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Effectiveness of an hospital bed management model: results of four years of follow-up

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Abstract

Background. *Several experiences of Bed Management have been published, most of them focusing on Emergency Department organization. Aosta Hospital is 70 km away from the nearest Hospital, so that ambulance diversion is not feasible and patients' admissions from ED need to be managed at the local level solely. Aim of this study was to test efficacy of an innovative Bed Management model.*

Setting and method. *Bed Management procedure consisted of an algorithm of both rational outward allocation of patients and support to "difficult" discharges. Hospital indicators of the pre-intervention period (years 2008-2011) were compared with those of the post-intervention period (years 2012-2015), splitting data into ten medical wards mostly admitting patients form ED and seven surgery wards mostly admitting "planned" patients.*

Results. *In the before-after analysis, mean length of stay decreases from 7.84 to 7.41 days (p= 0.000), and bed occupancy from 81% to 77%. Outlier days fell from 6.3% to 5.4% (p= 0.000), and the same did long stay patients (from 5.8% to 5%, p = 0.000). By contrast, ED admissions increased from 16.5% to 17.8%, as very short stays (23.9 to 25.3%, p= 0.000) and the 30 days unplanned readmissions (9.9% to 11.9%, p =0.000). The observed variations were more significant in the medical wards. Finally, waiting times in ED significantly decreased during the study period in the medical wards.*

Conclusion. *We propose a comprehensive BM model, including governance of difficult discharges within a general hospital perspective. Further organization research on Bed Management is needed, also to propose BM standards, to be adopted in any Hospital.*

Introduction

Delays in admissions to the wards of patients coming from the Emergency Department (ED) represent a well-defined clinical risk factor (1-2), including Hospital Acquired Infections (HAIs) (3); moreover, ED overcrowding and admissions delays have also been shown to have more indirect, yet important effects, such as longer length of stay (LOS) and increased Hospital costs

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(4-5). In recent years, several attempts have been described regarding the so called Bed Management (BM) (6-8), mostly tested in the United Kingdom, as a typical nurse function. So far, available literature about BM is scattered, and results are not solid enough to argue the effectiveness of the proposed models that are, with some exceptions (7), insufficiently described in detail to be tested elsewhere. Last but not least, available studies mostly focus on ED and/or Intensive Care Units (ICU) (8), while the impact of BM models at the whole hospital level has not been described yet. In Italy, scarcity of hospital beds is a worsening problem, mostly due to the combination of population ageing (9) with hospital bed cuts, further set by law 7/2015, which defines new organizational, qualitative, quantitative and technological standards for the hospital network in Italy, including the cut of more than 3,000 hospital beds. As a consequence, optimizing hospital beds utilization has now become a pressing policy priority, to match with comprehensive care strategies for the dependant elderly in the out-of-hospital setting, even if, at this regard, interesting pilot experiences have been described at the regional level (10).

Aim of our study was to implement a BM model, to test its efficacy at the hospital level employing several indicators of activity and to discuss its suitability for other Italian settings.

Setting and methods

Valle d'Aosta (3,262 Km^2, about 128,000 residents at 31 December 2014) is the smallest Italian region, entirely included in the northwestern Alps area. It contains one only Health Agency, one general Hospital with some 490 beds, 28 of them for long-term care of the elderly, 7 devoted to palliative care (hospice) and 50 of them for "day hospital". There is an ICU with 10 beds, and a neonatal ICU with 6 cradles; surgical beds are 35%. There are 23 wards hosting 19 specialties, 7 of them surgical; the ED is provided with 10 beds: the hospital lacks cardiosurgery and neurosurgery. The hospital bed capacity and the organizational profile remained unchanged all over the study period, with the significant exception of Healthcare Professionals (HCPs) reduction in the ED, that lost one doctor and one nurse on day shifts. The territory hosts two long-term care residencies for the elderly (41 beds, reduced to 28 after 2015) and a network of 41 small residencies, spread over the region and with a (in theory) more social vocation, with some other 1,100 beds capacity.

