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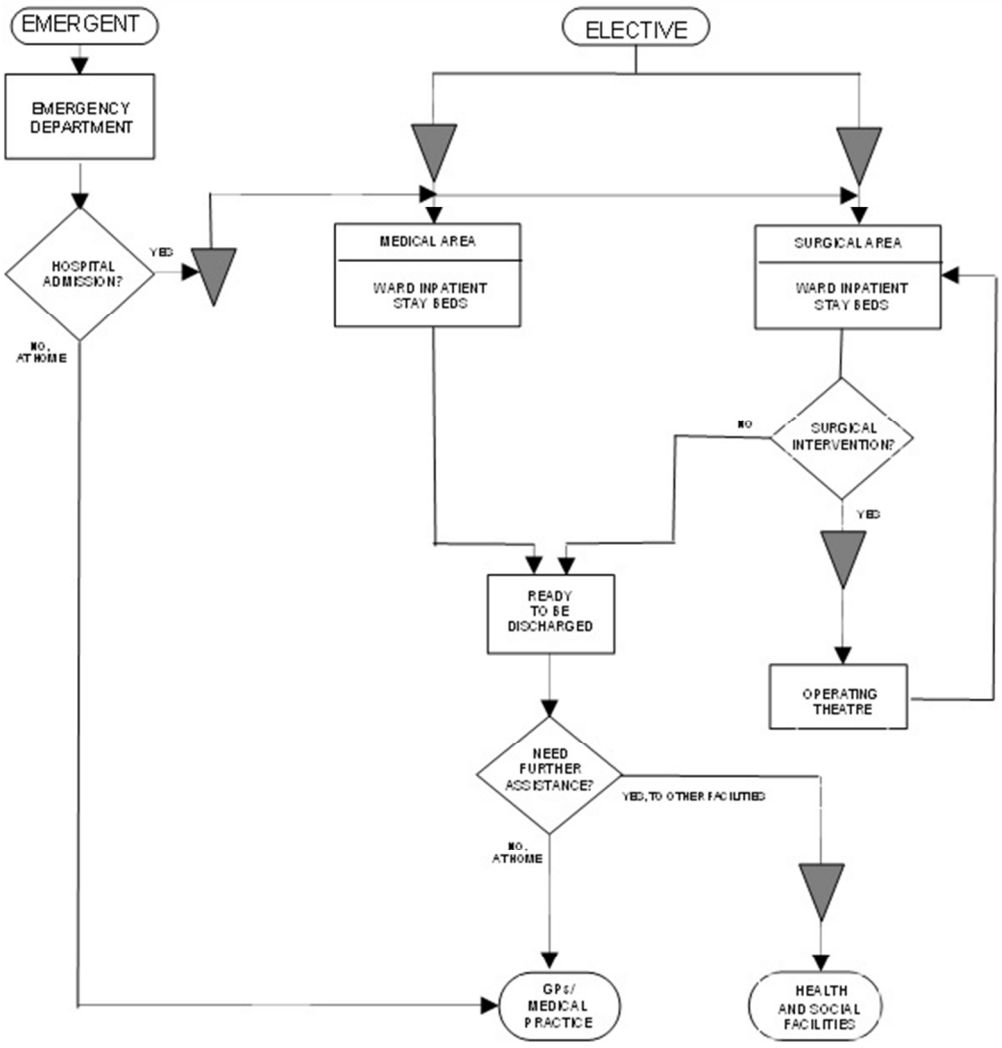

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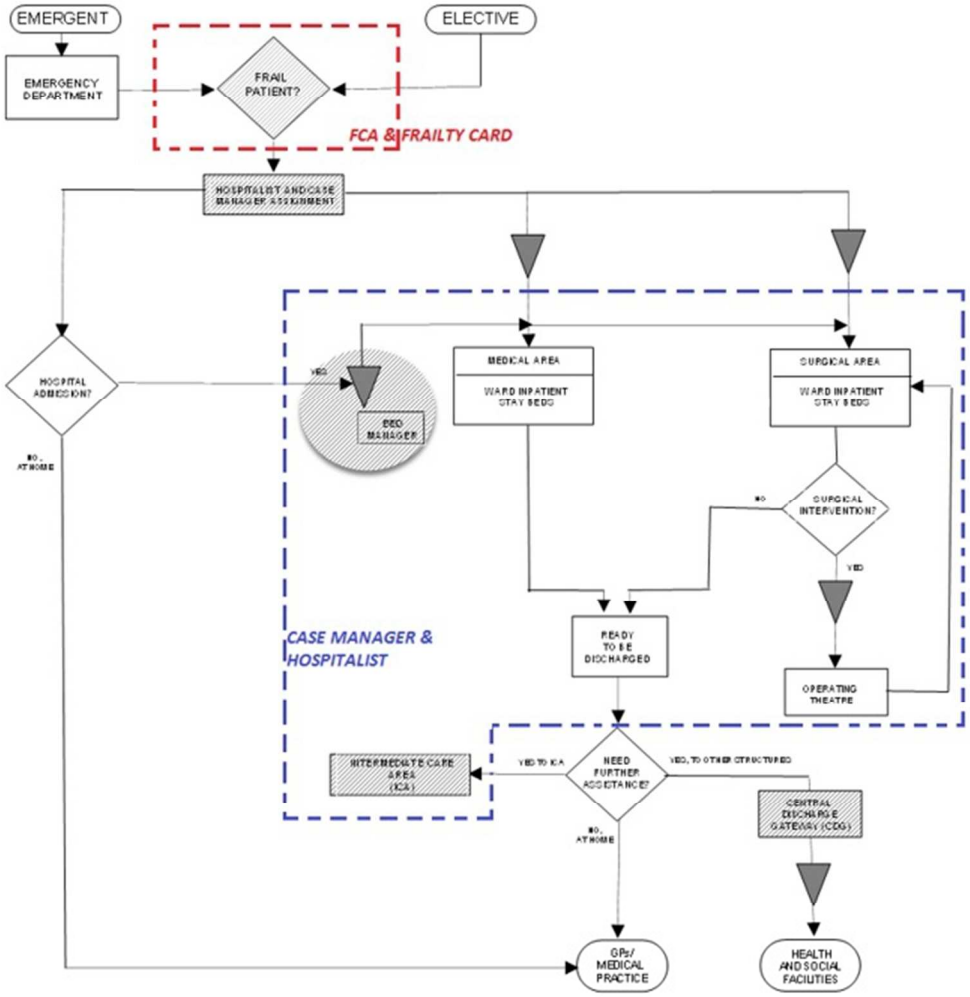

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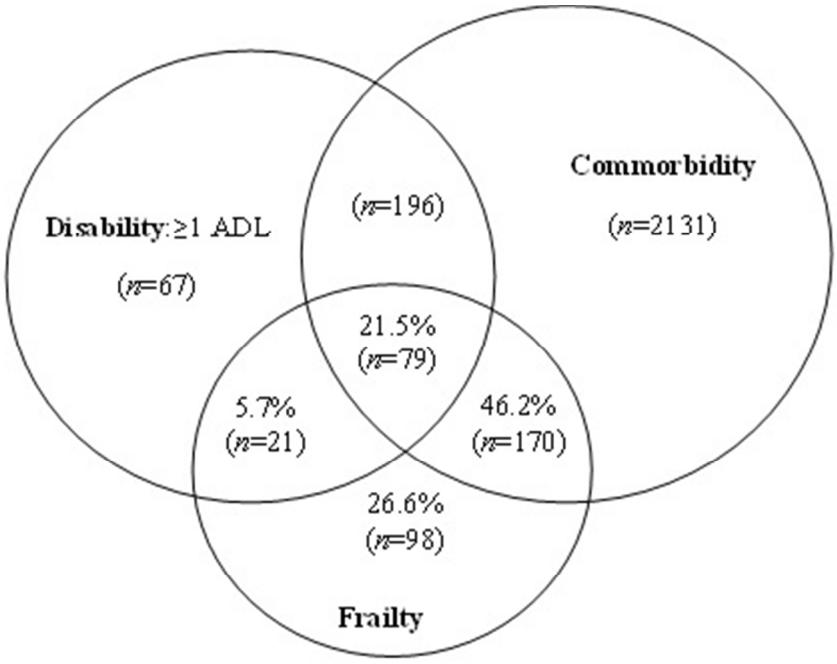

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Conceptual modelling of the flow of frail elderly through acute-care hospitals: An evidence-based management approach

