Demand and Supply–Based Operating Modes—A Framework for Analyzing Health Care Service Production

PAUL LILLRANK, P. JOHAN GROOP,
and TOMI J. MALMSTRÖM

Aalto University

Context: The structure of organizations that provide services should reflect the possibilities of and constraints on production that arise from the market segments they serve. Organizational segmentation in health care is based on urgency and severity as well as disease type, bodily function, principal method, or population subgroup. The result is conflicting priorities, goals, and performance metrics. A managerial perspective is needed to identify activities with similar requirements for integration, coordination, and control.

Methods: The arguments in this article apply new reasoning to the previous literature.

Findings: The method used in this article to classify health care provision distinguishes different types of health problems that share generic constraints of production.

Conclusions: The analysis leads to seven different demand-supply combinations, each with its own operational logic. These are labeled demand and supply–based operating modes (DSO modes), and constitute the managerial building blocks of health care organizations. The modes are Prevention, Emergency, One visit, Project, Elective, Cure, and Care. As analytical categories the DSO modes can be used to understand current problems. Several operating modes in one unit create managerial problems of conflicting priorities, goals, and performance metrics. The DSO modes are constructed as managerially homogeneous categories or care platforms responding to general types of demand, and supply constraints. The DSO modes bring methods of industrial management to bear on efforts to improve health care.

Address correspondence to: Paul Lillrank, Otaniementie 17, P.O. Box 15500, 00076 Aalto, Finland (email: paul.lillrank@tkk.fi).

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MUCH HEALTH POLICY DEBATE HAS FOCUSED ON MACROLEVEL issues such as economic access, regulation, and reimbursement, although no national macrosystems satisfy all constituencies (Reid 2009). With advances in medical knowledge, more becomes possible and more is wanted, but with greater specialization and volume, all systems have difficulty organizing and managing the production of health services (Battistella 2010; Bohmer 2009). Organizations need to treat every patient as an individual with “whole person needs” (Berry and Benapudi 2007), while also using methods of mass production to provide equal service with limited resources.

The production of health services faces the operations management (OM) dilemmas of integration, coordination, and control (Lawrence and Lorsch 1967). Knowledge management (Nonaka 1994) is needed to integrate diverse medical knowledge into coherent diagnoses and treatment plans without losing the benefits of specialization. Different providers’ service elements must be coordinated in time and space into processes, workflows, and pathways while also adapting easily to changing circumstances (Schmenner and Swink 1998). Finally, goals must be set and performance must be measured, monitored, and controlled without encroaching on professionalism and motivation (Freidson 1984).

Health care clearly is too huge and too diversified to be treated as a single industry with one perspective on and one solution to operations management. Complexity theory (Miller and Page 2007) holds that if all the elements are viewed through a conceptual lens, apparent variety can reveal meaningful, even simple, patterns. Therefore, health care should be segmented or classified into parts that, in some important aspects, are homogeneous enough to be managed.

Traditionally, the lens of urgency revealed a pattern and an organizational solution. That is, urgent and severe needs were treated in emergency departments, separately from cases that could wait. The lens of clinical medicine, however, offers a view of different body functions (orthopedics, ophthalmology), affected by various diseases (infections, cancer), to be treated with a range of methods (invasive, conservative)

that call for specialized clinics. The demographic lens reveals groups, such as children, women, the elderly, and veterans, that may require hospital systems of their own. Accordingly, a managerial lens is needed to illuminate classes of integration, coordination, and control.

The purpose of this article is to explore the possibility of classifying health care into managerially homogenous operating modes (*modi operandi*). A system, organization, and professional can operate in different modes without necessarily changing their structures or resources. For example, when seeing a patient, a physician may conclude that he or she has several problems but one is urgent and requires immediate attention, whereas the others may be treated later; the physician may determine that the problem can be solved with one intervention that can be planned and scheduled at the patient's convenience; or the physician may observe that the current situation is connected to the patient's past medical history and should be considered in that context. That is, a versatile and well-equipped practitioner can easily shift among modes. However, with high case volumes and specialized resources, a better way of dealing with this might be to build organizations, processes, and methods that focus on a specific mode of operation.

