e-Health – For Continuity of Care
C. Lovis et al. (Eds.)

doi:10.3233/978-1-61499-432-9-126

Cross Hospital Bed Management System

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Abstract. The lack of adequate numbers of hospital beds to accommodate the injured is a main problem in public hospitals. For control of occupancy of bed, we design a dynamic system that announces status of bed when it change with admission or discharge of a patient. This system provide a wide network in country for bed management, especially for ICU and CCU beds that help us to distribute injured patient in the hospitals.

Keywords. Systems Integration, Beds/supply and distribution, Software Design, Database Management Systems, Hospital Information Systems

Introduction

The mortality in the groups of patients who were admitted to the CCU with delay was significantly higher overall in the groups of patients who were either not admitted or whose admission was delayed [1].

Lack of beds led to premature discharge in hospital. Premature discharges have a significant impact on mortality [2].

Each hour of waiting was independently associated with a 1.5% increased risk of ICU death. There is a significant association between time to admission and survival rates. Early admission to the ICU is more likely to produce positive outcomes [3].

A problem that has been encountered during mass-casualty incidents is the lack of adequate numbers of hospital beds to accommodate the injured. One solution for the lack of beds is the creation of baseline data systems. For example SAGEC 67, a free-access, information database concerning the availability of beds should help the participating countries, initially France, Germany, and Switzerland[4]. SAGEC 67 is a website, which helps the physician in case of mass casualty disaster to face the lack of beds in Europe[5].

We design and implement a national-wide bed management system for management cross hospital referral patient in crowded hospital that hasn't enough bed for admission patient. Also this system use for accommodate victims in mass-casualty incidents.

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1. Methods

We design a model for transferring bed status in hospitals. Model represent as WSDL[6] standard which can be interface for data collection from Hospital information System. Bed data of hospitals can transfer by SOAP[7] protocol. The data warehouse stores all bed status logs from hospitals. And design a web application for analysis bed status log and report beds available in hospitals.

These data include information on the geographical location of the hospitals, hospital wards and types of bed available in every ward, and in the end status of each bed, whether a bed is occupied or empty. The main point of this system is Direct Sending from the HIS to SEPAS without user intervention. Due to the seriousness of accidents patients, many hospital staff are reluctant to accept patient with acute conditions and require specific bed [ICU and CCU]. The online system by changing the status of bed to announce the new status to health care executives is very valuable.

2. Results

2.1. Design Data Model

Hospital bed is the principal axis of our data model design. Bed centric approach primary benefit is that hospital can be sending only one bed data in one SOAP transaction thus the occupied bandwidth is less and the processing time of SOAP Message will be less Although Hospitals can send more bed data in SOAP Message.

The bed status property of the beds data is a key property in data model of bed. This property indicates whether the bed is empty or not? The possible values for bed status property are shown in Table 1.

For best results in integrated report we used concept of DV_CODED_TEXT from OpenEHR[8] Data type [Shown in Figure 1].

The UML diagram of data model is shown in Figure 2.

Table 1. Values of bed status property

Code	Status	Description
1	Occupied	Bed is Not empty
2	Ready to accept patient	Bed is empty and ready for accept patient
3	Out of Service	Bed is off for some reason like corrupted
4	Reserved	Bed is reserved for a patient.
5	Patient in transition	The patient was transferred to another ward, but has not yet announced its acceptance by the destination. Bed will be released soon.
6	Patient in discharge	A patient discharge order issued by the doctor and the patient is being discharged affair. Bed will be released soon.