Purpose – The ageing of the world's population is causing an increase in the number of frail patients admitted to hospitals. In the absence of appropriate management and organisation, these patients risk an excessive length of stay and poor outcomes. To deal with this problem, we propose a conceptual model to facilitate the pathway of frail elderly patients across acute-care hospitals, focused on avoiding improper wait times and treatment during the process.
Design/methodology/approach – The conceptual model is developed to enrich the standard flowchart of a clinical pathway in the hospital. The modified flowchart encompasses new organisational units and activities carried out by new dedicated professional roles. The proposed variant aims to provide a correct assessment of frailty at the entrance, a better management of the patient's stay during different clinical stages and an early discharge, sending the patient home or to other facilities, avoiding a delayed discharge. The model is completed by a set of indicators aimed at measuring performance improvements and creating a strong database of evidence on the managing of frail elderly's pathways, providing proper information that can validate the model when applied in current practice.
Findings –The paper proposes a design of the clinical path of frail patients in acute-care hospitals, combining elements that, according to an evidence-based management approach, have proved to be effective in terms of outcomes, costs and organisational issues. We can therefore expect an improvement in the treatment of frail patients in hospital, avoiding their functional decline and worsening frailty conditions, as often happens in current practice following the standard path of other patients.
Research limitations/implications – The framework proposed is a conceptual model to manage frail elderly patients in acute-care wards. Our research approach lacks application to real data and proof of effectiveness. Further work will be devoted to implementing a simulation model for a specific case study and verifying the impact of the conceptual model in real care settings.
Practical implications – The paper includes suggestions for re-engineering the management of frail elderly patients in hospitals, when a reduction of lengths of stay and the improvement of clinical outcomes are required.
Originality/value – This paper fulfills an identified need to study and provide solutions for the management of frail elderly patients in acute-care hospitals, and generally to produce value in a patient-centred model.

Article Type: Research paper

Keywords: Evidence-based Management, Frail Patients, Clinical pathway, Hospital Management, Patient Flows, Conceptual Model.

1. Introduction to the problem under study

During the last decades, demand for healthcare has faced deep changes due to several factors, such as an ageing population. The number of older persons is rapidly increasing, and forms a growing share of the population all over the world: people aged 60 years or over numbered 962 million in 2017 (more than twice the number in 1980), and are expected to double again by 2050, reaching two billion. The number of people aged 80 years or over is projected to increase more than threefold between 2017 and 2050, rising from 137 million to 425 million. This growth is faster in Europe and in Northern America, where in 2050, older people are expected to account for 35% and 28% of the population respectively (United Nations, 2017).
The increase of the older population, often with chronic pathologies and multimorbidities, produces a frailer and more dependent population (van Eeden *et al*., 2016). From a clinical perspective,

frailty is considered the most problematic expression of population ageing (Clegg *et al.*, 2013). Even though a unanimous international definition of and consensus on how to measure frailty does not yet exist, it is recognised that frailty develops as a consequence of the age-related reduction in physiological reserve and the ability to resist environmental stressors. This leads to the elderly being vulnerable to relatively minor stressor events, entailing a high risk of falls, disability, hospitalisation, and mortality (Fried *et al.*, 2001).

These risks are generally recognised to be associated with age (Song *et al.*, 2010). As a consequence of population ageing, frail patients are increasing and will continue to increase in the future, demanding new and more complex care solutions (McColl-Kennedy *et al.*, 2012).

Unlike acute patients, frail patients are chronic and never exit the healthcare system once they start their care pathway. Hence, they begin a continuum of care (primary, secondary and home care) and a continuum of relationships that involve a large number of actors with different skills and roles. Consequently, the way these relationships are organised and managed decisively impacts the outcome of the care solutions adopted.

Under these pressures from the demand-side, the supply-side's ability to provide appropriate organisational solutions depends on healthcare systems' ability to organise the network of services around these patients' needs. They should do so according to a new patient-centered approach (Chewning and Sleath, 1996; Mead and Bower, 2000) that links different care settings (Black and Gallan, 2015). In this network, the design and construction of integrated healthcare systems becomes a critical issue.

The contribution of this paper is a presentation of a conceptual model for the hospital management of frail patients.This conceptual model meets the specific needs of frail patients, offering them a more appropriate care, including the use of different professional roles (Hospitalist, Case Manager and Bed Manager), units (Intermediate Care Area and Central Discharge Unit) and tools (Comprehensive Frailty Assessment) that work jointly to improve the clinical paths of frail patients. In the existing literature, several authors provided evidence of single elements, through trials or simply using observational data. The main idea of this work is to fill the gap left by the large existing literature that discusses different approaches, by considering all of these elements together using a conceptual model to represent the flows of frail patients in acute-care hospital wards. The model also provides an approach based on both patient and hospital processes, in order to improve the overall hospital performance and patient outcome. It uses a dedicated clinical pathway for frail elderly patients with the introduction of facilitators, tools and units that are usually not present in hospitals' organisation, even if the need for these facilitators is rising in hospital settings.

The assumption of this paper is that the acute-care ward still plays a central role in successful integrated patient-centered solutions, since it is a major crossroads of patients, and therefore must adopt management principles and tools to manage frail patient. Frail patients spend some time in acute hospital wards coming from and returning to their own residence, or to less intensive care levels (nursing homes, post-acute facilities, social care units, caregivers, etc.) (Philp *et al.*, 2013).

In this network of services at different levels, the role of the acute ward is still crucial, since the hospital stay is often a major cause of problems. The waiting and the organisational bottlenecks cause patients and their families' distress, which risks a regression of patients' health and mental conditions. Appropriately managing the flow of frail patients in acute hospital wards can be considered a prerequisite for efficiently managing the flows within the broader health system. This management can also lead to the decongestion of acute-care hospitals, with consequent positive effects in terms of care appropriateness and a reduction in healthcare costs.

This study aims at contributing to this by proposing a new conceptual model for designing the flow of hospital care delivery to frail elderly patients, in order to facilitate their clinical pathway across acute-care hospitals, their discharge, and if necessary their admission to another facility/service (nursing homes, social care units, etc.).

The conceptual model is expected to be able to gather evidence about its ability to provide frail patients with appropriate and affordable acute care, and thus to contribute to the construction of a model of evidence-based practices for frail patients. Indeed, the contribution of the conceptual model provides new insights into Evidence-Based Management (EBMgt). EBMgt helps the decision-maker to identify the organisational strategies, relative structures and change-management practices that enable healthcare professionals and managers to provide evidence-based care (Walshe and Rundall, 2001; Shortell *et al*., 2007). In EBMgt, healthcare managers make organisational decisions using information provided by social science and organisational research (Lemieux-Charles and Champagne, 2004; Rousseau, 2005), considering the best scientific evidence available in the literature. The literature analysed shows the limited number of integrated solutions capable to face problems deriving from hospital frail patients' admissions, management and delayed discharges.

According to the principles of evidence-based practice, evidence has to be taken into account from four different sources: the scientific literature, the organisation, the practitioners and the stakeholders (Barends *et al.*, 2014). Our approach included three of the four sources, and the fourth only in an indirect way. The scientific literature-source consists of evidence from empirical studies published in academic journals, and in our approach is represented by the literature on the different tools adopted to face frailty, Emergency Department (ED) boarding, complex patient management and discharge.

The organisation-source consists of representing the organisation using data, facts and figures gathered from it. In our approach, the organisation is represented by the analysis of hospital flows and the organisation of hospital activity. The practitioner's component consists of the professional experience and judgment of the practitioner about the approach. In the analysis presented in this paper, we interviewed hospital managers, physicians and ward staff to understand the organisation and to define the hospital flow of frail patients and the main sources of bottlenecks in the care process.

Finally, the stakeholder component encompasses the values and concerns of the people involved the decision are evaluated only by a set of indicators that prove the ex-post effects (Porter, 2010). In this way, the stakeholder principle is indirectly considered by the proposition of a set of indicators. The indicators measure the outcome for the people affected by the decision - in this case the patients and the hospital -, and consider a reduction in patient boarding and bed blockers, and a better management of frail elderly patients, which reduces inappropriate discharges and repeated hospital admissions and leads to a better use of resources.

