

Restructuring patient flow logistics around patient care needs: implications and practicalities from three critical cases

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Abstract To make hospitals more patient-centered it is necessary to intervene on patient flow logistics. The study analyzes three innovative redesign projects implemented at three Italian hospitals. The three hospitals have reorganized patient flow logistics around patient care needs using, as proxies, the expected length of stay and the level of nursing assistance. In order to do this, they have extensively revised their logistical configuration changing: (1) the organization of wards, (2) the hospital's physical lay-out, (3) the capacity planning system, and (4) the organizational roles supporting the patient flow management. The study describes the changes implemented as well as the results achieved and draws some general lessons that provide useful hints for those other hospitals involved in such type of redesign projects. The paper ends by discussing some policy implications. In fact, the results achieved in the three cases investigated provide interesting material for further discussion on clinical, operational, and economic issues.

Keywords Operations management · Patient flow logistics · Care-focused hospital · Intensity of care · Hospital redesign · Italian healthcare system

1 Purpose of the study

This study proposes a framework for investigating the emerging trends in hospital redesign driven by “patient flow logistics”. The analysis derives from three critical cases of hospital redesign recently carried out in the Italian Healthcare System [1].

Since a review of literature has revealed a lack of works on organization design for hospitals [2–4], our intention is to make a contribution to filling this gap and to provide a framework for a better understanding of the contents of the most recent and popular scheme for hospital reorganization developed around the idea of “care-focused” hospital.

The focus has been deliberately narrowed and centred on the logistics issues and the underlying logics that drive choices concerning patient flow in hospitals, as we attempt to facilitate cross-national comparison otherwise difficult due to the fact that organizational changes are value loaded and tend to be culture-bound [5–7]. Through a deep analysis of three critical cases, we want to understand which are the changes to patient flow logistics able to realize the patient-centred model and what it takes to actually implement this type of changes. A solid framework to identify possible areas of action for changes in patient flow logistics is necessary considering the current gap in literature and the recent wave of hospital restructuring projects in U.S. and in Europe [8]. When embarking on such projects, boards and top-management need to take into consideration whether the project has incorporated all relevant evidence-based design to assure that the new

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facility will be optimal for users and staff and, most important, patient-centered.

To outline such a framework, this work will develop according to the following structure. After briefly describing backgrounds of the care-focused hospital model (Section 2), we explain in Section 3 what we mean by patient flow logistics, which are the areas of action and the objectives pursued. Section 4 is dedicated to research methods and Section 5 presents the description of the three cases of innovative hospitals that have extensively redesigned their model of delivery of care intervening on patient flow logistics. Focus will be on the organizational impacts of the changes. Section 6 is then dedicated to a first assessment of the results achieved in the three cases, Section 7 draws some general lessons that provide useful hints for those other hospitals involved in such type of redesign projects, while, in the last section, policy implications will be discussed.

2 Background: toward a focused-care hospital

All modern hospitals worldwide seem to be under several pressures, four of the main ones being [4]:

- *Financial*, since hospitals typically absorb the largest part a country's health care budget, they have been largely affected by budgeting cuts and by the introduction of per capita (managed care) or prospective payments systems (for instance, the DRGs system¹), and often have to cope with the rising costs of new technologies and drugs;
- *Institutional and social*, as public expectations of high quality health care increase in the face of diminishing resources and as accountability and standardization of clinical practice are demanded by both consumers and professional regulatory bodies;
- *Clinical*, as specialization is still an ongoing process in medical sciences and increasing cross-specialization means that the 19th century boundaries of medical specialties need to be redefined (to prevent new “turf wars” driven by different but overlapping technologies-competences-specializations for the treatment of the same patient-pathology);
- *Professional*, since new professions are emerging which claim similar status to doctors while other traditional professions, as nurses, are demanding status. According to Kinston [9], the problem of the nursing profession is of

particular significance in organizing services in hospitals because its members are struggling to determine their distinctive nursing task and also moving towards having a supplementary physician role [10, 11]. This brings to the issue of a greater emphasis on competence rather than credentials [12]. Internal re-organizations are contemporarily driven and affected by the degree of rigidity or permeability of such professional barriers.

