

Using Administrative Data from the Hospital Information System to Evaluate Healthcare Interventions

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Abstract:

Objective: To evaluate the effects of Basic Hospitalization Fee (BHF), Diagnosis Procedure Combination Per-Diem-based Prospective System (DPC/PDPS), and electronic medical record (EMR) on hospital length of stay (LOS) using administrative data stored in the hospital information system (HIS).

Methods: de-identified data of inpatients admitted in 1997-2010 were obtained from the information center of a Kochi Medical School Hospital. The monthly average LOS (ALOS) was driven from cases with LOS<91 days and interrupted time-series analysis was employed.

Results and discussion: Between 1997-2010, there were 98,379 admissions with LOS≤90 days and whose ALOS was 20.380 days. The BHF initiated a trend of -0.097 (95% confidence interval (CI): [-0.131, -0.063]) days/month and a change in the level of monthly ALOS of 2.54 (95% CI: [1.500, 3.582]) days. The DPC/PDPS significantly reduced the ALOS by 1.942 (95% CI: [-2.856, -1.028]) days but led to an upward trend of ALOS by 0.107 (95% CI: [0.069, 0.144]) days/month. The electronic medical record (EMR) caused a downward trend of monthly ALOS of -0.053 (95% CI: [-0.080, -0.027]) days/month.

Conclusion: the health information technologies, in addition to their benefits on healthcare delivery, provide a valuable resource to evaluate healthcare interventions.

Keywords: Basic Hospitalization Fee, Diagnosis Procedure Combination Per-Diem-based Prospective System, EMR, evaluation, length of stay

1. Introduction

Various health information technologies, such as HIS, have been extensively implemented for the last few decades to improve the quality of healthcare and efficiency and patient safety, and it was shown that the EMR was effective in achieving these goals. Besides improving healthcare services, EMR provides a wealth of clinical and administrative data that could be employed to evaluate healthcare-related interventions cost-effectively.

In this work, we used administrative data stored in the HIS of Kochi Medical School Hospital, an advanced treatment hospital in west Japan, to evaluate the effectiveness of BHF, DPC/PDPS, and EMR on ALOS. The BHF is a medical care reimbursement system in which, in addition to the fee-for-service (FFS), the hospitals were rewarded flat-rate financial incentives per inpatients with LOS shorter than the predetermined duration. Another intervention targeting the LOS was the DPC/PDPS that was introduced in June 2003 in the hospital. The third intervention evaluated in this study was the EMR. Though the primary objective of the implementation of EMR is not shortening LOS, studies showed that it also contributes to the reduction of LOS.

The objective of this study was to measure and compare the effectiveness of these interventions on LOS.

2. Methods

Deidentified data of inpatients consisting of anonymized ID, admission, and discharge dates from 1996-2010 were obtained from the hospital's information center. Admissions>90 days were removed from the analyses and the ALOS was aggregated into months based on admission dates to extract the monthly ALOS (MALOS). The MALOS from January 1997- December 2003; January 2003- December 2010 and January 2000-December 2006 were used to evaluate the impact of the BHF, PDPS, and EMR respectively (Table 1). An interrupted time series analysis (ITS), a regression-based quasi-experimental study design that is employed to evaluate the effectiveness of interventions that have been implemented at a clearly defined point of time, like the interventions in this study, was implemented. To employ ITS, in addition to the outcome variable (monthly ALOS), three independent variables were created:

T_t- months covering the study periods sequentially, increasing by 1 each month,

X_t- a dummy variable indicating the pre-intervention periods (coded 0) or the post-intervention period (coded 1), and

T_{it}- post-intervention periods, which were assigned the value of 0 for all pre-intervention series and increased with a unit representing months after the intervention.

The following segmented regression model was used to obtain the coefficients:

$$\text{Monthly ALOS} = \beta_0 + \beta_1 T + \beta_2 X_t + \beta_3 T_{tr} + \varepsilon_t,$$

Where β_0 represents the baseline monthly ALOS at $T = 0$, β_1 is the change in outcome associated with T representing the underlying pre-intervention trends, β_2 is the level change following the interventions, and β_3 indicates the trend change following the interventions.