The paper is organised as follows: Section 2 focuses on the debate concerning the definition and measurement of frailty and its increasing relevance in healthcare systems, with reference to the major critical issues of frail patients' care in acute-care hospitals. In Section 3 we review some evidence-based instruments (*i.e.* organisational roles, units and tools) to face the above-mentioned critical issues. In Section 4 we describe the system "as is" and in Section 5 we develop our conceptual model with a schematic flowchart representation, where roles, units and changes proposed are introduced along with a set of quality indicators aimed at evaluating the impact of our model. In Section 6, some concluding remarks for future research are discussed.

2. Frail Patients in Acute-Care Hospitals

The recent rise in life expectancy and advances in medical technology are increasing the number of elderly hospitalised, which account for more than 50% of hospital admissions in industrialised European Countries (Eurostat, 2016). We expect that a number of these older patients present some features that will worsen hospital outcomes, such as an increased length of stay, functional decline, iatrogenic complication, cognitive impairment, and so on. They are commonly considered a subgroup frailer than other patients. One of the first definitions of the concept of frailty dates back

to about thirty years ago, when the American Medical Association reported the growth of "frail", vulnerable old adults, as the group of patients that presents the most complex and challenging problems (American Medical Association, 1990). Nowadays, the current practice in health is to deal with the problem of meeting the needs of frail patients. Frailty is a term widely used to denote a multidimensional syndrome of a loss of reserves (energy, physical ability, cognition, health) that gives rise to vulnerability. This appears to be a valid construct, but its exact definition remains unclear (Rockwood *et al.*, 2005).

Indeed, frailty overlaps with other conditions, in particular with "disability" and "comorbidity". The first condition refers to a situation in which the person has difficulty carrying out activities required to live independently, the so-called Activities of Daily Living (ADL) originally proposed in the 1950s and in current use all over the world, after being revisited by many researchers (Katz, 1963). It also refers to a more complex set of behaviors, such as telephoning, shopping, food preparation, housekeeping, doing the laundry, using transportation, and using medicine, the so-called Instrumental Activities of Daily Living (IADL) proposed by Lawton and Brody (1969). Scales are used to assess an individual's independent living skills, and measure functional ability as well as deteriorations and improvements over time.

The second condition, comorbidity, consists of the presence of two or more chronic diseases. This condition is rather simple to measure and quantify. The prevalence of multimorbidity is over 60% worldwide, and is probably greater than 80% among people aged ≥85 years (Salive, 2013). These two conditions, however, still do not coincide with frailty. The latter refers rather to a state of high vulnerability, including disability and comobordity, but also to a risk factor due to the geriatric problems of older age, such as falls and incontinence. This situation is usually not reported in administrative data or billing systems, and requires a clinical assessment or patient self-report methods. Frailty therefore is an aggregate expression of risk deriving both from age and from the accumulation of many problems, not only clinical conditions. All these dimensions should be seen as distinct, which would help explain why some persons with frailty have no adverse outcomes, some frail persons have no chronic conditions, and some persons with a single chronic condition are frail and vulnerable, with poor outcomes.

In order to get some insight into the complexity of estimating the prevalence of frail patients inside a hospital, we refer to Figure 1, where the results of a study are reported (Fried *et al.*, 2001) separating the three different dimensions. The study identified 368 patients out of 4,317 as frail (8.5%) and further identified overlaps with comorbidities and disabilities. Figure 1 also shows how only about 10% of patients with comorbidity have frailty characteristics.

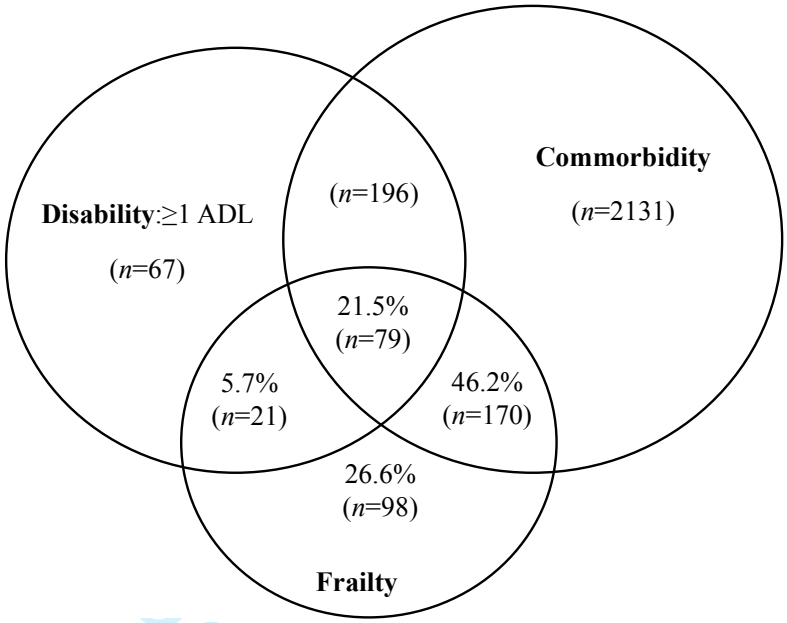

Figure 1. Venn diagram showing the overlap between frailty, disability and comorbity conditions (Fried *et al.*, 2001)

A more recent study provides higher values for the prevalence of frailty, declaring that approximately 10% of people aged over 65 and 25-50% of those aged over 85 are living with frailty (Lincolnshire Community Health Services, 2015). This evidence is in line with the current demographic increase of expected life duration, engendering a corresponding increase in the period during which one lives in a condition of frailty. We can therefore expect that acute-care hospitals will admit a greater number of frail people, requiring urgent organisational interventions to face their new needs. What is generally lacking in our opinion is an additional assessment of socioeconomic conditions, which are further determinants of frailty and which result in poor outcomes, with few exceptions. This is reported in a study (Rodrigues *et al.*, 2013) that recognises that frailty may involve not only physical components, but also social aspects.

Frailty needs to be appropriately managed inside the acute-care hospital by designing appropriate pathways, which are expected to work together with trajectories for acute and not-frail patients. The debate concerning appropriate care for frail patients has traditionally focused mainly on the development of low clinical content and low-cost intensity interventions such as home care, day care, nursing homes and social care, in order to decongest acute-care hospitals, and also on the development of geriatric units or units specialised in elderly needs inside acute-care hospitals (Fox *et al.,* 2013). The problem in our view should be faced by taking into account the entire care process of the patient, whatever the stay ward is: orthopedic, urology, or general surgery, and not only medicine wards.

In order to contribute to and enrich the debate, our paper adopts a process-based view aimed at optimising frail elderly patient flows inside acute-care hospitals, in order to: i) reduce their admission time and length of stay; ii) better coordinate multidisciplinary interventions; iii) encourage speed discharging and if necessary admission to other long-term facilities; and eventually iv) reduce the risk of adverse events. Hospitalised frail patients in particular are at a higher risk of adverse events which, when they occur, complicate patients' health status and lead to functional impairment or death (Brennan *et al.*, 1991; Leape *et al.*, 1991; Madeira *et al.*, 2007; Szlejf *et al.*, 2012). Therefore, it is critical to minimise the length of time that such patients spend in acute-care hospitals. When designing solutions for new care settings and clinical pathways able to improve these patient flows, we focused on the three most critical moments during frail patients'

acute-care hospital stay, which concern the admission, the hospital stay and the discharge. Frail patients are often already under the care of other facilities (community hospital, nursing home, domiciliary care), where they come from when admitted and where they need to go back to when discharged. For this reason, well-designed flows, inspired by the transitional care approach, are very important. Transitional care aims in fact at promoting a safe and timely passage of patients between levels of health care and across care settings. The American Geriatric Society defines transitional care as "a set of actions designed to ensure the coordination and continuity of health care as patients transfer between different locations or different levels of care within the same location" (Coleman and Boult, 2003). This is particularly important for frail elderly patients that, need to move frequently within different health care settings for their health status (Coleman, Boult, 2003; Naylor, 2004).

For frail patients who cannot be transferred home for any reason, discharge from an acute-care hospital can be very complex and difficult, thus resulting in inappropriate hospital stays and increasing the phenomenon of *bed-blockers,* i.e. elderly patients who cannot go back home for any reason and must remain in hospital until a bed in another institution (facility) is available (Benson *et al.*, 2006; Manzano-Santaella, 2010), or *delayed discharges* (Bryan *et al.*, 2006). Delayed discharges are in fact one of the most critical issues concerning frail patients in acute-care hospitals. Naylor and Keating (2008) report at this regard that many factors contribute to gaps in care during critical transitions, among them poor communication, incomplete transfer of information, and the absence of a single person to ensure continuity of care.