Aosta Regional Hospital is 70 km away from the nearest Hospital, which is located in a different Region (Piedmont), for that reason ambulance diversion is not admitted, with some exceptions regarding the specialities unavailable in the Aosta Hospital. Consequently, the Hospital had been empirically self-trained to manage by itself all transfers from ED to other wards; over time, the instrument to avoid excessive waiting times in the ED was the adoption of out-ward admission (for example: a medicine patient into a surgery ward). After 2005 this fully empirical approach became gradually ineffective and hard to manage, in particular with increasing litigation among HCPs and deterioration of the working climate. For the above reasons the Health Agency Direction in 2011 gave mandate to the Hospital Medical Direction to create and implement a Bed Management Procedure (BMP); a project team was established, including representatives from ED and from Hospital clinical areas: medical, surgical, critical. The BMP was defined by October 2011 and adopted since January 1, 2012.

The main features of the BMP are described in Table 1 and Fig. 1.

The effectiveness of the proposed model was tested through a before-after approach, by comparing pre-intervention period

(2008-2011 or control period) with after-intervention period (2012-2015). Data were drawn from the archives of clinical charts and the following indicators were selected for analysis:

- number of discharged patients
- percent of deceased patients
- mean patients age
- number admission days
- mean occupancy rate
- mean length of stay (days)
- outlier days, percent
- admissions <3 days, percent
- long stay patients >14< 24 days, percent
- long stay patients > 24 days, percent
- 30 days unplanned readmissions, percent

Table 1 - Bed management model summary

- BM is a responsibility of the Hospital Medical Direction (HMD)
- The dedicated team includes medical doctors, nurses and the social service, for the purpose embedded into the HMD
- BM is active on a 7 d/24 h basis
- BM deals the urgent admission from the Emergency Department (ED) to the wards and with complex discharges from the wards
- The ED specialist decides to admit the patient and selects the specialty of destination, regardless of bed availability
- Time allowed for patient allocation is 1 hour
- The designated specialist accepts the patient in the designated ward; if no bed is available there, in another ward of the same department: if no bed is available, in the same clinical area; finally, anywhere in the hospital
- The BM team:

  - daily checks activities, patients' flows and ED needs

  - when requested, supports specialists and wards to properly admit patients

  - supports wards and the Social Service in discharging patients with social needs, with a special focus on "early diagnosis" of social needs

- number of ED entries
- rate of admissions from ED
- mean waiting times in ED (hours).

Outlier days came from cases with a length of stay longer than the upper trim point of each Diagnosis Related Group (DRG). Waiting time in ED was calculated since the triage of patients discharged from ED.

We supposed that the model could affect hospital wards admitting patients mostly from ED, typically those from the medical area; for this reason data were evaluated not only as whole hospital (all wards, including critical area), but also split into medical area ("study group", ten wards) and surgical area ("control group", 7 wards), that admit patients mostly by planned admissions.

Statistical analysis was performed by using the SPSS statistical software version 22 (IBM SPSS Statistics, IBM Corporation, Chicago, IL) comparing categorical variables in contingency tables (χ^2 test, with α level 0.05 and 1-β level 0.80) and continuous variables with *t* test for independent samples.

Results

Results are summarized in Table 2; for most indicators observed variations were more evident for the medical wards ("study wards") compared to the surgical wards ("control wards"), even if differences were lower than expected. Mean age of admitted patients increased from 51.9 to 54.3 years (p= 0.000) paralleled by increase of ED entries (from 155,921 to 214,710), while percent deceased remained stable at the Hospital level and decreased from 7.6% to 6.8% in medical wards (p = 0.002). In the post intervention period LOS lowered from 7.8 to 7.4 days (p =0.000) with, coherently, less admission days and a lower bed occupancy. Our BM model had a strong mandate to foster prompt discharge of long-stay patients with social and familial

