibit integration. Often these antecedents are widely present in healthcare processes and need to be addressed in order to achieve integration. As discussed earlier uncertainty/variability is known to hinder integration. At the same time high levels of uncertainty/variability requires actors to integrate in order to improve performance (Germain *et al.*, 2008; Giménez *et al.*, 2012). Böhme *et al.* (2014) recognize that most of the uncertainty/

variability in hospitals are internally induced, rather than by fluctuating patient demand. Thus part of the barrier to integration can be solved by analyzing and acting on both internal and external demand patterns. Parnaby and Towill (2008) suggest that all personnel in the care process are actively involved in such analyses in order to redesign and implement improvements to “their” process. This will both reduce uncertainty and increase visibility.

Shared resources were found to be a major barrier to cross-departmental planning and combining appointments as well. In practice, dedicated time slots are used to allocate shared resource capacity (e.g. Green *et al.*, 2006; Day *et al.*, 2010) in an attempt to balance resource utilization with the required service level. From a resource utilization perspective, the reluctance of departments to allocate capacity to a specific user is understandable and even more if due to uncertainty/variability the user is unable to anticipate required capacity accurately. The emphasis on resource utilization in hospitals creates a conflict between the supplier of shared resource capacity meeting their performance requirements and the requesting departments’ need for quick access to the shared resource.

Finally, we distinguish a third category of antecedents that facilitate integration. Since most integrative practices are dependent on IT but not triggered by it, IT seems better viewed as facilitating rather than as initiating or inhibiting. The use of IT in hospitals does result in better coordination of patient flows (Devaraj *et al.*, 2013), and an increased emphasis on IT is critical to improving process integration (Narayanan *et al.*, 2011). However, simply automating existing processes is unlikely to make IT beneficial (Devaraj *et al.*, 2013). Van Merode *et al.* (2004) emphasize the importance of an information system to integrated hospitals, and our data show that the functionalities generally available in a hospital information system are crucial for facilitating and executing integrative practices in all stages. Pagell (2004) suggests that IT alone does not advance integration in industry and our data suggest that this holds for hospitals as well.

Conclusions

This study explored operational antecedents of integrating planning functions in hospitals. Three theoretical contributions stemmed from our analysis.

We approach planning of hospital operations from a multistage perspective that allows for different contents of integration rather than the span or amount of integration. Building on the ideas of Pagell (2004), Van der Vaart and Van Donk (2004), Barki and Pinsonneault (2005) and Braunscheidel *et al.* (2010), we use supply chain integration as theoretical lens and show that existing knowledge on integration can be beneficial in a healthcare context. In addition, this study adds two operational antecedents (process visibility and uncertainty/variability) uncovered within a healthcare context.

This study offers a more detailed perspective on integration and its antecedents in hospitals in two ways. It distinguishes between different roles: initiating, inhibiting, and facilitating. Additionally, antecedents turn out to be influential on specific stages of integration, rather than on integration as a whole. As a result, this study offers a novel and more comprehensive perspective on integration of planning in hospitals.

Unlike in earlier contributions, operational rather than organizational antecedents were explored. We demonstrated that antecedents stemming from the primary process can offer an explanation why hospitals lag behind other organizations in integrating their planning functions. Naturally, organizational and behavioral antecedents, such as

top management commitment, organizational culture, and communications, remain of importance. Nevertheless, the five antecedents found in this study have to be considered as essential additions to these more general antecedents.

The management contribution of this paper lies in addressing the issue of how integration can be achieved, rather than just prescribing integration as a means to improve performance. Antecedents discussed in this study could help explain the success or potential failure of process-based approaches such as focussed factories and service lines (e.g. Pearson *et al.*, 1995; Hyer *et al.*, 2009; Vos *et al.*, 2009). In line with Parnaby and Towill (2008) hospital administrators can use the outcomes of this study to improve process visibility and integral performance management. Hospital planners can benefit from the results of this study by adopting a process focus, rather than a patient focus by balancing individual patient or provider needs with an overall picture. Our results show caregivers that the impact of their decisions go far beyond the care step they are directly involved in. By providing process visibility and clear lead time objectives, internally induced variability can be reduced much more effectively, thus improving patient flow performance (Drupsteen *et al.*, 2013). Finally, our detailed model can be an aid for discussion in hospitals what is needed in a specific process and what antecedents need to be addressed to reach that result. For patients, we submit that waiting can most likely be reduced.

This study has several limitations. We deliberately chose to investigate an internal supply chain with a lower care complexity. However, patients' age and the demand for complex (e.g. multi-morbidity, higher risk on complications, higher urgency) care increase. That raises questions if the original theoretically informed antecedents would have a similar impact; whether the effect of current antecedents would remain similar; and whether new antecedents would emerge, in more complex care processes. Extending this study to more complex care processes (e.g. oncology) could offer novel insights into the role of antecedents in achieving integration of planning.

As the healthcare sector progresses into becoming a free market, more and more independent medical centers emerge, focussing on a limited set of activities. Given the increasingly complex needs of patients and the decentralization of elective care, future research needs to focus on the integration within healthcare supply networks. Lillrank *et al.* (2011) offer a solid starting point in this field. However, much of the complexities and how to manage them are still unknown.

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Appendix. Interview protocol

- (1) Could you summarize the responsibilities of your function?
- (2) Could you explain what the concept of cooperation means to you?
- (3) Could you describe the degree of cooperation between your department and the three other departments (orthopedics, radiology, anesthesiology, and OR)? Please use terms such as good/bad/not existent, etc.
- (4) Could you describe the content of any cooperation between your department and the three other departments?
- (5) Can you give any more examples of cooperation between the four departments?
- (6) Which items would you consider when trying to investigate cooperation between hospital departments?
- (7) What actions do you think could be undertaken to increase cooperation between the four departments?
- (8) Is the current form of cooperation geared toward solving problems or geared toward preventing problems?
- (9) What mechanisms/programs/initiatives are undertaken by the hospital to promote cooperation among departments?
- (10) Which factors hinder cooperation between the four departments?
- (11) How do your decisions influence other departments?
- (12) How do decisions made by other departments influence your work?
- (13) Are you aware of any cross-functional teams/meetings involving the four departments that are:
 - Focussed on the medical aspect of care?
 - Focussed on the logistics aspect of care?
- (14) Could you give a few examples of the issues dealt with in these teams/meetings?
- (15) If you have a formal meeting with someone from another department, what is that person's function?

- (16) What information is exchanged between departments?
 - What information do you require from other departments?
 - What information do other departments require from you?
- (17) How does the current information system influence the exchange of information between departments?
- (18) Is the care process of a patient seen as a collection of individually managed steps, or as an integrated process?
- (19) How does this show?
- (20) Could you explain the patient planning for the process steps in which you are involved?
- (21) Could you explain the extent to which the complete care process of a patient is controlled?
- (22) When do you intervene in a care process (e.g. when a patient is active in the system for far too long)?
- (23) Could you explain the performance goals set for your function?
- (24) How do medical goals relate to organizational goals?
- (25) Could you explain the performance goals set for your department?
- (26) Could you indicate how much of your time is spent on extra-departmental activities?
- (27) What is your opinion of the performance of your department?
- (28) How does your department perform in terms of the performance goals set by the hospital?
- (29) What is your opinion of the performance of the other three departments?

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