In this context, to cope with previous pressures, most hospitals are increasingly looking with interest at a new organizational paradigm, labelled as “the care-focused organization”. This scheme aims at reshaping hospital care delivery processes around the needs of patients and away from the traditional physicians-centred view [4, 13–17]. This means guiding hospitals beyond the rationale (and shortcomings) of the traditional organization based on the professional bureaucracy archetype. They can no longer sustain functional self-referential designs, where resources are duplicated, economies of scale are underexploited, clinical integration and clinical governance is nonexistent, and autonomy (in using the specialty's resources) prevails over accountability (on outcomes requiring the integration of different specialties in using fixed and shared resources, such as operating rooms, equipment, beds, and staff). Hospitals can no longer support excessive specialization of staff or inefficiencies in how staff is used resulting from narrow functional areas and professional demarcations, nor can they allow the high rate of delay, cancellation of clinical procedures, and waste of resources resulting from poor communication among departments and disciplines [18–20].

In recent years modern hospitals have applied various methods to make hospital organizations more patient-centred. Most actions diffused are consistent with the paradigm of care-focused hospital [4, 21–24]:

- *Units grouping*. Units (specialties) should be aggregated into departments (or clinical directorates) in accordance with care requirements and the opportunities presented by economies of scales;
- *Multidisciplinary care teams*. A care-focused approach to patients requires integrated cure and care delivered by multidisciplinary and multiprofessional teams;
- *Resources pooling*. Beds, operating rooms, equipment, nursing staff, and other staff allocated to the department are shared by all functional specialties regrouped;
- *Redesign of the physical environment*. Unit and patient grouping and resource pooling may require a redesign of the physical environment. Newly built hospitals are designed to maximize, from the outset, resource pooling and patient grouping, flexibility and modularity of spaces, while old hospitals, built around fixed and focused spaces, often need to be restructured;

¹ Diagnosis-related group (DRG) is a system to classify hospital cases into homogeneous groups, also referred to as DRGs, expected to have similar hospital resource use. The system, firstly developed by Medicare as part of the prospective payment system, is now extensively used as hospital payment system in different countries, including Italy.

- *Patients grouping.* Pooled wards are reshaped according either to length of stay of patients or to patients' needs. In the first case, multi-specialty wards are created for patients of similar length of stay, such as: day-surgery/day-hospital, short-stay hospital, week hospital (for patients admitted on Mondays/Tuesdays and discharged before Saturdays), long stay-low care, sub-intensive care (high care), intensive care, and emergency. In the second case, wards could be organized on the basis of patient needs, for instance patients that need an higher level of nursing assistance or require the assistance of respirators, or patients with complicated IV's, such as oncology and dialysis patients, patients that make an higher use of diagnostic tests, etc.

To this extent changing towards care-focused and patient driven hospitals means extensive redesign and innovation in patient flow logistics. In this sense, as shown by some recent cases where innovations in professional behaviours and operating theatre management were inspired by Toyota and Ferrari work practices [25], hospitals have much to learn from industries in the way they structure and manage logistics flows.

3 Patient flow logistics

Recent studies seem to agree that to make hospitals really patients-centered it is necessary to realize a better patient flows management [26, 27].

Patients typically, during their hospital stay, pass through different settings and structures such as outpatient clinics, emergency departments, operating rooms, wards, intensive care units, post-acute care settings and so on. The complicated set of decisions related to the physical movement of patients throughout the healthcare chain (acute settings and post-acute care) can be named as patient flow logistics [26].

This quite complicated network of patient flows is often not controlled, with serious negative effects on the hospital's performance. Very recently several studies [24–31] have shown the strict link between poor patient flow management and a series of problems that typically plague modern hospitals such as: (1) short supplies, (2) long queues and delays, (3) bottlenecks, (4) waste of resources, (5) long length of stays, (6) low levels of productivity, (7) inappropriateness of clinical settings, and (8) workload variability.

For example, Walley and Steyn [27], on the basis of an analysis of 33 different sites, found that “typically 60 to 70% percent of the patients occupying hospital beds are receiving active treatment and the rest are either waiting for initial visits by doctors, are stuck in the system because of delays, or are not ill but have not left the hospital for some reason”.

Aiken and her colleagues [28] showed a direct link between poor management of patient flows and patient outcomes. They tested the correlation between patient flow variability and two outcome measures: (1) patient mortality and (2) failure-to-rescue (deaths following complications). With a population study of 232,342 general, orthopedic, and vascular surgery patients discharged from 168 hospitals, they found that, after adjusting for patient and hospital characteristics (size, teaching status, and technology), each additional patient per nurse meant a 7% increase in patient's likelihood of dying within 30 days of admission and a 7% increase in the odds of failure to rescue.