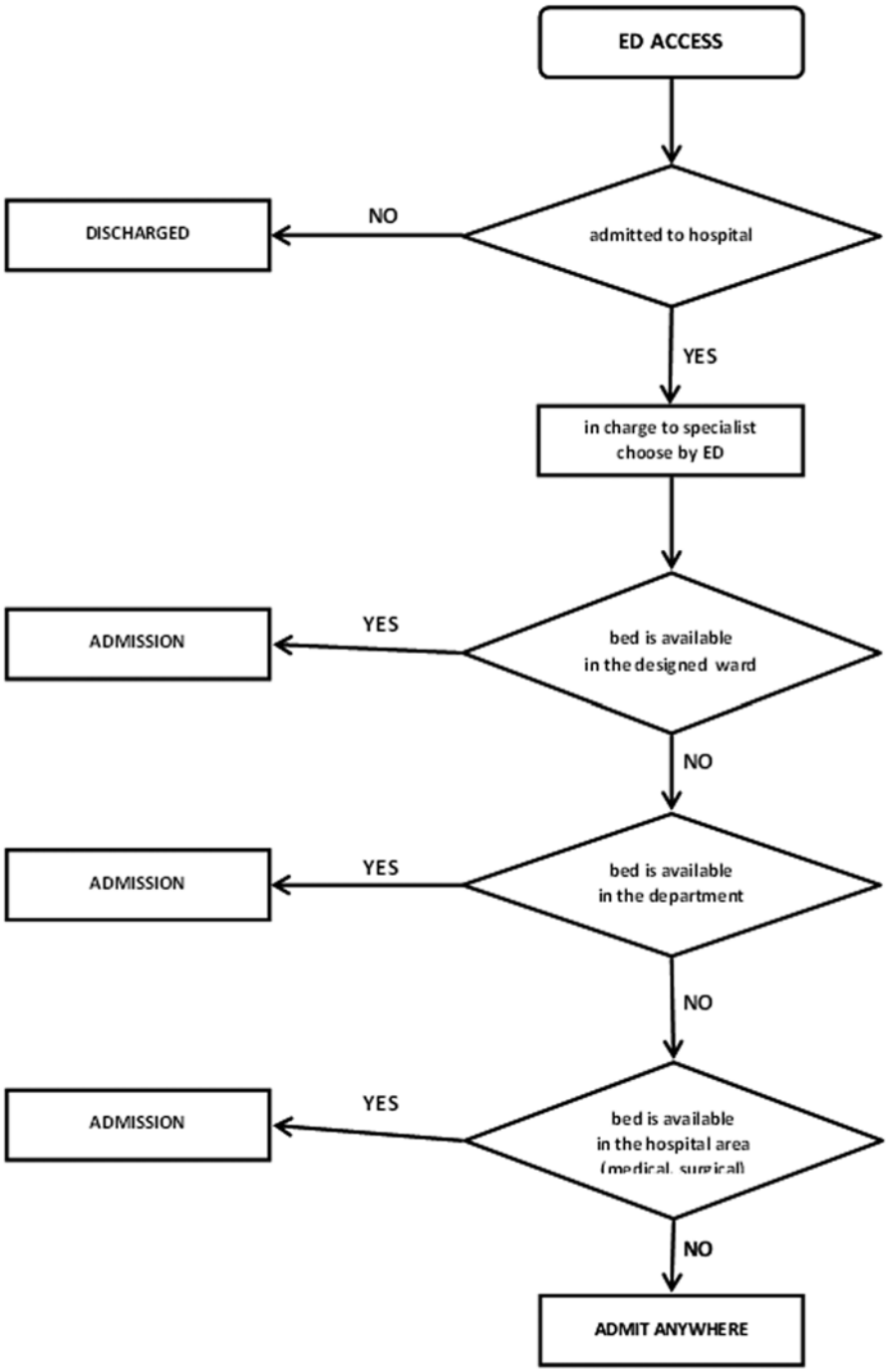

Figure 1 - Bed management alghorhytm

Table 2 - Aosta Hospital, four years of bed management, before-after analysis

		hospital			medical area			surgical area		
		pre intervention	after intervention	p	pre intervention	after intervention	p	pre intervention	after intervention	p
discharged patients	n.	63,233	63,927	nd	19,876	22,558	nd	33,222	31,592	nd
mean patients age	years	51.9	54.3	0.000	69.3	70.8	0.000	50.5	51.7	0.000
deceased	%	3.8	3.8	0.931	7.6	6.8	0.002	0.4	0.4	0.676
admission days	n.	495,707	473,608	nd	204,279	213,094	nd	185,237	168,577	nd
mean lenght of stay	days	7.84	7.41	0.000	10.28	9.45	0.000	5.58	5.34	0.000
short stay patients <3 days	%	23.9	25.3	0.000	12.1	14.4	0.000	32.0	34.1	0.000
long stay patients >14< 24 days	%	8.7	8.4	0.042	14.9	13.7	0.000	5.6	5.0	0.001
very long stay patients > 24 days	%	5.8	5.0	0.000	7,8	6,4	0.000	2,5	2,20%	0.004
outlier days	%	6.3	5.4	0.000	6.4	4.8	0.000	4.4	3.9	0.005
<30 days readmissions	%	9.9	11.9	0.000	12.8	14.6	0.000	8.8	8.6	0.396
mean waiting times in ED	minutes	190.4	190.7	0.827	245.7	236.2	0.000	136.5	146.6	0.000

ND: not determined

issues hampering discharge; several indicators were proposed for that purpose. In the after-intervention period percent of outlier days decreased from 6.3% to 5.4% at the Hospital level (p=0.000) and from 6.4% to 4.8% in the medical area (p=0.000), such as percent of long-stay patients, especially those exceeding 24 days of admission (from 5.8% to 5.0%, p=0.000), even considering that, for the latter, we couldn't distinguish between social and purely clinical long-stay cases. Our BM model strongly facilitated ED work, allowing patient admission without any negotiation with ward specialists; as a possible consequence, the admission rate from ED increased from 16.5% to 17.8% and very short stays (<3 days) increased from 23.9% to 25.3% (p=0.000), especially in the medical area (Table 2). Finally, ED waiting times during the study period significantly decreased for patients admitted to medical wards, while increased in the surgical wards.

Discussion

The starting point of our BM experience was characterized by an empirically working model in need of an urgent regulation. After adoption of a BM strategy, synthesized in the shared procedure, we observed significant and coherent improvement of many hospital activity indicators; furthermore, the overall hold of the model must be underlined, in face of several and worsening stress factors: increasing patients' age, strong increase in ED entries, HCP cuts in the ED since 2014, decrease of the specialists from 3 to 2 during the daily shifts. Similarly to other authors (11-12) our paper provides a before-after analysis, but with a