Our article is organized as follows. First, we discuss the nature and need for managerial homogeneity. Second, we review the principles of demand segmentation as applied to health care and argue that segmentation needs to be based on both patients' demands and the constraints of supply. Third, we define five generic grouping factors based on demand, and supply constraints. Fourth, we derive seven demand and supply-based operating modes (DSO modes) and describe their managerial logic. Finally, we discuss how these operating modes help manage health care and suggest topics for future research.

Managerial Homogeneity

A basic premise of operations management is that tasks with similar integration, coordination, and control requirements should be performed in similarly focused organizations (Henderson and Clark 1990, Johnston and Clark 2004; Skinner 1974). A lack of focus or managerial homogeneity, such as producing both standard products and custom-engineered goods on the same production line (Hayes and Wheelwright 1979), or using the same resources for both acute and elective cases,

leads to problems with capacity utilization and waiting times (Joustra, van der Sluis, and van Dijk 2010). In manufacturing, the “make-to-stock,” “make-to-order,” and “assemble-to-order” operating modes are well established (New and Szwajczewski 1995), and for services, several classification schemes are used, such as applying variables like volume and level of customer involvement (Schmenner 1986), degree of variety and relative throughput time (Schmenner 2004), and different time-space dimensions (Towill and Christopher 2005). The assumption here is that activities that use similar combinations of resources, coordinate over similar time and location constraints, or control for similar goals are most efficiently managed under a supportive organizational architecture.

Recognizing the need for managerial homogeneity in health care, Glouberman and Mintzberg (2001) devised a model dividing health care into four worlds: cure (physicians), care (nurses), control (administrators), and community (boards). These four worlds are assumed to operate according to different logics and therefore to have communication problems requiring specific attention. Christensen, Grossman, and Hwang (2009) and Bohmer (2009) built on the idea of a fundamental dividing line between precision medicine and intuitive medicine. Whereas precision medicine allows an exact diagnosis and the application of predictable treatment schemes, intuitive medicine depends on clinical judgment in the face of uncertainty. Whereas sequential value-adding processes can be configured for precision medicine, intuitive medicine requires iterative processes and “solution shops.” Bohmer and Lawrence (2008) suggested identifying care platforms according to “families” of health conditions and interventions that may cross disease or body system boundaries in similar ways. Then a production system for each family could be designed to combine all the required elements into a single process.

These approaches begin at the supply side, although their classifications also take demand into account.

Classification Based on Demand

In contemporary marketing theory (Kotler and Keller 2006), the starting point is that different people have different needs that are explicated as wants, which, combined with purchasing power, constitute the effective demand. Thus the task of marketing is to segment demand into homogeneous categories according to some strategic logic (Kotler, Shalowitz,

and Stevens 2008). Once the segmentation has been performed, the production should be organized to deliver offerings to the chosen segments.

The case-mix methodology is one way of classifying health problem types and their treatment and associated costs. Diagnosis-related groups (DRGs) are the best-known classification system. Based on the World Health Organization's International Classification of Diseases (ICD), this system groups acute inpatient episodes into a number of service products on the basis of clinical condition and resource consumption, with the number of products in the various DRG versions ranging between 400 and 700. Consequently, DRG is more a billing system than a basis for organizational structure (Sanderson and Mountney 1997).

Beyond the case-mix and DRG approaches, the literature contains almost nothing on the segmentation of demand in health care (Calkins and Sviokla 2007), although public and private health care (Cakir 1998; Cakir and Sine 1997), insurance status (Dranove, White, and Wu 1993), and health risk status and wealth (Calkins and Sviokla 2007) have been used as dividing variables.

Garfield (2006) suggested that the organizational architecture follow a segmentation scheme that divides patients into the well, the worried well, the early sick, and the sick. The corresponding organizational units would be, respectively, a testing and referral center, a health care center, a preventive maintenance center, and a sick care center.

The "Bridges to Health" model developed by Lynn and colleagues (2007) comes closest to what can be called a segmentation of people's needs. This model divides the population into eight groups: people in good health, maternal/infant situations, acute illnesses, stable chronic conditions, serious but stable disability, failing health near death, advanced organ system failure, and long-term frailty. Each group has its own definitions of optimal health and priorities and quality targets for the corresponding services.