Further, different studies have shown how variable demand patterns have a negative impact on (1) delays and queues [26–31]², (2) the working conditions for the personnel [32] and (3) clinical outcomes.

Therefore, similarly to the way manufacturing companies manage their materials, healthcare organizations can act on patients flow logistics changing [25, 32]:

1. Location and lay-out of spaces and facilities
2. Configuration of the wards
3. Capacity planning
4. Technologies and Information System
5. Organizational structure supporting patient flow management.

These five elements are often referred to as an organization's logistical configuration [32]. Developing a care-focused and patient-centered hospital, as described in the previous paragraph, requires a proactive management of patient flow logistics, aimed at reshaping the logistical configuration according to three key drivers:

1. Spaces, and resources need to be shared and managed jointly. The current practice of allocating resources to specialties within a hospital often results in a loss of bed capacity, operating theatre time, and other resources. The underlying reason for this capacity loss is that allocations of beds and operating theatre hours to specialties often tend to be based on historical rights rather than the requirements for resources resulting from the flow of patients;
2. Wards should be organized around the concept of intensity of care according to the patient-centered hospital model;
3. Hospital workload (expressed by the number of patients to be treated) needs to be smoothed through better management of capacity planning.

² Queues form most commonly when arrival patterns or service times have a random element. Generally, the greater the variation in arrival of service time, the more likely it is that there will be a queue and the expected queue will be long.

The three cases analyzed in the current study, recognized as best practices within the Italian scenario, have reshaped patient flow logistics around these principles intervening on all the components of the hospital's logistical configuration [33, 34].

Compared to other works recently published, the current study is somehow unique because assesses the impact of hospital logistical changes on both clinical and organizational matters drawing on the experience of three Italian hospitals that have extensively redesigned their patient flow logistics in order to provide a more patient-centered and efficient care.

The in-depth analysis of these three cases—based both on qualitative and quantitative data—offers a complete framework to evaluate the effects of hospital redesign projects and the conditions that need to be respected to successfully realize them.

We deliberately focused the analysis on patient flow issues since they are very much critical for the success of hospital redesign projects. Furthermore, this narrowest focus allows more meaningful international comparisons. We in fact intend to provide useful hints to those hospitals involved in restructuring projects, either in U.S. or in Europe, partially filling the gap found in the literature.

4 Research methodology and goals of the paper

The three cases analyzed are

1. Forlì Hospital, public community hospital with 558 beds included within Forlì Local Health Authority;
2. Foligno Hospital, public community hospital with 350 beds included within Foligno Local Health Authority;
3. Pontedera Hospital, public community hospital with 340 beds included within Pisa Local Health Authority.

They represent three innovative cases that have extensively redesigned the following key components of hospital logistical configuration:

1. The organization of the wards,
2. The physical lay-out,
3. The capacity planning system, and
4. The organizational roles supporting the patient flow management.

The analysis of the three cases has been structured with the aim to answer four different research questions:

1. Which are the possible concrete logistical models to actually implement the care-focused hospital?
2. Which components of the hospital logistical configuration need to be changed?
3. Which are difficulties and drawbacks to take into account in hospital redesign projects?

4. Do changes in patient flow logistics actually bring improvement in quality, safety, appropriateness, and efficiency?

The study of the three cases has been based on a variety of different sources:

- Official documentation, regional laws, archives, historical data, and organizational plans provided directly by the organizations in question;
- Participation at meetings;
- Systematic bibliographic review specifically on the three cases under study: scientific journals, national and local newspapers, and healthcare magazines;
- Semi-structured interviews conducted at each site with: (1) the hospital clinical director; (2) two nurse managers; (3) the head of the new units created with the redesign of patient flow logistics; (4) the head of operating theatre (OT), and (5) two clinicians. During the interviews, we used the tool of semi-structured interviews. The questionnaire was in two distinct parts: (1) an introductory part similar for all the interviews and (2) a second part tailored to the specific role played by the interviewee within the system.

By necessity, the focus of the current paper is hospital patient flow logistics. However, it is important to stress that the healthcare chain does not usually terminate within hospital borders. As a matter of fact, it is of paramount importance to manage the interconnections between acute care and community care (for instance, the issue about hospital discharging process or the linkages to the post-acute care settings and home care) [30, 35].