wider array of indicators; clearly, we cannot presume a causal effect between observed variations of several hospital indicators and the BM model start: at this regard we believe that BM implementation may have fostered cultural and behavioural changes among HCPs, improving team-work and increasing sensitivity about BM-related issues and overall patient management. Moreover, our results are coherent internally and over time, thus rendering a casual effect unlikely. Next, over the implementation period no changes took place in the Regional Health Service that could in any way explain the observed results. We believe the main reason for the results observed is that BMP was prepared and shared by professionals belonging to all the hospital areas involved in hospital patients' flows, with supervision by the Hospital Medical Direction. In this respect, we propose the role of the HMD as a key feature in the BM success in our hospital; we created a truly interactive doctor-nurses team with both a very operative and supportive profile alongside with a more authoritative role, with a focus on periodic feedback of observed activity results. Most BM papers focus on ED only; to our knowledge, our paper is the first with a more comprehensive approach, aiming to the overall governance of hospital patients' flows. In particular, we embedded the social service into the BM team, therefore creating strong and collaborative efforts to manage discharges of "difficult" patients, typically the disabled elderly with several comorbidities and/or patients without enough social and family support (13-14). Moreover, we chose to separately analyze the results from wards more likely affected by the BMP (medical area) and from a "control group" of surgical wards, which mostly admit planned patients; interestingly, variations were observed also in the "control group", although at a lesser degree and with the significant exception of ED waiting times, suggesting that the behavioural changes elicited by BMP went beyond the ED-medical area urgent-admission axis. In our BM model we propose outward admission of patients (for example: a patient with acute heart failure assigned to a medicine ward and admitted to the vascular surgery

ward) as a general rule to decrease ED waiting times and, as a consequence, clinical risk for acute patients; this approach has some inconvenience, especially the risk of outward admitting, directly from ED, instable, acute patients. This risk was managed, when feasible, by a two-step approach; 1- outward transfer of an already admitted, well-known and stable patient (for example: a patient waiting for hospital discharge); then 2) admission of another patient from ED into the designated ward.