In the standard marketing models, needs come before wants, but in health care, this sequence is not obvious. Patients may not need what they want (one more examination) or not want what they need (a healthier lifestyle). Patients may expect what cannot be provided or ignore what is available. Patients are often reluctant, scared, and confused and have difficulty articulating their needs. Because the resulting information asymmetry between the patient and the provider distorts demand (Neuman and Neuman 2007; Robinson and Thomson 2001), demand alone is not a complete grouping factor.

Supply Constraints

Health service providers cannot answer each and every need and want, even under the best of circumstances. Supply is constrained by three factors.

First, for technical reasons, clinical medicine cannot always produce the outcomes that patients expect. Diagnoses cannot always be made accurately, and some medical conditions have no known cure and may lead to chronic or terminal conditions.

Second, in some instances the cure is not an intervention performed by medical staff but a lifestyle change for which the patient is responsible. This is a continuum where at one end is intervention-centric medicine, in which the service provider does the job and the patient's only responsibility is to be present. At the other end are behavioral changes, which the service provider can only help the patient make. So-called patient-introduced variability (Frei 2006), such as the capability and motivation to comply with treatment regimes, is a factor that constrains supply.

Third, in insurance-financed health care systems patients' purchasing power is supplied by a third party and regulated by gatekeepers, whether they are public or private insurers making coverage decisions or public authorities issuing guidelines for clinical decisions. The supply is constrained by the general availability of resources. A specific economic constraint is the availability of service at the point of need. Because services cannot be produced for inventory, capacity must be managed according to fluctuations in demand (Ronen, Pliskin, and Pass 2006). On the local level, demand can be highly variable in regard to case mix, severity, urgency, and arrival time, and because of a lack of resources, some demands may not be fulfilled.

Generic Classifying Variables

In an ideal situation, all the resources and capabilities needed to treat a case successfully would be available at one location for an uninterrupted workflow. All care could be managed as if it were urgent and severe. But if this is not possible because of technical, behavioral, or economic constraints, treatment must be arranged as a process. A *process* consists of several service elements or steps, performed at different times

or locations or by different actors equipped with different resources. Processes are coordinated through handoffs, such as referrals or patients' records, while workflows are coordinated through direct communication among team members (Lillrank 2009). Because of the necessity of processes, urgency and severity must be supplemented with three generic variables describing demand-supply combinations.

First, diagnostic clarity forms a continuum where at one end are clear and obvious causes (a bicycle accident leading to a broken wrist) with an unproblematic cure (a cast). At the other end are unclear and complicated cases (abdominal pain) that may have several causes requiring the integration of knowledge gained from iterations of diagnostics and alternative interventions. As Christensen, Grossman, and Hwang (2009) and Bohmer (2009) pointed out, the distinction between precision medicine and intuitive medicine should lead to the separation of sequential processes from iterative processes.

Second, a case may have an expected end point at which the patient's health either is sufficiently restored or may become a chronic condition without a defined end. If there is an expected and desirable end point, processes can be managed as chains of tasks contributing to that end. If there is no end point, processes should maintain a health status or arrest a decline. From this follows the distinction between cure and care, and those processes intended to cure must be coordinated differently from those intended to provide ongoing care.

Third, while urgent and severe conditions usually are easily identified, a growing number of not urgent but potentially severe conditions can be identified by screening and subclinical diagnostics. From this follows the distinction between processes treating elevated risk through behavioral changes, and processes treating obvious illness through clinical interventions. The presence of a medical risk does not provide the same discomfort as an obvious disease. Patients are motivated differently, and the rules and roles of interactions between provider and patient are different.

Operating Modes in Health Care

We use the five classificatory variables—urgency, severity, clarity, continuity, and risk—to define the seven operating modes based on demand and supply. The term *operating mode* describes not an organization or a

FIGURE 1. Demand and Supply–Based Operating Mode Flowchart.

system but a set of integration, coordination, and control principles, and an organization or team can, if necessary, switch between modes. The operating mode thus is a theoretical construct describing an ideal type (Weber 1964) that cannot necessarily be observed in a pure form. It is not assumed that patients can easily self-select modes or that the application of a mode of operation should be obvious to a provider. Figure 1 depicts these modes with an algorithm.