5 The three Italian case studies

5.1 Which are the possible drivers to redesign patient flow logistics around intensity of care?

As already mentioned in the introductory section, the traditional hospital logistics model organized around the different clinical specialties turned out to be not patient-centered and misaligned with the needs of clinical processes. Thereafter, recently hospitals have been involved in efforts to come up with a new model based on the concept of “patients-centeredness and “intensity of care”. However, these concepts risk of being too general and vague, and so it is necessary to come up with more pragmatic criteria to redesign hospital patient flow logistics. The analysis of the three cases shows the presence of at least four different criteria to operationalize the concept of “intensity of care”:

- The expected length of stay;
- The level of nursing assistance;

- The level of technology required to support patient care;
- The level of urgency.

Of particular interest are the efforts made by hospitals in reorganizing patient flow logistics around the expected length of stay and the level of nursing assistance, since organizational arrangements are challenging physicians' discretionary powers over hospital resources and procedures. On the other hand, although reorganization based on technology and urgency still requires good operative management, it is less critical for physicians, self-explanatory and inevitable as medicine and technology evolve. For instance, the level of technology is the variable that drives the organization of intensive care units: patients are sent to this department because they need mechanical ventilation systems. As for the level of urgency it must be stressed that, more and more often, modern hospitals tend to keep urgent and, in general, unscheduled cases separate from elective patients [4, 31].

For what concern reorganization around “expected length of stay, excluding outpatient visits and day surgery procedures, we can identify four different categories of patients with different “standardized” expected length of stay:

1. Patients whose stay in the hospital is less than three days (mainly medical patients who access the hospital through the emergency department);
2. Patients—medical and surgical—whose stay in the hospital is less than 5 days;
3. Patients—medical and surgical—who need to stay in the hospital more than 5 days but fewer than 14;
4. Patients—either medical or surgical—who need to stay in the hospital more than 14 days for different possible reasons (age, co-morbidities, complications and so on).

In the traditional hospital logistical organizational models all these subgroups of patients are mixed up and assigned to the wards according to the relevant clinical specialty [4].

Vice-versa, innovating radically, all the hospitals analyzed have redesigned wards according to principles of “intensity of care” based, as a proxy, on the patient expected length of stay. They reorganized patient flow logistics and created five different and separate areas grouping wards:

1. Urgency Area

This is a separated area closed to the emergency department that accommodates non elective patients that can probably be discharged within three days. The rationale behind the setting up of this area is to keep separated, as much as possible, unscheduled cases from elective cases. Patients admitted to the urgency area tend to terminate their hospital stay in this setting. Furthermore, all the hospitals analyzed have created a separate path for urgent surgical patients with specific operating rooms and medical teams.

2. Week Surgery

Surgical Patients that are expected to have a surgical follow-up of less than five days are accommodated in a multi-specialties ward that actually closes Friday night. In this unit, beds are assigned randomly and in a flexible way to the various surgical specialties that use this area. Generally, week surgery encompasses all the surgical specialties including Orthopedics and Gynecology. In the event a patient is admitted to the Week Surgery and cannot be discharged by the end of the week, s/he will be transferred on principle to a pool of beds created within the inpatient care setting adjacent to the short cycle area.

3. Week Hospital

Patients admitted to this area are medical patients who do not need to stay in the hospital for more than five days. This represents quite a unique organizational experiment since typically the clients of the medical area are patients from the emergency department, which, by definition, has a variable and unpredictable patient flow. However, at least for a portion of medical patients, it is possible to predict the expected hospital stay. We are talking about patients that: (1) are clinically stable; (2) need to go over a sequence of diagnostic tests that can be carried out within a range of five days; (3) present general symptoms such as asthenia, loss of weight, anorexia etc.; (4) present altered exams. Various medical specialists are entitled to demand a bed in this area: primary care physicians, week hospital head; emergency department personnel and specialists working either inside or outside the hospital.

4. Medium Care/General Wards

This hospital area is still organized around the traditional clinical specialties where each unit has its own beds and personnel.

5. Post-Acute Care

This area usually accommodates patients requiring low clinical and nursing care and who for various reasons (age, co-morbidities, complications and so on), need to stay in the hospital more than 15 days. Patients can arrive from different hospital settings: medical and surgical hospital areas, emergency department, or directly from the community, referred there by primary care physicians.