3. Results

In 1997-2010, there were 98,379 admissions with $\text{LOS} \leq 90$ days and had ALOS of 20.380. The BHF initiated a downward trend of monthly ALOS post-implementation of -0.069 (95% CI: [-0.113, -0.025]) days/month. Following the implementation of the BHF, the level of monthly ALOS went up by 2.54

(95% CI: [1.500, 3.582]) days. The DPC/PDPS that was implemented in June 2003 significantly reduced the LOS by 1.942 (95% CI: [-2.856, -1.028]) days but led to an upward trend of ALOS by 0.107 (95% CI: [0.069, 0.144]) days per month. On the other hand, the DPC/PDPS reduced the LOS by 1.942 (95% CI: [-2.856, -1.028]) days but led to an upward trend of ALOS by 0.107 (95% CI: [0.069, 0.144]) days/month. The EMR caused a downward trend of MALOS by -0.053 (95% CI: [-0.080, -0.027]) days/month but could not change the level of LOS immediately post-implementation (Table 1 and Table 2). level of LOS post-implementation (Table 2).

Table 1: ALOS in the hospital during the study periods

Admission dates	No. of admissions (ALOS [95% CI])
Jan. 1997- March 2000 (pre-BHF)	15762 (26.408 [26.085, 26.731])
April 2000- December 2003 (post-BHF)	23029 (23.051 [22.805, 23.297])
Jan 2000- May 2003 (pre-DPC)	20114 (24.0145 [23.746, 24.283])
June 2003-December 2006 (post-PDPS periods)	26908 (19.622 [19.417, 19.827])
Jan 2003- Dec. 2006 (pre-EMR periods)	29707 (19.791 [19.594, 19.988])
Jan 2007- Dec. 2010 (post-EMR periods)	37004 (16.564 [16.407, 16.721])

4. Discussion and conclusion

In addition to the benefits HIT provides for healthcare quality and patient safety improvement, it also creates a precious opportunity for researchers, clinicians, healthcare administration, and policymakers to use the data for research and make informed decisions. If the clinical data are accumulated for long enough, stronger study designs, such as ITS, could be employed and better-quality evidence could be generated for informed decision making. In this study, we evaluated three interventions that were employed at various times using ITS. The analyses showed that the BHF triggered a reduction in the trend of LOS in the hospital but following its intervention, the LOS was increased temporarily. As we could not

find data on other variables, such as epidemiological data, we could not confidently say that the increment was attributed to the intervention.

This study revealed that, in line with the existing literature, the DPC/PDPS reduced the ALOS by 18.3% immediately after the implementation. Despite the abrupt reduction of LOS, the DPC/PDPS initiated an upward trend of MALOS by a rate of 0.107 days/month. The negative consequences of the intervention in the healthcare quality- increasing readmission and in-hospital mortality rates, shown by the study mentioned, probably caused the upward trend in ALOS.

Table 1: The impacts of the intervention at the study site

Variables	BHF		DPC/PDPS		EMR	
	Coefficients (95% CI)	P-value	Coefficients [95% CI]	P-value	Coefficients [95% CI]	P-value
Intercept	28.381 [27.601, 29.161]	<0.0001	6.612 [25.947, 27.277]	<0.0001	20.571 [20.036, 21.105]	<0.0001
T	-0.097 [-0.131, -0.063]	<0.0001	-0.117 [-0.145, -0.090]	<0.0001	-0.031 [-0.050, -0.012]	0.0020
X_t	2.54 [1.500, 3.582]	<0.0001	-1.942 [-2.856, -1.028]	0.0001	-0.362 [-1.103, 0.38]	0.3415
T_{tr}	-0.069 [-0.113, -0.025]	0.0027	0.107 [0.069, 0.144]	0.0011	-0.053 [-0.080, -0.027]	0.0002