The algorithm first asks, is there an apparent disease or wound, or is the case indicative of an elevated risk stemming from conditions such as a hereditary disposition or a lifestyle with possibly severe consequences? If the latter is true, the case is in the Preventive risk management mode. If there is an apparent current problem, go to the next question.

Is the condition urgent, requiring immediate treatment? If so, it is in the Emergency mode. If it is not urgent, go to the next question.

Can the medical condition be treated as one set of procedures with the resources currently available at one service provision point? If this is true, the case falls into the One visit mode. If the case requires resources that are not immediately available, or the condition cannot be reliably assessed, the case will require several steps using different resources at different times and locations. That is, it may turn into a process.

Can the case be structured into a process following known clinical workflows? If not, it may be a rare case that has no known precedents or patterns or that is extremely complex or costly and requires extensive

case-by-case integration, coordination, and control. If this is true, the case falls into the Project mode.

If the case exemplifies a process, that is, a sequence of steps that cannot be handled during one visit, can a precise diagnosis be made and a treatment regime planned and scheduled? If so, the case is in the Elective mode, meaning that the sequence and timing of each process step can be determined and thus planned and scheduled accordingly. If not, go to the next question.

On the basis of the current diagnosis, can the medical problem be assumed to have a preferable end state; that is, can the patient be expected to recover or to reach a manageable condition? If yes, the case is in a Cure process mode.

If the answer to the previous question is negative, the ailment is chronic and will follow the patient throughout life. The case is in a Care process (disease management) mode.

Managing the Modes

Here we will briefly discuss some of the different managerial challenges of the operating modes in regard to demand type (table 1) and integration, coordination, and control (table 2).

TABLE 1
Time Dimensions of DSO Modes' Demand

	Time Dimension	Question
Prevention	<i>Future</i>	What would probably happen if nothing were changed?
Emergency	<i>Urgency</i>	How much time do we have to save and stabilize?
One visit	<i>Now</i>	What can we do for you now while you are here?
Project	<i>Synchrony</i>	What kinds of things need to be done relative to one another?
Elective process	<i>Deadline</i>	When are we going to perform the procedure, and what needs to be done before it?
Cure process	<i>Foresight</i>	How far can we plan this process? What do we need to learn before deciding on the next step?
Care process	<i>Rhythm</i>	What is the regular schedule of care and therapy needed for an optimal quality of life?

TABLE 2
Principal Integration, Coordination, and Control Issues of DSO Modes

	<i>Integration Knowledge Management</i>	<i>Coordination Process and Time Management</i>	<i>Control Performance Management</i>
Prevention	Patient behavior, current sacrifices, and future gains	Early detection and ongoing monitoring	Risk avoidance and compliance
Emergency	Triage and variety of capabilities and assets	Capacity allocation	Save and stabilize; response time
One visit	Current situation	Workflow	Easy access; case closure versus length of encounter
Project	Multiperspective and multiactor	Synchrony	Case by case
Elective process	Diagnosis to treatment	Preparations to deadline	Before-and-after improvement
Cure process	Learning and iterations	Feed-forward and feedback loops	Stepwise contribution to health
Care process	Balance of care	Ongoing, cyclical rhythm	Stable condition and less decline

Several generic management issues and measures are common to all modes, many of which were adapted to health care from industrial management methods, such as the Toyota Production System (TPS). These include productivity (the ratio of input to output), quality (conformity to specifications and patients' satisfaction), responsiveness, waiting and throughput time (the time it takes a patient to pass through a process), patient-in-process inventory (the number of unfinished cases) (Kujala et al. 2006), resource allocation, and the proper sequence of steps. But instead of discussing these issues, we focus on the integration, coordination, and control issues specifically characterizing each mode.