Furthermore, besides reorganizing patient flow logistics around the expected length of stay, Foligno hospital has also set up a brand new unit called “High Care” that accommodates patients requiring more intensive level of nursing assistance³, yet not patients with clinical conditions requiring or eligible for intensive care units. Three different

³ It is important to stress that nursing acuity and severity of illness may or may not be correlated in a given patient or patient population. For example, severely ill patients who are receiving only palliative care may require less nursing-care time than patients who are less acutely ill but require intensive education and discharge planning.

types of patient flows arrive at the High Care Unit: (1) surgical patients; (2) medical patients and (3) patients coming directly from the emergency department. This new unit is physically located on a different floor than surgical inpatient units with low and intermediate nursing load, but is adjacent to the medical inpatient units

This unit is run by two nurse managers who are in charge of its organization. The clinical care of every patient is overseen by a clinical case manager who is responsible for the appropriateness of the plan of care and acts as the patient's individualized contact person. The case manager is required to work with maximum flexibility, by integrating with any other medical professionals that might be needed and/or with the physicians who previously attended the patient in another care setting. The roles of clinical case managers for the medical patients have been assigned to two physicians "dedicated" to the High Care Unit, while the various surgeons on duty take turns in attending the surgical patients.

The definition of admission and discharge criteria for the High Care Inpatient Unit is still an open issue. In this regard, the Surgical area has started to regulate the flow of patients based on DRGs, while the medical area has been using more specific assessment forms based on the parameters identified in international literature in order to evaluate the nursing load [36, 37].

5.2 Redesign patient flow logistics: the impact on the organization

The three cases analyzed have redesigned hospital patient flow logistics around the concept of intensity of care. In order to do so, besides radical changes in the configuration of the wards, they have implemented important modifications to:

1. The physical lay-out
2. The planning of available capacity
3. The organizational roles supporting the patient flow management.

Concerning the first point, innovation in patient flow logistics has implied important changes in hospital physical lay-out. Thereafter,

- ✓ Beds have been rearranged in order to come up with new wards (week surgery, week hospital, high care, post-acute care);
- ✓ Some pool beds have been set aside to accommodate patients that, for different reasons, are outside the different pipelines (for example, week-surgery patients that, for whatever reason, need to stay in the hospital more than 5 days);
- ✓ The sterilization units and the operating rooms have been centralized;

- ✓ The pre-admission testing has been centralized and moved to a single point.

It is worth emphasizing how all these changes and the creation of new wards did not lead to any considerable change in the overall number of beds.

Secondly, all the three cases analyzed show that the success of this type of restructuring projects heavily depends on the presence of a well-designed capacity planning system. It is important to:

1. Establish clear criteria for eligibility to the different clinical settings in order to avoid patients having to be pointlessly, and possibly harmfully, moved back and forth. For example, week patients should be discharged directly by week hospital or week surgery area without passing through other hospital settings;
2. Synchronize the operating rooms scheduling with the other hospital activities and services. This is particularly true for the functioning of Week Surgery Area: if you want to discharge surgical patients by Friday, it will be important to schedule procedures that require two–three days of surgical follow-up at the beginning of the week;
3. Enhance the coordination between the different hospital settings. For example, to make the post-acute care area work effectively it is important to establish clear coordination mechanisms with the wards. For this reason, in the cases analyzed, wards are required to book a bed in the post-acute care area by the second day of stay. Ward staff set an expected date of discharge as soon as a patient is admitted and follow specific clinical pathways to know what needs to be done before discharge [38, 39]. When discharge dates are extended beyond the original plan, the document can be studied to understand the reasons patients have been delayed. The discharging process is often overlooked but it represents a key element for optimizing patient flows' management. In fact, once a discharge schedule is in place, internal transfers of patients, such as from an intensive care unit to a patient care unit, can be synchronized to that schedule. Individual units can begin scheduling and orchestrating movements of their patients at a local level. This synchronization allows local, unit-level control and system-wide optimization to occur simultaneously.
4. Smooth peaks and valleys in hospital demand avoiding to put the hospital productive machine under unnecessary stress. The three cases analyzed have worked extensively on the operating room planning, centralizing the operating room agendas and evening out the cases throughout the week with a particular attention to the cases that need a transfer to the intensive care unit. Furthermore, they have centralized and streamlined the

pre-admissions process putting in place an effective triage system in order to optimize, as much as possible, the capacity utilization of the different patient pipelines;

5. Centralize, as much as possible, the scheduling process of the most important hospital resources (ORs, beds, imaging). A centralized and more structured capacity planning represents a key component when you move from a decentralized logistical model to a centralized one where spaces and resources are shared among different organizational units.