The flows should be improved in order to reduce older patients' stay in the hospital, admitting only those older patients who really need hospital treatment, minimising delays for those who are admitted, and discharging them from hospitals as soon as possible, *i.e.* when patients are clinically stabilized to be discharged. Different solutions (organisational units, professional roles and tools) have been discussed by the literature and introduced in practice to reduce hospital admissions or length of stay of frail elderly patients. In the following section, the most important and evidence-based organisational interventions are described.

3. Evidence-based tools: A literature review

In recent years, alternative organisational changes have been proposed in many countries in order to facilitate the clinical pathways of patients inside acute-care hospitals. These changes have paid attention to the transition of care towards other healthcare facilities, thus developing or improving existing integrated care models (WHO, 2016).

In this section, the changes that are most suitable to facilitate the path of frail patients are described in detail. We attempted to find evidence for their effectiveness in the literature, although unfortunately, proof is often neglected in the case of organisational tools. We choose the following organisational interventions, addressed to: i) frailty assessment; ii) the introduction of new professional roles (case manager, hospitalist and bed manager) and iii) new organisational units (an Intermediate Care Area (ICA) and a Central Discharge Gateway (CDG)). Based on an analysis of the literature, these interventions seem able to reduce emergent patients' admission time and length of stay, speed up the discharging process and, if necessary, the patient's admission to other long-term facilities. Each intervention is briefly explained, after which the relevant literature is discussed, paying particular attention to main findings in terms of proof of impact.

3.1. Frailty assessment and Comprehensive Frailty Assessment (CFA)

Once the frail elderly patient enters the acute-care hospital (both as elective or emergent), a frailty assessment must be carried out by an specially designed elderly care assessment unit or commission,

in order to determine his/her medical, psychological and functional capabilities (Ellis *et al.*, 2011). When compiling the assessment, the patient is assigned a code through which, respecting his/her privacy, he/she is placed in an tailored path where a specific professional figure (front-end staff) is in charge of him/her. A continuous flow of information monitoring the patient's activity is ensured (back office). The tracking and tracing system of the patient informs any actor or part of the system in advance about the presence (or arrival) of a patient who needs specific care.

The assessment can be done by means of different tools, a card, an electronic device (e.g. RFID), etc. As different definitions of frailty are provided, so different algorithms are utilised (Woo *et al.*, 2015).

Each algorithm and each scale is assessed through consultation with clinicians and hospital managers, considering different risk factors such as comorbidities and geriatric conditions. The assessment has to be done as soon as the patient enters the hospital, in order to have the information on his/her clinical and frailty condition available so as to activate the services dedicated to patient care sooner.

The Frailty First Aid (FFA) should be present in the emergency room twenty-four hours a day. The FFA immediately alerts a commission, called the Comprehensive Frailty Assessment (CFA). The CFA conducts a multidimensional medical, functional, psycho-social and environmental evaluation of the older person's problems and resources, in order to develop a personalised path inside the hospital, assigning a case manager, a hospitalist, a bed manager and all the other functions charged with following the frail patient. Most hospitals have some form of initial frailty assessment in place, although these are rarely integrated with other hospital processes and carry many different denominations (Stuck *et al.*, 1993).

Frailty assessment has always proved to be effective. One of the first studies dates back to about twenty years ago (Stuck, 1997). A randomised controlled study in unselected older patients admitted to an acute-care hospital found that thanks to the assessment, patients' function at hospital discharge was improved, and the risk of nursing home admissions decreased in patients receiving integrated geriatric care, as compared to patients receiving the usual acute hospital care. Another trial found a statistically significant reduction of hospital readmissions and cost savings in the intervention group compared with controls (Stuck, 1997).

The most recent and convincing results are reported in a systematic review (Ellis *et al.*. 2011), where twenty-two trials evaluating 10,315 participants in six countries were identified. Patients who underwent a specific frailty assessment were more likely to be alive and in their own homes after up to six months, and at the end of a scheduled follow-up (median twelve months), when compared to those who received general medical care.

This systematic review was recently updated and completed (Ellis *et al.*, 2017) in order to also estimate the cost-effectiveness of frailty assessment. While CFA may lead to a small increase in costs, evidence of cost-effectiveness is uncertain due to imprecision and inconsistency in the studies.

In conclusion, the Comprehensive Frailty Assessment (CFA) proposed herein is a multidimensional early assessment tool, crucial to guiding frail people towards the proper diagnostic and therapeutic process inside the hospital. CFA results in a coordinated and integrated treatment plan until discharge, the subsequent follow-up and the transitional step towards other care settings (home, nursing homes, and so on). The frailty assessment is effective and is the first step of a care approach for detecting frailty in the community, allowing targeted intervention to potentially delay decline and future disability. This means that, like other suggested tools in the paper, CFA should be integrated, coordinated and guided by a unique frailty team that supports the work of central health management.

3.2. Case manager

Of the professional roles introduced in the healthcare delivery practice and studied by the literature, the case manager and the hospitalist seem to best facilitate the clinical trajectories of frail patients.
In our opinion, both figures should be activated at the beginning of the care process and assigned to the patient's care: one nurse (the case manager), mostly dedicated to the assistance aspects of the care, and one physician (the hospitalist), mostly dedicated to the clinical aspects. Both originated in a US context and aim at meeting the needs of service integration. They also offer cost control and over-performance deterrence, and help ensure the continuity of care (Haggerty *et al.*, 2003). There is no unique definition of case managers, but they are primarily focused on achieving quality while controlling costs through coordination and the management of care.
The primary tasks of a case manager are therefore to assess the patient's and carer's needs, develop tailored care plans, organise and adjust care processes accordingly, monitor the quality of care and maintain contact with the patient and carer (Singh and Ham, 2006).
Case management developed in Europe (first in the UK), when the management and care of patients with long-term conditions, increasingly deinstitutionalised, became a priority in the financially restricted European public health systems. In those systems, case management is considered a solution for the care of the elderly and dependent population, in order to reduce emergency and acute hospital-bed use (Reilly *et al.*, 2010).
While case management is mostly developed in acute-care settings, it is primarily a response to those patients who need coordinated actions taken by a professional. This professional mostly has a background in nursing or social works (White and Hall, 2006), and takes action according to a patient-centred logic of integrating healthcare and social services provided by different players.
Evidence shows that case management decreases the number of hospital (re)admissions and improves patient satisfaction, while evidence on the cost-effectiveness of case management remains controversial (Curry and Ham, 2010). Indeed, case-management interventions reduced hospital admissions and the length of stay in hospitals, with corresponding savings in total healthcare costs (Leung *et al.*, 2004).

3.3. Hospitalist

The hospitalist is another professional role coming from the organisational healthcare landscape of the US, introduced in 1996 with the aim of creating a generalist within the hospital responsible for managing the care of hospitalised patients. The hospitalist assumes the role of a General Practitioner (GP) within the hospital (Wachter and Goldman, 1996). Unlike the case manager, who is born out of the need to cope with the progressive deinstitutionalisation of patients and hence is mostly a nurse, the hospitalist is a physician, specialised in supervising a patient's care during a hospital stay. This person receives patients from the GP, is their personal medical advisor and manager of their health for the duration of their hospital stay, and then returns the patients to the GP after discharge (Cammarata, 2005).
After only five years since its introduction, the hospitalist has been shown to be associated with significant reductions in costs (13.4%) and hospitalisation (16.6%) (Wachter, 2002, Watcher and Goldman, 2002).
Subsequently, this figure of the generalist has spread very quickly, and twenty years later, hospitalists are present in 75% of US hospitals (Wachter and Goldman, 2016).
Nowadays, the hospitalist is common in many US hospitals, where they play a key role and collaborate with other medical specialists and the administration, increasingly taking on a leading role in quality improvement programs (Yousefi and Wilton, 2011). The hospitalist model of care delivery inside the hospital became a point of reference for Canada as well (Yousefi and Wilton, 2011) and then for other countries, such as Singapore (Hock Lee *et al.*, 2011) and Brasil (Schnekenber, 2011). Especially at the beginning, some criticism was raised because hospitals created a discontinuity of care between the hospitalist and the figure of the general practitioner in

the US-managed care system (Goldmann, 1999). More recently, other criticisms were formulated with regard to costs: the hospitalist allows for a decrease in the duration of hospital stays and therefore costs of the hospital, but shifts these costs to post-hospital care and increases the probability of readmission (Kuo *et al.*, 2011). However, opposite results come from other studies, where it is shown that hospitalists significantly reduce hospital stays without increasing costs (Rachoin *et al.*, 2012).
What is certain is that most trials and tests prove that a hospitalist can decrease the length of stay, thus reducing hospitalisation risks for frail patients. There still is little proof however, with a few exceptions, that the quality of care improves (Yousef and Wilton, 2011).