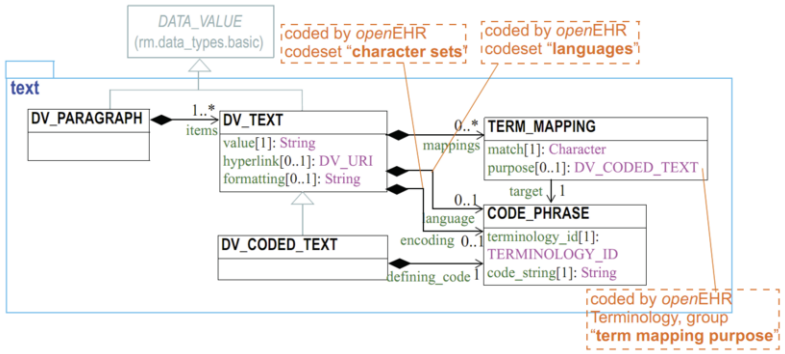

Figure 1. UML Diagram of DV_CODED_TEXT

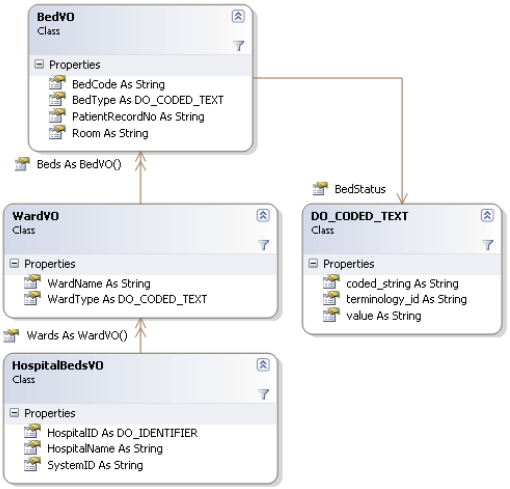

Figure 2. Class Diagram of Bed Data Model

2.2. Create web service

The data model was designed as a web service using .Net Framework technology. Web service launched by SEPAS Infrastructure. SEPAS Infrastructure is national infrastructure for Integrated Care Electronic Health Record. SEPAS Contains of ESB and essential component of SOA Architecture.

2.3. Bed Management Dashboard Development

We design database for store bed data which transfer from hospitals. And develop web site for analysis bed data and determined which bed in hospital is available.

"Guidance staff" is responsible for transfer patient between hospitals in public sector. We create user account for Employee of "Guidance staff" to have online access to bed data. Members of site can use the dashboard to find empty beds in hospitals at any time. ICU and CCU bed is important bed type for Employee of "Guidance staff". List of ICU and CCU empty beds grouped by hospitals Available in dashboard as shown in Figure.3 and Figure.4.

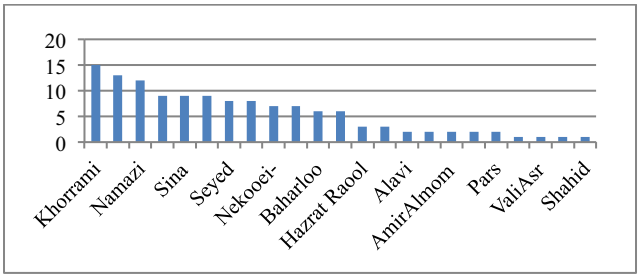

Figure 3. Count of ICU empty bed

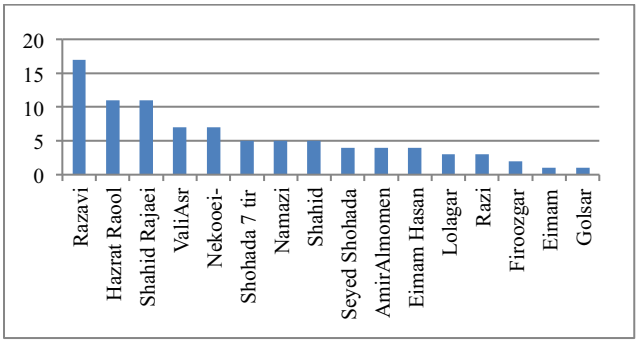

Figure 4. Count of CCU empty bed

2.4. Updating Hospital Information System

Bed Web service Tutorial Standard Document was written and we send the document for private company that develop Hospital Information System (HIS). The HIS must call bed web service and transfer bed data from HIS to bed management dashboard. Developer of HIS Updates software so that any change in Status of beds in HIS will lead to call Bed web service.

HIS companies that updated software for compatible by Bed management service were RahavardRayane ,Tirajeh, Rayavaran, TarasheHoushmand. 86 hospitals can connect to system via HIS.