Third, it must be stressed that, in all the three cases analyzed, changes in patient flow logistics have implied the creation of new organizational roles such as:

1. The heads of the new units: High Care, Week Surgery, Week Hospital, Urgency Medicine, and Post-Acute Care;
2. Admissions coordinators in charge of the pre-recovery process and of the admission procedures;
3. Hospital rounds coordinator in charge of the coordination of the visits to the ward by the different specialties;
4. Supply coordinator in charge of managing the logistics flows of goods (pharmaceuticals, medical devices, and other materials) to the different wards;
5. OR Suite Chief in charge of controlling the use of the operating theatres;
6. The bed facilitator—generally a nurse—in charge of establishing efficient patient placements in the different inpatient settings. In doing so the bed facilitator collaborates with the medical staff to assess patient needs and appropriate placement of individual patients. The bed facilitator is required to use operational and clinical judgment on a daily basis to prioritize bed assignment and reassignment.

6 Results achieved

As already mentioned, in all the cases analyzed changes in patient flows logistics were aimed at obtaining performance improvements in various areas, particularly: (1) quality of care; (2) appropriateness, and (3) productivity. Establishing clear-cut relationships is usually a complicated task, given the number of factors that contribute to the explanation of results in hospital settings. Also, from a methodological perspective, when assessing results from the analysis of three different cases it is important to consider:

1. The difficulty of measuring complex variables such as quality of care;
2. The presence of a quite long series of confounding variables that, regardless of the changes implemented, still have an impact on the hospital's final performance.

Yet, both a qualitative and quantitative assessment of results achieved with the adopted changes in patient flow logistics has been attempted and is hereafter discussed.

As for quality improvement, changes in patient flows have brought important positive returns due to the new logistical model:

- ✓ It is possible to concentrate scarce resources on the most needy patients;
 - ✓ Patients are no longer parked in areas where they cannot receive appropriate care (known as “trolley waits”); the new multi-specialty wards provide assistance to a quite diverse case-mix of patients;
 - ✓ The multi-disciplinary approach is strongly encouraged. Specialists, belonging to different clinical areas, are in fact forced to share spaces and resources stimulating a fruitful exchange of knowledge and information. In the words of an ear, nose and throat specialist from Forlì Hospital “... *with this new logistical model, I have the chance to share facts and experiences that helped me in my daily clinical activity with other colleagues. With the previous model I could only see the other specialists briefly, and by chance, in the hospital cafeteria ...*”.
- In addition, the new model has encouraged collaboration between the medical and surgical staff through the creation of inter-departmental teams for the treatment of a series of disease conditions. Under this perspective, the logistical integration has been both the “constrain” and the necessary element for life in common that has created room and opportunity for integration. As discussed by Shortell and his colleagues [8] “one cannot ask physicians and nurses fundamentally to change the way in which patient care is delivered while maintaining old management and governance structures embedded in institutional autonomy that still emphasize the management of departments, protection of turf, and filling of beds”;
- ✓ The logics of process management is further enforced and thus promotes the development of care maps and clinical pathways.

In terms of productivity and appropriateness, except for the Foligno hospital case, we recorded in the period immediately after the changes a significant reduction in hospital average length of stay. This trend can be interpreted in two ways. It can be read as a rough productivity indicator, that is, it takes less time to complete a product (in our case, a patient) but it can also be interpreted as an outcome indicator [40]. In fact, typically length of stay is one of the most important risk factors for hospital infections and it is generally negatively correlated with patient's satisfaction [41].

One of the goals of the changes implemented by the three cases analyzed was to increase hospital productivity, due to a more focused and proper utilization of capital, equipment, and human resources. The success regarding this dimension is confirmed by a series of different trends recorded in the three years immediately after the change in patient flow logistics (cf. Table 1):

- ✓ Reduction in average hospital length of stay
- ✓ Increase in bed occupancy rate
- ✓ Increase in hospital case-mix complexity
- ✓ Reduction in turn-over ratio.

Part of the productivity increase can be linked to the presence of multi-specialty wards and multi-skilled forces that can accommodate a wider range of patients and absorb service time variation. In operations management terminology, this redesign has moved the process from a “long and thin” structure to a “short and fat” structure, which is much more flexible.