3.4. Bed manager

Bed management has been introduced to face ED boarding, which is a major reason for ED overcrowding and elective admission postponements (Bagust *et al.*, 1999). Emergency patient admissions into wards and patient boarding were widely reported in the literature during the last decades (Bagust *et al.*, 1999; Proudlove *et al.*, 2007).
The main criticalities regard two central aspects: i) how to guarantee the completion of a care pathway in a timely and proper manner for emergency patients that were already diagnosed in ED and are waiting to be admitted into inpatient wards, and ii) how to avoid the delay of care delivery for elective patients, waiting to be admitted to the hospital to receive their timely and proper care.
A suggested solution is the introduction of the bed manager, a dedicated professional role that keeps a balance between a flexibility that allows for admitting emergency patients and a high bed occupancy (Green and Armstrong, 1994). Its main task is to report, at given interval time slots during the day, the volume, census, and occupancy rates of the available ward-stay beds in order to synchronise the expected discharges, i.e. bed supply, with the expected admissions from ED, i.e. bed demand (Haraden and Resaz, 2004).
When analysing the literature, we found few published academic studies reporting on the performance of bed management or its effectiveness in terms of patient flow and experience. In a study proposed by Howell *et al.* (2008), a decrease of the ED throughput times is reported, which is mainly due to a reduction of about 21% (approximately one hour and half) of the time spent inside ED by patients waiting to be admitted. This effect was still larger (28%) in the case of transferring patients from ED to Intensive Care Units (Howell *et al.*, 2010). Again, the percentage of hours during which the ED had to divert ambulances due to ED crowding and a lack of intensive-care unit beds decreased by 6% and 27%, respectively (Howell *et al.*, 2008).

3.5. Organisational units

The first organisational unit selected to deal with the problem of frail patient management is the Intermediate Care Area (ICA). The ICA is usually located downstream from the acute area (which is in turn divided into a medical and surgical area) and is inspired by the community or country hospital model directed to deliver subacute care, seeking to reduce the number of inappropriate admissions to acute-care hospitals and to facilitate the discharge of patients from acute care (Pitchforth *et al.*, 2017).
Given the extent of definitions and operational experiences in the literature (Melis *et al.*, 2004; Steiner, 2001), it is worth referring to the British Geriatric Society, which includes in intermediate care services that are limited in time (normally no longer than six weeks), involving cross-professional working and targeted at people who would otherwise face unnecessarily prolonged hospital stays or inappropriate admission to acute inpatient, long-term residential, or continuing NHS inpatient care. Using the framework of the service models of intermediate care fixed by the

British Geriatrics Association, the Intermediate Care Area we refer to in the following is structured as a community hospital or a nurse-led unit. The ICA is mostly created through the conversion of acute beds, and is designed to institutionalise frail older patients, who can be discharged but cannot yet stay at home or in another facility, until they are not clinically stabilized to be discharged (Paton *et al.*, 2004). The ICA is actually aimed at improving the integration of care between acute hospitals and post-acute care providers (such as nursing facilities, inpatient rehabilitation hospitals, long-term care, hospices, residential units, home-care agencies, etc.), bridging on two areas especially for frail, elderly and/or chronic patients.

Evidence for the effectiveness of intermediate care and community hospitals is relatively scarce, and evidence for many services that fall under the broad rubric of intermediate care is lacking (Pitchforth *et al.*, 2017; Steiner, 2001). In one study (Swanson and Hagen, 2016), the authors found evidence of reduced service utilisation, such as readmissions or community services use, among those treated in a community hospital compared with those treated in a general acute hospital. The authors demonstrated a correlation between the introduction of these beds and a small, but significant, reduction in acute-care admissions, highlighting intermediate care beds' potential to alleviate the burden on acute-care hospitals. In another study (Dahl *et al.*, 2015), a retrospective comparative cohort showed a reduction of the length of hospital stays following the introduction of intermediate care beds for elderly and chronically ill patients.

The second organisational unit selected is the Central Discharge Gateway (CDG) unit, aimed at following and facilitating the discharge process frail elderly in the final stage of acute hospitalisation. From a theoretical point of view, this unit belongs to the complex of actors and actions that the debate refers to with the wide term "transitional care". The American Geriatric Society defines transitional care as "a set of actions designed to ensure the coordination and continuity of health care as patients transfer between different locations or different levels of care within the same location" (Coleman and Boult, 2003). For frail patients who cannot be transferred home for any reason, discharge from an acute-care hospital can be very complex and difficult, thus resulting in inappropriate hospital stays and increasing the phenomenon of *bed-blockers* (Benson *et al.*, 2006; Manzano-Santaella, 2010) or *delayed discharges* (Bryan *et al.*, 2006). The issue needs to be addressed, in terms of flows management, as a major cause of bottlenecks and criticalities in the system (Proudlove *et al.*, 2007). The increasing presence of frail elderly patients that are usually difficult to discharge, because of a lack of family support, social care or the unavailability of post-acute facilities, are in fact among the main causes of distress and delay for both patients and hospital staff.

We propose that the discharge process should be led by a multidisciplinary team that is activated at the beginning of the care process in acute-care hospitals, and is coordinated by a professional role that is in charge of the patient. The team should conduct a comprehensive geriatric assessment of discharge, and then indicate the most suitable health facility for the patient, support the process of identification, select the patient's target structure, as well as transmit all information that allows for the continuity of care and the pursuit of all activities that favor the patient's transfer. This unit is required to develop strong relationships with all the system's players downstream and upstream (such as the GP) and to provide the patient and caregiving relatives with all the support they need in order to take conscious decisions. It should also act as a facilitator for the transfer of patients that need to be taken over by the new structure. It should therefore handle not only the patient's transfer, but also the transfer of all relevant information, respecting the patient's privacy. This unit and its introduction into the discharge process proved to be effective in terms of patient, process and hospital outcomes (Mileski *et al.*, 2017; Carr *et al.*, 2007; Venkatasalu *et al.*, 2015).

4. A standard flowchart to describe clinical pathways across the hospital

The conceptual model developed herein focuses mainly on a clinical governance approach, in specific on clinical pathways that "describe the spatial and temporal sequences of activities to be performed, based on the scientific and technical knowledge and the organisational, professional and technological available resources" (De Blaser *et al.*, 2006).

The method's approach starts by a simplified representation of standard clinical pathways that is able to mimic the flows of all patients, both emergent and elective, inside acute-care hospitals. In the first flow chart developed in Figure 2, only the organisational aspects, common to all hospitals, all countries and all disease conditions, are represented. In a second step, the standard pathway representation is enriched with the specific organisational tools for frail patients analysed in Section 3 and a set of performance indicators aimed at evaluating the impact and effectiveness of the organisational changes.

To represent the standard clinical pathways we use a flowchart map, where rectangles represent macro activities (i.e. groups of services delivered, such as stay, interventions, diagnoses, etc.), the rhombus are decision nodes, and the queues, generated when a resource blockage occurs in the patient flow, are represented as triangles. The flow chart is shown in Figure 2.