Managing Prevention. In the Prevention mode, demand consists of cases with an identified condition that exposes patients to elevated risk. These can be hereditary dispositions or lifestyle issues. The conditions are not urgent but constitute a risk that can lead to illness. Early detection is usually beneficial. Prevention involves motivational issues, since the elevated risk is typically not yet causing harm or inconvenience but

requires sacrifices from the patient, such as regular monitoring, medication, and lifestyle changes. Therefore the integration of the provider and patient perspectives is crucial. In regard to coordination, prevention is oriented toward the future because past and current states are evaluated against future risks, which may be modeled as base, worst, and best cases, each with associated costs and benefits. Prevention can be organized as ongoing patient relations and peer-to-peer networks in which people with similar conditions offer support and advice to one another. The main performance criterion to control against is avoiding risk by complying with and maintaining a routine.

Managing Emergency Medicine. As a result of urgent, variable, and uncontrollable demand, the Emergency mode must deal with a wide variety of conditions and sudden peaks in demand, all under the constraint of urgency. Integration pertains to performing quick and accurate triage that allows a patient to be pointed to the right clinical workflow, requiring both an assortment of specialized resources and overcapacity. Each case has a time window for treatment, according to which activities are coordinated and which capacity is allocated. The goal is preventing death or permanent injury by shortening the response time from the point of entry to the point at which the patient's condition is stable enough for admission to the next care step.

Managing Visits. In the One visit mode, demand is typically not very urgent or severe. Patients wish to get their case treated and closed as fast and effectively as possible during one visit. The mode is typical of primary care providers, such as community health centers and retail clinics that treat minor ailments with simple clinical interventions. The One visit mode is distinctive in that it is a here-and-now situation. The patient's medical history is not highly relevant, and an extensive integration of knowledge beyond that of the current situation is not necessary. The coordination issues are easy access, proper scheduling, and a workflow ensuring a rapid and smooth flow from entry to exit. Demand can be structured on a drop-in basis or by appointment. One visit-based units have an interest in coordinating and controlling the on-site workflow to optimize case closure and the length of encounters.

Managing Projects. In the Project mode, demand refers to complex, resource-intensive, multiple-specialty cases that have no predefined treatment process. Such cases are typical in child and juvenile psychiatry, in which several clinical specialties and external stakeholders, such as school and law enforcement, are involved. If managed badly, patients

may be referred back and forth to different specialists and may repeatedly undergo the same tests as a result of discontinuity in the flow of information. Projects require the deep integration of various types of specialized knowledge and stakeholder perspectives. Coordination pertains to synchronizing several parallel examinations and procedures. Each patient is a Project with case-specific objectives and control items, to which a particular case manager should be assigned.

Managing Electives. In the Elective mode, demand is predictable, as it already has been screened and selected. What is distinctive about the Elective mode is that procedures can be scheduled accurately and the intervention produces a step-like change in the patient's health condition, with a noticeable before-and-after difference. In the Elective mode, treatment is typically performed as day surgery followed by monitored recovery and rehabilitation periods. Integration refers to the precision of the diagnosis and the predictability of the procedure. Coordination is directed toward a set deadline, by which various preparations should be completed. Control is concerned with queue management and the predictability of the schedule.

Managing Cure Processes. In the Cure process mode, although demand is not urgent, it is too complex to be treated in One visit. The diagnosis is not precise enough to lead to one elective intervention. Instead, the cure processes can be planned only a few steps at a time, as the results of the previous step influence the next. End-to-end scheduling is not possible, as the number and sequence of process steps may vary even for the same medical condition. Consider, for instance, an arbitrary ailment in oncology, internal medicine, or dermatology. Making an accurate diagnosis may not be possible at the outset but may require a process of diagnostic steps. Alternatively, an ailment may not respond to the original treatment scheme, necessitating revision of the treatment plan. Therefore integration is focused longitudinally on iterations of the process with learn-as-you-go feed-forward loops. Coordination requires accurate and up-to-date patient information systems and referral routines. In order to maintain a steady flow, the handoffs between steps should be fast and seamless. The process can be assumed to have an end point and a result toward which the value contributions of each step can be controlled.

Managing Care Processes. In the Care mode, demand consists of patients with chronic conditions, often with comorbidities. The demand is to maintain an optimal quality of life. Various perspectives need to be integrated to produce a balance of care over the patient's life cycle.