Furthermore, it must be noted that, in the case of the hospitals of Pontedera and Forli, we recorded an increase in patients’ satisfaction as emerging from surveys conducted directly on patients. Finally, all three cases analyzed have registered an increase in patient inflows, that is, patients coming from different catchment areas (local, regional, and even national, as in the case of Forli hospital), indicating an increased level of attraction for these hospitals due to gains in reputation and to the impact of streamlined production on waiting lists.

Table 1 Hospital productivity indicators (before and after the changes)

	Before change	After change (3 years average)
Average length of stay		
Pontedera	5.0	4.0
Forli	6.0	4.6
Foligno	6.1	6.5
Beds occupancy rate		
Pontedera	65%	82%
Forli	71%	78%
Foligno	81%	84%
Hospital case-mix complexity (average weighted DRGs)		
Pontedera	1.12	1.61
Forli	0.99	1.19
Foligno	1.07	1.09
Turn-over ratio ^a		
Pontedera	2.8	1.7
Forli	2.5	1.5
Foligno	1.4	1.2

^a Number of days that a hospital bed is left vacant, equal to $[(365 \times \# \text{ hospital beds} - \text{total \# of hospital stay days}) / \text{total \# of discharges}]$

7 Ideas for change

The study of the three cases outlines some difficult aspects that need to be taken into account in the process of changing patient flow logistics.

First, it must be noted that changes in patient flow logistics need to be coherent with a hospital’s production structure [40]. It is of paramount importance to have a minimum critical mass; it is thus important to verify that the new pipelines are consistent with the hospital production mix and patients’ clinical needs. For example, the creation of week surgery only makes sense if a sufficient number of surgical cases can be discharged within five days. If there is a lack of demand then the potential operational benefits will not be achieved. However, analyzing the current production mix can be misleading: past reasons for keeping patients in hospital over 5 days may have been due to inefficiencies and disorganization in the pre-surgery diagnostic procedures, in the management of wards or in the discharge process. So when ascertaining the size of the week-surgery area, inefficiencies need to be factored out.

Furthermore, another key point is related to the choice regarding the scope of specialties to be included in the multi-disciplinary wards. For instance the top management of Foligno hospital has decided to exclude from the week-surgery the specialties of cardiac surgery, orthopedics, and trauma since they demand more specialized assistance. It is difficult to decide where to draw the line: the trade-off is between having a big enough demand pool and having a range of tasks narrow enough to be manageable.

Second, since we are not dealing with cars or washing machines but with human beings it may happen, especially during the first transition phase, that some patients do not fit into the assigned pipeline. Hospitals need to be prepared for this possibility by setting up specified pool beds to accommodate these patients and paying particular attention to patient needs and expectations. If the number of transfers turns out to be excessively high, it will be necessary to look upstream to the root causes of the problems and take action on the allocation of beds, on the admission process, or on the triage criteria. It is important to continually verify that the different patient pipelines fit in with hospital production case-mix and patient clinical needs.

Third, it is critical to manage and overcome some cultural barriers especially on the physicians’ side. In fact, especially in the transitional phase, physicians (at least some of them) have complained about “wandering” to and from inpatient units located on different floors of the building as well as about having to share spaces and resources with other colleagues and specialties. It turned out to be particularly challenging to overcome the ancestral sense of ownership of hospital resources such as beds, nurses, or OR block time expressed by clinicians. In some

cases the fear of losing control over spaces and resources is paired with the concern of losing control over the clinical patient pathway. In such a case, it is important for the hospital management to convey the message that changes in patient flow logistics have been made around patient clinical needs and it is the physician that retains the final control over the patient's clinical history.

Fourth, the new logistical and organizational model relies heavily on a strong commitment from nurses who are required to take managerial responsibilities and to deal with a wider case-mix of patients⁴. To sustain the process of change it is thus necessary to heavily invest in nurse training programs both on managerial and clinical issues. In this sense, we can say that innovations in patient flow logistics have provided an opening for widening and further expanding the cultural debate about the nursing profession. The new care settings urge nurses to evolve their professionalism towards a multidisciplinary approach rather than a specialty approach. This can represent an organizational stumbling block, but can also become a major field for experimentation and for the development of professionals.

Finally, in order to nurture the process of change in the long-run, hospital top management will be required to set up a coherent control system with the double goal of:

1. Monitoring the effects of changes in terms of trends of production mix, productivity, level of appropriateness, and quality of care delivered;
2. Checking compliance with admission and discharge criteria for the various patient care settings (especially with regard to the Week Areas and High Care). For example at Foligno hospital they have set up an interdisciplinary working group on the definition of discharge criteria from the High Care Unit in order to ensure achieving the average turnover that should be found in such a unit.