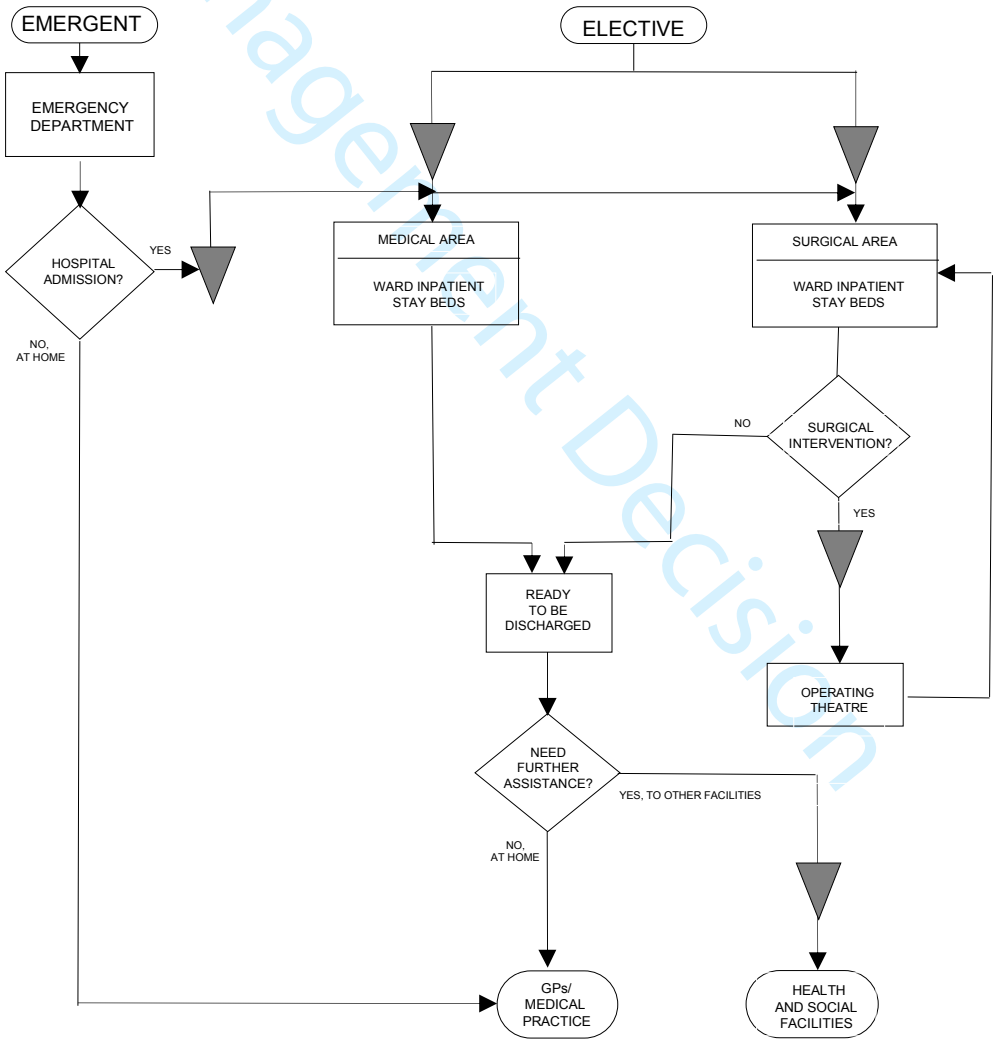

Figure 2. Flowchart representation of standard clinical pathways across the hospital

Patients can enter the hospital system as elective or emergent, and they move across a sequence of activities that constitute the care process inside the hospital until they exit, returning to their home

or to other health and social facilities, such as nursing homes or rehabilitation centres.Elective patients enter the system after an outpatient visit (not present in the flow chart), when a clinician evaluates the patient, defines the diagnosis and the possible surgical intervention required. Depending on the diagnosis, patients are included in the elective waiting list of a given specialty before being admitted to hospital. Two different waiting lists (queues) and stay areas are modelled, i.e. the medical and the surgical area of treatment.

Elective admissions are constrained by the availability of free beds. The number of free beds available on each day is determined by considering the patients who already occupied inpatient beds assigned to the specialty, as well as the expected number of patient discharges, also considering uncertain emergency patient arrivals. In the surgical area, if the patient needs an intervention, he/she is admitted while also considering the availability of operating rooms' slot times. Once admitted, the patient is included in the elective surgical waiting list.

Emergency patients are directly admitted from the ED if a free bed in the medical or surgical area is available. More particularly, after the clinical evaluation by clinicians in ED, a decision to admit can be generated. The decision of patient admission includes the assigned inpatient ward where the patient must hospitalised. If no beds are available, the patient must stay in the ED and wait for a free bed.

Once admitted in the assigned inpatient ward, both elective and emergent patients occupy the bed for a given amount of time (length of stay) before being considered "ready to be discharged".

If further assistance is needed or the patient cannot go back home for any reason (e.g. lack of caregivers at home), then he/she must wait until a bed becomes available in one of the health or social facilities dedicated to taking care of the patient's pathology after the acute care in hospital, such as nursing homes, rehabilitation centres, hospices, long-term care centres, etc.

The great challenge in hospital management is to provide to patients an appropriate clinical pathway reducing the presence of resource blockage (represented in Figure 2 as triangles). Concerns about blockages have increased in recent years and this paper focuses on these problems as they affect elder patients. The main source of these problems is the organisation of hospital management, but also structural problems can be related to the whole health delivery systems. What is crucial is, however, to face the problem in a holistic manner mapping the care process as in Figure 2 to ensure coordination among the different solutions tools.

Some resource blockages seems to be ascribed to bed shortage. This is the case of the boarding problem, given by the increase of patients arriving from the ED with respect to the elective patients. In Shi *et al.* (2016) are reported the average waiting times for patients in ED waiting to be admitted for a set of specialties (Surgery, Cardiology, General Medicine, Orthopedics, Gastroenterology, Oncology, Neurology, Kidney unit, Respiratory) of a major public hospitals in Singapore. Authors show that the average waiting time is 2.82 (with a standard deviation 0.01) hours and the percentage of patients that have to wait for more than 6 hours varies between 4.79 (with a standard deviation 0.47) for General Medicine unit to 11.6 (with a standard deviation 1.31) for Kidney unit. One possible solution consists in a flexible organisation of the hospital resources that considers seasonal peaks of service demand. An increase of the overall number of hospital beds will not solve the problem as it will lead to an exceed of supply in the periods where peaks are absent, with indicators such as bed occupation ratio too small for the ward. Another solution consists in the improvement of bed capacity planning and changing the rules used by Bed Manager to allocate patients into inpatient wards (Landa *et al.*, 2018).

Considering the second blockage (waiting lists), shortage are present only for elective patients waiting for a surgical intervention, as reported in the literature (Siciliani *et al.*, 2014). In Siciliani et al. (2014) is reported the measuring and comparing of waiting time for 12 OECD countries for a set of the most common elective procedure: hip replacement, knee replacement, cataract, hysterectomy, prostatectomy, cholecystectomy, hernia, coronary artery bypass graft (CABG), percutaneous transluminal coronary angioplasty (PTCA). In spite of improvement of waiting times. in recent

years the trend has reversed and the mean waiting times are increasing. Even if there is a high variability, hip replacement and knee replacement have a high mean value for waiting time, with a minimum of 39 days for Denmark to 495 days for Slovenia. Cataract has a minimum of 46 days in Canada and 111 and 113 days in Finland and Ireland, respectively. This shortage is also linked to the back-door entry for elective patients that try the emergency patient path (Lane *et al.*, 2000). In this case the solution is related to hospital organization. The solution is not represented by an increase of hospital beds, but should consider the admission of patients with the relative clinical priority, with the constraint of the maximum waiting time (Curtis *et al.*, 2010, Sanmartin, 2002, Noseworthy *et al.*, 2003).

The increase of hospital bed is not generally useful as the resource that creates the blockage is the operating room with respect to the beds or the poor allocation of beds among specialties. The problem is still an issue depending on the hospital management as it consists to ensure the optimum mix of OR availability with respect to beds availability (Ozcan *et al.*, 2017) or the allocation of beds following the intensity of care model for ward organisation rather than the traditional based on surgical specialty(Landa *et al.*, 2013).

Finally the third blockage that causes delays in discharge process seems out of the hospital responsibility, due mainly to shortage of home care, nursing home services or shortage of occupational therapists, and other service staff outside the hospital. In our opinion this is only partially true, because the key driver is the insufficient capacity in the health and social systems to effectively work together ensuring coordination. Incentives toward better coordination have been proposed for instance in Baumann *et al.* (2007), but the problem still exists as reported in another study (Landeiro *et al.*, 2017) where delayed discharges of elder patients in different countries vary from 1.6% to 91.3% (average of 22.9%), with a large negative impact on costs and health outcomes.

5. A conceptual model for frail patients' clinical pathways

The specific aim of this paper is to enrich the standard clinical pathway represented above with new organisational units and activities (developed by new dedicated professional roles) aimed at optimising the path of frail patients inside acute-care hospitals.

From a managerial point of view this means that we introduce:

- a frailty assessment for patients that are admitted in hospital (Section 3.1);
- new professional roles, i.e. case manager, hospitalist and bed manager, in charge of frail elderly patients, from admission to discharge (Sections 3.2, 3.3 and 3.4);
- two new organisational units, i.e. ICA and CDG, that are assumed to improve the flows of frail elderly patients towards discharge and new facilities (Section 3.5 and 3.6).