Care should be provided up to a certain level, below which there is a risk of complications and beyond which additional care has only a marginal impact. Patients are monitored and receive care or therapy following a coordinated daily, weekly, or monthly schedule. Outpatient Care visits should not be confused with the One visit mode, as they have a diagnosis and continuity requiring integrated patient information systems. Moreover, many of the control issues pertinent to Elective or Cure processes are irrelevant, since therapy does not accumulate value toward an end result and patients are not expected to leave the system until their death. Control is concerned with monitoring the patient's health condition against set standards.

Discussion

The DSO mode approach builds on and contributes to previous research. The Bridges to Health model (Lynn et al. 2007) segments demand according to population characteristics and connects each segment to the specific aims of care: safety, effectiveness, efficiency, patient centricity, timeliness, and equity. The Bridges to Health model, however, does not specify how supply should be organized to answer to these demands. Christensen, Grossman, and Hwang (2009) and Bohmer (2009) observed that the emergence of precision medicine has enabled sequential processes but that a substantial amount of care is, and will remain, based on clinical intuition and iterative processes. Furthermore, the focus on patient centricity has led to a distinction between intervention and behavior-centric medicine. Working from an Operations management perspective, the DSO modes contribute a managerial lens. The aim is to find patterns of integration, coordination, and control in response to different types of demand-supply constellations, that is, what patients need and want in relation to what can be supplied given the technical, behavioral, and economic constraints.

Like any conceptual lens, the DSO modes offer a sharp focus on some issues but blur others. They contribute a managerial perspective that is more elaborate than a conventional process focus, as Cure, Care, and Electives are different processes with different coordination requirements. Visits are more accurately described as workflows performed by an individual or a team. Projects coordinate several processes. Because one lens does not give a full picture, health care organizations cannot

ignore the functional, clinical, and demographic perspectives. Applying several lenses inevitably leads to trade-offs. For example, emergency departments have traditionally been organized around the demands of urgency, integrating several clinical specialties for rapid response. This can be economically justified if the demand is sufficient to keep capacity utilization at reasonable levels. Fluctuations in demand, however, occasionally lead to idle capacity, which can be used to treat electives as long as acute cases are prioritized. Unexpected acute cases, however, may cause elective cases to be canceled, thereby interrupting the flow and reducing the performance of the elective process in terms of reliability, prolonged waiting time, and throughput time, all of which carry a cost.

Combining emergency and electives creates a two-mode system that has difficulty coordinating staffing and scheduling (Joustra, van der Sluis, and van Dijk 2010). In such situations, the question is whether managerial or medical logic should be the first organizing principle. Some units could be dedicated to elective surgery, with different medical subspecialties, such as orthopedics and neurosurgery. Or, for example, an orthopedic clinic could have separate units for electives and emergencies. Both managerial and medical lenses should be used to resolve such organizational dilemmas.

Modes and the Mess

Our description of the DSO modes shows why many health care organizations are messy and confusing. If a patient is managed in the wrong mode or without an awareness of overlapping modes, the case's integration, coordination, and control may become tangled in conflicting priorities, goals, and performance metrics. Generally, in complex organizations, only what is clearly separated can be properly joined (Kahane 2010). Therefore, the DSO mode approach calls for establishing clear interfaces between modes. That is, a patient in the Care mode may develop a condition that requires Emergency treatment; an Emergency can be the beginning of a lengthy Cure process; a Cure process may have several Elective phases; an Elective can fail and turn into a Care process; and a Project can dissolve into one or a few Cure processes. In such instances, there should be routines to change mode, or the case must be transferred from one mode to another.

The DSO lens does not necessarily mean that a hospital should be organized into one-mode departments. Rather, it strives to identify and manage the different modes. For example, birthing can be defined by a demographic (expectant mothers and infants) and a functional (obstetrics and infant care) lens, and it can be organized in single units affiliated with general hospitals. The DSO lens reveals four operating modes. Uncomplicated vaginal deliveries can be treated in a One visit mode with the help of midwives. Pregnancy and delivery, however, are conditions involving elevated risk; therefore a Preventive mode is simultaneously applied. If problems are detected early on, C-sections can be scheduled in the Elective mode, and if something suddenly goes wrong, an Emergency mode should be available.