8 Policy implications and conclusions

Analyzing the results achieved and how the change process has been managed at Pontedera, Foligno and Forli hospital provides some interesting ideas for future development.

First, concerning results, the three cases confirm that hospitals have large opportunities for re-engineering their processes and provide evidence that an organizational

model based on a clinical framework—such as the “intensity of care” or the “length of stay” criteria—can be beneficial both in terms of efficacy and efficiency.

Some organizational arrangements, such as the week hospital of Pontedera, or the medical supervisor for the critical ward in Foligno hospital, seem to be first experimentations at world level. At least, no similar experience has been reported in literature.

Given the increasing interests that hospitals are showing in operations management, and particularly the better practices for managing patient flow logistics, the healthcare political agenda of modern countries should start seriously considering promoting the set up of an international study project aimed at systematizing current knowledge and experiences. Such a project can stimulate and force the hospital sector to explore new opportunities.

Indeed, the three Italian hospital cases have all produced their changes under strong external pressures posed by regional health authorities. In this perspective, a second important policy implication regards the focus that major stakeholders put on such change initiatives. Pontedera Foligno and Forli hospitals were all identified as regional site for the experimentation of new hospital organizational models, and this “label” has determined positive stress and commitment of top managers and clinicians. Furthermore, from the Italian experience, what emerges even more is the potential to create something like an international benchmarking project, since the three Italian hospitals have developed their changes by mutual cross-fertilization and through benchmarking with leading Italian private hospitals and other international ones. They organized shared workshops to engage their physicians, exchanged knowledge about successes and failures, created connections among the medical directors, and toured other hospitals to learn about innovative solutions.

The determination of external stakeholders (regional authorities) resulted in strong commitment from the management, which put on top of its agenda the reorganization of the hospital patient flow logistics. This commitment influenced physicians and other professionals, and increased their level of engagement in the process. One lesson that we can learn from the three experiences regards the key role that nursing and technical staff play. While doctors tended to resist, since the change in the delivery model affects their traditional privileges (such as self-government of schedules, “property rights” on hospital resources, etc.), nursing managers were the first allies in the process, as they felt it meant an opportunity to improve their organizational status.

Therefore, once administrators were able to outline new organizational arrangements with the nursing and technical staff, it was easier to engage physicians to address their side of the change.

⁴ For example, in the case of Foligno hospital it is a nurse that is in charge of managing and coordinating patient inflows and outflows from the High Care Unit. At Forli hospital two nurses occupy the position of hospital rounds coordinator and supply coordinator.

The engagement was then built up along a three-step process:

1. Sharing of minds, that is, a collective alignment on the importance of experimenting innovative organizational models based on needs of patient flow logistics. Strategic workshops with top managers, physicians and nurses were organized, with the participation of representatives from regional authorities;
2. Exposure to successful hospitals adopting innovative models. For instance, managers and physicians from Forlì hospital toured Italian, Scandinavian and Spanish hospitals;
3. Involvement in group work lead by project managers. Teams, comprising physicians and nurses, were put in charge of drafting proposals for re-engineering spaces, procedures, schedules, etc.

One more important lesson, connected to the need for a continuous and long term engagement of professionals, regards the role of information and communication technologies (ICT) systems: in this context, a significant help might be provided by the reshaping of ICT systems, the developing of paperless procedures, the strengthening of procedures—such as schedules of operating rooms, admissions to critical area, etc.—by use of computerized processes.

Finally, certain similarities between the three Italian hospitals in this study may help to explain their success, and provide further input for policy decisions:

- All hospitals were mid-size;
- All hospitals were non-teaching and located in urban areas of the Italian “province”, where the labour situation, organizational climate, and inclination towards collaboration are greater than in metropolitan areas;
- All hospitals underwent a major restructuring or facility rebuilding, requiring the relocations of clinical units and providing a “logistical shock” that facilitated the inception of the re-engineering project.

In this sense, from the perspective of a healthcare system it seems beneficial to foster introduction of patient-flow-logistics-based changes in hospital settings starting with organizations facing the same contextual conditions depicted above. As shown in the Italian case, this should make it possible to build successful stories and momentum in order to address changes in much more complex contexts such as large and teaching hospitals.

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