In the conceptual model, we assume that for each emergent and elective patient entering the system, an evaluation process is performed by a commission of clinicians, a Comprehensive Frailty Assessment (CFA), to verify whether there is any frailty condition.

Once frail elderly patients are admitted to the wards (medical or surgical) to receive acute care, they follow the same clinical pathway of other patients, with the exception that they continue to be followed by the hospitalist and the case manager, who coordinate the patient's interventions with the ward staff. If the patient is frail, then he/she falls under the responsibility of a hospitalist and a case manager that are responsible for specific aspects of the care process. The hospitalist supports the patient's clinical pathway with respect to all needs in terms of healthcare and frail conditions, and will supervise any phase of the process, intervening if and when necessary. The case manager will be in charge of the day-by-day management of the patient.

The flowchart representation is customised to frail patients' needs when the patient is ready to be discharged from acute wards. It considers different hypotheses: the first one is that patients can be discharged to their home only if they have appropriate family or caregivers' support. In this case,

the patient goes back home and the entire pathway documentation, such as exams, tests, visits and the results, is sent to the patient's General Practitioner or Medical Practice. The second hypothesis is that patients cannot be discharged if they need further assistance, e.g. patients' psychophysical conditions have not yet stabilised and they are expected to continue to be temporarily instable. In this case, patients can be admitted to the Intermediate Care Area (ICA), where they can receive less intensive and multidisciplinary care for a limited period of time.

Since the number of patients requiring access to the ICA may vary, in order to get economies of scale the intermediate care area can also be opened to non-frail patients. In any case, frail patients should take priority, and the frailty code alerts the ICA staff at any moment about the number of frail in-patients that need to be admitted once they are declared dischargeable by the acute area. Indeed, the ICA is introduced primarily to reduce or at least shorten bed blockers' inappropriate hospital stays in acute wards.

The last hypothesis is that other patients, once dischargeable from the acute ward (or even from ICA), need further long-term assistance and must be institutionalised in other social or health facilities, i.e. nursing facilities, inpatients rehabilitation hospitals, long-term care, hospices, or residential units. It can take a long time for the ward staff (or even for the ICA staff) to find the most appropriate facility for the specific patient's needs, so the flowchart is enriched with a Central Discharge Gateway (CDG). The CDG is a unit in charge of contacting the different facilities outside the hospital in order to safely and quickly transfer the patient, and all information about their clinical pathway, to the institution that can continue the process of care outside the hospital. CDG's main goal is to facilitate the flow of frail elderly patients, in order to avoid delayed discharges and bottlenecks due to a lack of communication among the different actors involved in the care processes. For this reason, just like ICA, CDG is introduced to face critical issues linked to frail elderly patients. Indeed, in order to obtain economies of scale, CDG can also support the transfer of any patient who cannot be discharged to their home but is in need of admission in another facility after his/her discharge, for any reason.

The introduction of these elements in hospitals requires a re-engineering of some processes, with new resources and new competences of a part of hospital staff. Hospital areas already available or obtained from space optimisation of different wards can be used for ICA, while CDG services can be performed by an office with administrative staff that contact the facilities and organise the logistic aspects of patient discharge. Case manager and Bed manager are professional tasks that can be assigned to specialised nurse, while Hospitalist has to be a physician of General Medicine with both organisational and clinical competences. FCA requires staff already present in inpatient wards.

A full representation of the tools and the professional roles integrated into the hospital organisation is represented in Figure 3.

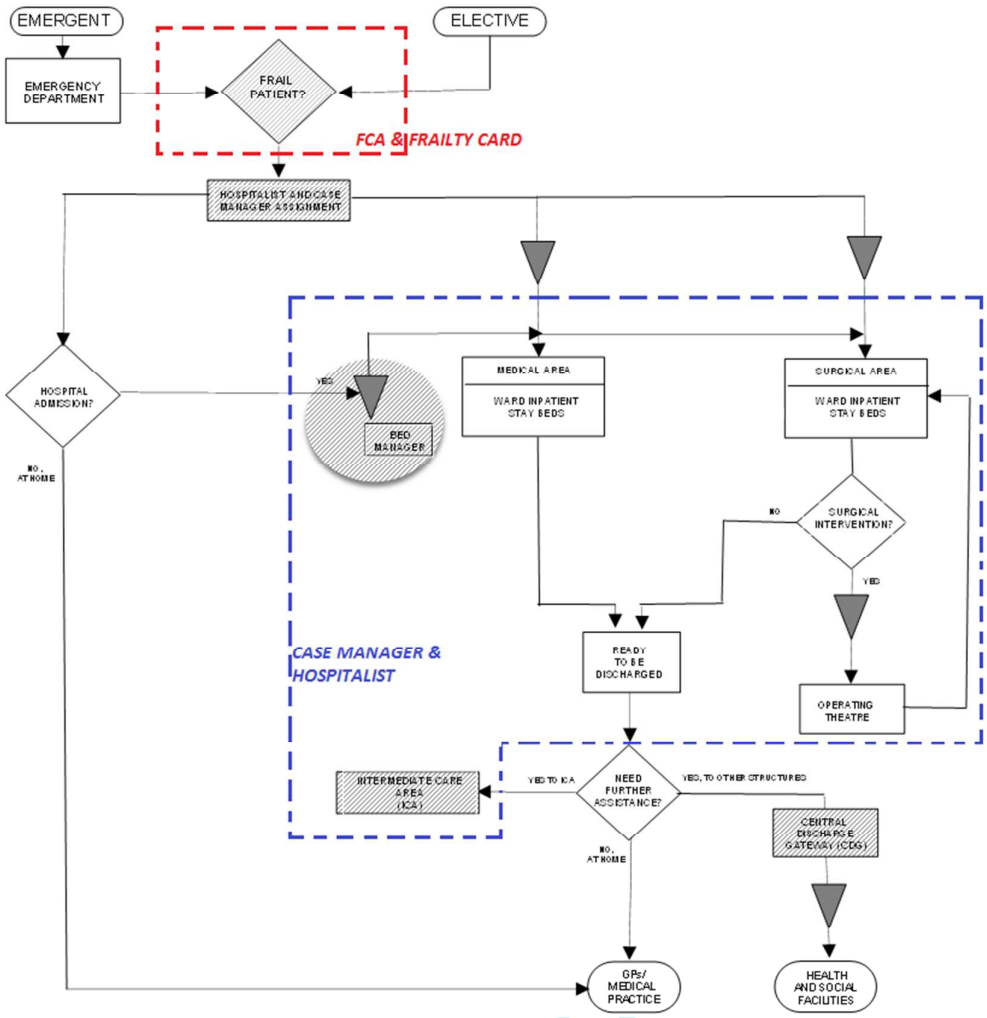

Figure 3. Flow chart of conceptual model for frail patients

5.1. A set of quality indicators for an evidence-based model for frail patients

In order to validate the model, a set of indicators was defined to monitor the flow of patients and evaluate the impact of the model's application on the delivery of care to frail patients in acute-care hospitals. Naturally, this set of indicators needs to be supported by a Hospital Information System (HIS) that is able to collect data and information concerning frail patients. In case there is no unanimously accepted medical definition of frailty or missing updates for frail elderly conditions in the HIS, the information system should focus on the population aged 65 years and over in order to collect relevant data.

In order to build the set of indicators, we refer to Donabedian's healthcare quality model (Donabedian, 1966, 1988, 2005), which was introduced in the 1960s and named after the physician and researcher who developed it. This model became a milestone for quality improvement processes and for models of evidence-based practice in healthcare (Anderson Elverson and Samra, 2012; Titler, 2001). Donabedian's model is based on the measurement of three dimensions - structures, processes and clinical outcomes - that are assumed to be strictly related. Improvements in the structure of care should lead to improvements in clinical processes, which should in turn improve patient outcomes (Moore *et al.*, 2015). More specifically, structure indicators are expected to measure the settings in which care is delivered, in terms of material, human and organisational

resources, while process indicators assess what the provider does for the patient. Finally, outcome measures try to describe the effects of care or of a change in care processes on the health status of patients (Mainz, 2003).

In order to validate the model and gather some evidence about its ability to overcome the most critical issues (e.g. providing frail patients with appropriate and affordable care), the set of (structure, process and outcome) indicators is expected to measure if and how the model is able to achieve the objectives it pursues, i.e.: i) to reduce frail patients' admission time and length of stay, ii) to better coordinate multidisciplinary interventions, iii) to speed up discharging and if necessary admission to other long-term facilities and, eventually, iv) to reduce the risk of adverse events.