Each of these modes has different managerial requirements. One visit deliveries focus on easy access and the immediate situation; Prevention requires ongoing monitoring; Electives require cross-functional coordination and control; and Emergencies require the mobilization of standby resources. Thus the question of organizational architecture is whether there should be, as in some Nordic countries, one organization that strives to integrate, coordinate, and control all four modes in one location under one management or, as in some Central European countries, a network of mode-based service provision points.

Modes and Other Organizational Categories

Several organizational categories cut across all modes. Because all operating modes can be performed in inpatient and outpatient settings or as facility- or field-based services (Agnihotri, Sivasubramaniam, and Simmons 2002) and with a wide variety of asset specificity and cost levels, these categories are irrelevant to our argument.

Modes and Management Methods

The DSO modes shed light on why efforts to improve health care by applying industrial management methods, such as Lean (Aherne and Whelton 2010; Chalice 2007; Vissers and Beech 2005), Total Quality Control (Berwick, Godfrey, and Roessner 1990), and the Theory of Constraints (Breen, Burton-Houle, and Aron 2002; Motwani, Klein, and Harowitz 1996; Wright and King 2006), have produced uneven

results. Similar management interventions have led to different results (Lubitz, Doyle, and Valentine 2005), and if identical interventions produce different outcomes in apparently similar settings, the receiving organizations may differ in some unrecognized way (van Aken 2004).

Industrial management methods in health care have focused on generic management issues such as productivity, quality, and processes. But the intellectual roots of industrial management lie in the factory system and the managerial logic of predictable processes, tangible products, objective measurements, and closed systems. In health care, operating modes may, like immune systems, reject management principles based on unsuitable integration, coordination, and control logics. Therefore it stands to reason that methods of improvement should be tailored to each mode. Process management following the Toyota way applies best to the Elective mode (Walley 2003), as it has clear objectives and processes that can be scheduled. Cure processes with unpredictable workflows requiring continuous adjustment might benefit from insights from research and development processes with similar iterative learning features. Prevention and Care processes have many similarities to industrial maintenance services. The obvious role models for the One visit mode come from the retailing industry, and the models for the Project mode come from project-based businesses, such as consultancies and law offices. Quality management with a focus on conformity to specifications is best used for the Elective and Cure process modes with already-defined results, whereas customer-perceived quality is a more suitable approach to the One visit, Care, and Project modes. Statistical process control is well suited to the monitoring of long-term Care, and less applicable to Projects. More research on how management methods should be tailored and applied to each mode is needed.

Future Research

Because the DSO modes are theoretical constructs, the question for future research is not whether they are true or false but whether they are useful or useless. Does the DSO lens provide a view of health care organizations that would help practitioners develop better management systems? Indeed, many recent organizational innovations in health care tend to follow some of these modes. Examples are retail clinics, organized to cater to the One visit type of demand (Hansen-Turton et al.

2007; Maybin 2007). In contrast, focused hospitals exploit the efficiencies of the Elective mode, performing a limited range of clearly defined and predictable procedures, such as artificial joint replacements, hernia operations, and cataract surgery (Chilingerian 2004; Herzlinger 1997). Integrated provision units (IPUs) concentrate on medical conditions that are difficult to diagnose, such as migraine and back pain, and treat each case as a project (Porter and Kimball 2008). Coordinated networks have been established to care for the elderly and patients with chronic diseases (Christensen, Grossman, and Hwang 2009). If solutions to all of a person's needs can be provided in one mode, the homogeneity of the managerial logic will call for specific organizations. The question, however, remains: are such single-mode units more effective than the alternatives, and, if so, can this be explained by their managerial homogeneity rather than by other factors?

The usefulness of the DSO modes' conceptual lens can be explored by applying it to various aspects and problems of health care. For example, what information technology does each mode require? What knowledge integration and corresponding requirements does a team in each mode need? Are revenue models and incentive systems significantly different in each mode? Because each mode's processes differ, what are the implications for the definition, measurement, analysis, and improvement of each process? In organizations that must apply different modes, what kind of integration, coordination, and control problems appear at the boundary of operating modes, and what kind of cross-mode interfaces and routines could be developed? Finally, are these problems different from or similar to those evident at the boundaries of clinical functions?

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