Noteworthy, our BM model has two aspects of concern, which may both be assumed as side effects of a right approach: first, it strongly facilitates ED activity by avoiding bed-negotiation and, as a consequence, the risk of inappropriate admissions was increased (as suggested by increase of both admission rates and short stays). Second, we were somehow surprised by the significant increase of <30 days readmissions; in this case the relationship with the proposed discharge policy is fair at best, but it deserves close attention. We are now preparing the 2016 edition of the BM procedure, which will consider with the due attention the above cited model flaws.

Our study has one major limitation, that is, HCP satisfaction with the model and working climate changes have not been measured; these aspects need to be analyzed by further studies.

In conclusion, we propose a simple and comprehensive approach of Hospital Bed Management, including governance of difficult discharges and characterized by strong involvement of HMD, that showed to be partially effective in a before-after analysis. We believe that a well-shared and authoritative BM model may work both directly and indirectly, changing HCP attitudes and sensitivity toward proper patient management.

Finally, there is a strong need of research about hospital organization, including BM models, that urges to be challenged in well designed controlled studies, at least at country level, where it had been proposed in one case (15), but with efficacy as yet unproven. In any case, the portability to many Hospitals should become a strong prerequisite of any proposed BM model. We therefore underline the need for inter-hospital collaborative studies on BM, possibly leading to putative standards for this now pivotal hospital function.

Riassunto

Efficacia di un modello ospedaliero di Bed management: risultati di quattro anni di follow-up

Premessa. Le numerose esperienze di Bed management pubblicate sono per lo più incentrate sull'organizzazione del Pronto Soccorso. L'ospedale di Aosta dista 70 km dalla struttura più vicina, il che rende impossibile dirottare altrove le Ambulanze dirette al Pronto Soccorso; per tale motivo i pazienti urgenti devono essere gestiti esclusivamente a livello locale. L'obiettivo di questo lavoro è stato di verificare l'efficacia di un modello innovativo di gestione dei posti letto (Bed Management).

Contesto e metodi. La procedura di Bed Management è caratterizzato da un algoritmo di ricovero razionale fuori reparto e di supporto alle dimissioni difficili, per lo più a impronta sociale. Abbiamo comparato una serie di indicatori di attività ospedaliera tra un quadriennio pre intervento (2008-2011) e uno post intervento (2012-2015), aggregando i dati per dieci reparti medici, che ricoverano prevalentemente da Pronto Soccorso, e sette reparti chirurgici, che effettuano prevalentemente ricoveri programmati.

Risultati. Nell'analisi *before-after*, la degenza media è scesa da 7.84 a 7.41 giorni (p= 0.000), e l'occupazione media dei posti letto dall'81 al 77%. Le giornate oltre soglia sono passate dal 6,3 al 5,4% (p= 0.000), e le degenze prolungate dal 5,8 al 5% (p = 0.000). Per contro, il tasso di ricovero da Pronto Soccorso è salito dal 16,5% al 17,8%, così come i ricoveri molto brevi, aumentati dal 23,9 al 25,3% (p= 0.000), e i ricoveri ripetuti a 30 giorni, passati dal 9,9 all'11,9% (p =0.000). Le variazioni riscontrate erano in tutti i casi più evidenti nei reparti medici rispetto ai reparti chirurgici. Infine, i tempi di attesa in Pronto Soccorso si sono significativamente ridotti per i pazienti destinati all'area medica.

Conclusioni. Abbiamo proposto un modello complessivo di Bed Management, in grado di regolare le attività di tutti i reparti ospedalieri, compreso il governo delle dimissioni difficili. Vi è tuttavia urgente bisogno di ricerca organizzativa sul tema, con l'obiettivo di definire

standard ospedalieri per il Bed management, adottabili ovunque.

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