For each of these objectives some structure, process and outcome indicators have been chosen, based on research and practice evidence about the delivery of care to frail patients in acute hospitals. In Table 1, a general overview of the indicators is provided.

5.1.1 Reducing frail patients' admission, admission time and length of stay

In order to assess the degree to which this objective is achieved, the model proposes the use of some indicators. The indicator *Proportion of frail elderly patients being admitted to wards beyond the assessment* (National Audit Office, Department of Health, UK, 2016) is proposed in order to evaluate whether the model contributes to better managing admissions, preventing inappropriate ones. Other relevant indicators are *Bed occupancy for frail elderly patients* and *Average length of stay for frail elderly patients*, which are expected to decrease with the application of the model. Also, the *readmission rate of frail elderly patients* ~~for these patients~~ appears to be an appropriate indicator, since timely and appropriate care is expected to promote a decrease in readmission after thirty days (Silvester, 2014). Finally, the *Frail elderly patients/Hospitalist ratio* and *Frail elderly patients /Case Manager Ratio* are two structure indicators for measuring the efficiency and effectiveness of the two human resources we introduced in the model.

5.1.2 Better coordinating multidisciplinary interventions

Coordination is at the very basis of the model. The patient centred approach improves coordination inside the hospital, among its units and among hospital and other actors of the healthcare system. The *Number of frail elderly patients waiting for admission to ICA* and *Average waiting time of frail patients waiting for admission to ICA* are two process indicators that are meant to evaluate the ability of the model to speed frail patients' admission to this unit; the *Prevalence and type of medication discrepancies* on the contrary concern coordination problems among hospital and other actors, during for example patients' transitions from community to acute-care hospitals (Villanyi *et al.*, 2011). Coordination between long-term facilities and acute hospitals is expected to improve information flows and decrease medication discrepancies.

5.1.3 Speeding up discharging and if necessary admission to other long-term facilities

With reference to speeding up the discharging of patients that are ready to be discharged, the most appropriate indicators appear to be the *Number of delayed discharges attributable to frail elderly patients* and the *Average length of delayed discharges attributable to frail elderly patients* (National Audit Office, Department of Health, 2016). Similarly, if admission to other facilities is necessary, the indicators to use are the *Average length of a delayed transfer of care attributable to frail elderly patients* and the *Number of delayed transfers of care attributable to frail elderly patients* (NHS Benchmarking Network, 2017).

5.1.4 Reducing the risk of adverse events

Concerning the impact on the health status of frail older patients, which needs more time to be evaluated, the *In-hospital mortality of frail elderly patients* appears to be a fundamental indicator (Silvester, 2014). Moreover, considering the vulnerability of frail patients, it is important to reduce high-risk events. For this reason, the *Number of hospital-acquired infections (HAI) of frail elderly patients* is considered, with specific reference to the infections most often observed in frail patients, such as pneumonia, urinary tract and skin infections (Jones, 1990). Also, the *Number of geriatric syndromes*, such as delirium, falls, incontinence, poor nutrition, immobility, functional decline and pressure sores (George *et al.*, 2013) is considered.

Objective	Indicator	Type Structure (S), Process (P), Outcome (O)
Reducing frail elderly patients' admission time and length of stay	Proportion of frail elderly patients being admitted to wards beyond the assessment process	P
	Frail elderly patients - hospitalist ratio	S
	Frail elderly patients – case manager ratio	S
	Bed occupancy of frail elderly patients	P
	Average length of stay of frail elderly patients	P
	Readmission rate of frail elderly patients	O
Better coordinating multidisciplinary interventions	Average number of frail elderly patients waiting for admission to ICA	P
	Average waiting time of frail patients waiting for admission to ICA	P
	Prevalence and types of medication discrepancies	O
Speeding discharges and if necessary admission to other long-term facilities	Average length of delayed discharges (from the day the patient is declared dischargeable to the day of the discharge)	P
	No. of delayed discharges attributable to frail elderly patients	P
	Average length of a delayed transfer of care attributable to frail elderly patients	P
	No. of delayed transfers of care attributable to frail elderly patients	P
Reducing the Risk of adverse events	Hospital-acquired infections (HAI) of frail elderly patients	O
	In-hospital mortality of frail elderly patients	O
	No. of geriatric syndromes	O

Table 1 – Set of quality indicators for an evidence-based model for frail patients.

6. Conclusion

Future demographic trends lead us to expect a modification of the composition of people demanding to be admitted to acute-care hospitals. Nowadays, more than half of patients in European countries are elderly, and they are increasing rapidly. This causes more frail people to address health services, because frailty depends on a set of conditions all linked to age, such as comorbidity, disability and geriatric disorders. Over time, specific health services for frail elderly have been developed in all countries, building a network in order to follow them continuously across different care settings. For a successful integrated care pathway, a central role is still played by the acute-care hospital, where frail patients spend some time coming from and returning home or to less intensive care levels (nursing homes, post-acute facilities, social care units, caregivers, etc.).
Compared to the growing demand for hospital services, the corresponding supply appears to be inadequate. It is not a matter of resources, but rather a matter of the organisational structure of the hospital. Following the evolution of medical science, this structure has evolved according to a more and more specialist approach aimed at caring for the single diseases of a specific organ.
Frail older people on the other hand require a holistic approach that takes into account all dimensions as a whole. Hospitals are generally not equipped to treat complex patients properly.
This organisational gap results in unnecessary waits and increasing patient length of stay. More time spent in hospital wards means poorer outcomes, because in addition to the usual iatrogenic

risk, for an elderly person a hospital stay means leaving his/her environment, involving functional decline and a deterioration of their mental conditions. The problem is not new, and tools have been developed for years to try and avoid these negative consequences, such as a comprehensive assessment of geriatric conditions, a case manager, a low intensity ward, and so on.

The novelty of the paper is to propose that all positive previous experiences are included in the care process, by developing a conceptual model designing the care path for frail patients inside an acute-care hospital. The conceptual model was developed looking for the main available evidence-based instruments that have already been found to facilitate a frail elderly path. The conceptual model is therefore in a certain sense already EBM, because the standard clinical pathway of the hospital has been enriched with new organisational units and activities (developed by new dedicated professional roles) aimed at optimising the path of frail patients inside acute-care hospitals.

But even if different tools have been proved to be effective during years of local experience in single countries or hospitals, we maintain that further research on the evidence is necessary, applied to the entire process. The developed conceptual model can be considered a framework for finding further proof of the entire process, and not only of the single tools as was done until now.

However the overall study present both strengths and weaknesses. The strength of this study lies in its contribution consisting of providing a new organisational path for frail elderly that considers a holistic view with respect to the actual literature. Each element included in the model derives from an efficient innovation in hospital management and organisation, but each study analysed it separately. The hospital is composed of a synergy of different elements and units that interact and are integrated to provide healthcare to patients in need. Focusing on and analysing only a singular problem or area within the organisation is the wrong approach.

The weakness of the framework proposed herein consists of the lack of proof for the conceptual model's effectiveness. Each element of the model has proved effectiveness in terms of outcome and output when implemented inside a hospital system, but we cannot prove the effectiveness of joining all the elements inside a unique framework, as we proposed. In order to verify the real effectiveness, hard work needs to be done: firstly, coming to an agreement with a hospital that can help with the provision of detailed data, and secondly, through the development of a simulation model that can represent the system. Once the system is represented and validated, a what-if and scenario analysis can be performed in order to verify the impact of the conceptual model and the different strategies in terms of resource (quantity) and organisation. Another limitation is represented by the adoption of only three principles of evidence-based practice, as we did not consider the stakeholder point of view directly, especially patients. In the development of this point it is necessary to provide a qualitative study based on Patient and Public Involvement (PPI) interviews to analyse the preferences of both National and Regional Healthcare System directors and frail patients. As this element is really important, this will be a supplementary study that will be developed in the future to support the framework.

Some studies have already been proposed by some of the authors, and they attempt to model and verify the impact of bed management in hospital organisations by using different simulation techniques, such as Discrete Event Simulation, System Dynamics and Hybrid Simulation approaches. Future directions of research will be focused on introducing and developing a hybrid simulation model able to represent the care process and verify the impact of the organisational changes in the current practice. The simulation model will represent reality, providing a scenario analysis to evaluate the impact of the conceptual model on the hospital's organisation under several resource constraints, and considering the variations of service demand and supply.

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