3. Discussion

We design and implement cross-enterprise bed management system for overcrowded hospitals. The first purpose of our work is facilitating decision making in management of referral patients who need admission in hospitals, In particular need CCU and ICU admission. The incidence of bed and ward admission and the average length of stay can be used in calculating bed need[9]. ICU-services take about 15-20% of the hospital budgets[10]. Decision of number of ICU bed is critical decision for hospitals and government. One of the critical determinant of the work undertaken by public hospitals is the bed occupancy rates[11].

Average bed occupancy level has been the primary measure that has guided hospital bed capacity decisions at both policy and managerial levels[12]. Expand Capacity Hospitals' capacity can be expanded by adding new beds to meet incremental patient demand. Each additional hospital bed requires approximately $1 million in capital costs and more than $250,000 per bed annually for operating costs[13]. The information stored in this system can be used to calculate bed occupancy. In summary, the benefit of this system is conceivable as follows:

a. Developing a decision making system for management of referral patients who need admission in hospitals.
b. Calculating ratio of bed occupancy for each hospital.
c. Developing a decision making system for adding new beds to meet incremental patient demand as requirement especially for ICU and CCU bed.
d. Direct Sending status of bed from the HIS to SEPAS without user intervention.
e. This system has a potential benefit for the development of decision support systems and data mining in order to assist future planning.

4. Acknowledgement

The authors are grateful to Dr. Gholamreza Masoumi.He was Head of Disaster and Emergency Management Center, MOH of Iran I.R., when the system developed and implemented in the hospitals.

References

[1] Walker DM, Wicks M, Hubbard WN, Thomas RD. Increased mortality from inadequate provision of coronary care unit facilities. J R Soc Med. 1994 Apr;87[4]:211-2.
[2] Rodriguez-Carvajal M, Mora D, Doblas A, Garcia M, Dominguez P, Tristancho A, et al. [Impact of the premature discharge on hospital mortality after a stay in an intensive care unit]. Med Intensiva. 2011 Apr;35[3]:143-9.
[3] Cardoso LT, Grion CM, Matsuo T, Anami EH, Kauss IA, Seko L, et al. Impact of delayed admission to intensive care units on mortality of critically ill patients: a cohort study. Crit Care. 2011;15[1]:R28.
[4] Hadef H, Bartier JC, Delplancq H, Dupeyron JP. Using baseline data to address the lack of hospital beds during mass-casualty incidents. Prehosp Disaster Med. 2008 Jul-Aug;23[4]:377-9.
[5] Hadef H, Bartier JC, Pelaccia T. SAGEC 67, a free-access database linking at least three countries, for finding spare beds in the event of a mass casualty incident. Eur J Emerg Med. 2009 Aug;16[4]:183-7.
[6] Web Services Description Language [WSDL] W3C; 2001 [cited 2012]; Available from: http://www.w3.org/TR/wsdl.
[7] Simple Object Access Protocol [SOAP] 1.1. W3C; 2000 [cited 2010 2012/04/19]; Available from: http://www.w3.org/TR/2000/NOTE-SOAP-20000508/.
[8] openEHRArchitecture.[cited2012];Availablefrom:http://www.openehr.org/releases/1.0.2/architecture/overview.pdf.
[9] Pearson GA, Reynolds F, Stickley J. Calculating the need for intensive care beds. Arch Dis Child. 2012 Nov;97[11]:943-6.
[10] Wild C, Narath M. Evaluating and planning ICUs: methods and approaches to differentiate between need and demand. Health Policy. 2005 Mar;71[3]:289-301.
[11] Phillips A, Smallwood L. Hospital beds and the quality of a national health system. Aust J Rural Health. 2010 Jun;18[3]:93-5.
[12] Green LV. How many hospital beds? Inquiry. 2002 Winter;39[4]:400-12.
[13] Litvak E, Bisognano M. More patients, less payment: increasing hospital efficiency in the aftermath of health reform. Health Aff [Millwood]. 2011 Jan;30[1]:76-80.