ORIGINAL ARTICLE

Association between Total Daily Doses with duration of hospitalization among readmitted patients in a multi-ethnic Asian population

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Abstract Increased length of stay (LOS) in the hospital incurs substantial financial costs on the healthcare system. Multiple factors are associated with LOS. However, few studies have been done to associate the impact of Total Daily Doses (TDD) and LOS. Hence, the aim of this study is to examine the association between patients' LOS upon readmission and their TDD before readmission. A retrospective cross-sectional study of readmission cases occurring from 1st January to 31st March 2013 was conducted at a regional hospital. Demographics and clinical variables were collected using electronic medical databases. Univariable and multiple linear regressions were used. Confounders such as comorbidities and drug related problems (DRP) were controlled for in this study. There were 432 patients and 649 readmissions examined. The average TDD and LOS were 18.04 ± 8.16 and 7.63 days ± 7.08 respectively. In the univariable analysis, variables that were significantly associated with the LOS included age above 75 year-old, race, comorbidity, number of comorbidities, number of medications, TDD and thrombocytopenia as DRPs. In the multiple linear regression, there was a statistically significant association between TDD ($\beta = 0.0733$, $p = 0.030$) and LOS. Variables that were found significant were age above 75 year-old ($\beta = 1.5477$, $p = 0.008$), Malay ($\beta = -1.5123$, $p = 0.033$), other races ($\beta = -2.6174$, $p = 0.007$), depression

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($\beta = 2.1551$, $p = 0.031$) and thrombocytopenia as a type of DRP ($\beta = 7.5548$, $p = 0.027$). When TDD was replaced with number of medications, number of medications ($\beta = 0.1487$, $p = 0.021$), age of 75 year-old ($\beta = 1.5303$, $p = 0.009$), Malay ($\beta = -1.4687$, $p = 0.038$), race of others ($\beta = -2.6499$, $p = 0.007$), depression ($\beta = 2.1951$, $p = 0.028$) and thrombocytopenia as a type of DRP ($\beta = 7.5260$, $p = 0.028$) were significant. In conclusion, a significant relationship between TDD and number of medications before readmission and the LOS upon readmission was established. This finding highlights the importance of optimizing patients' TDD in the attempt of reducing their LOS.

1. Introduction

Length of stay (LOS) is defined as the number of bed days in each inpatient episode (Berki et al., 1984). It has been identified to be one of the main indicators of hospital performance and patients' consumption of resources (Berki et al., 1984; Becker et al., 1980; Kulinskaya et al., 2005). In Singapore, the mean LOS in the public acute care hospitals is 5.8 days in 2012 (Hospital Services, 2013). Based on the 2012 data, most patients were admitted into the hospital due to accident, poisoning and violence (8.3%), cancer (6.0%) or ischemic heart disease (3.6%) Top 10 Conditions of Hospitalisation, 2014. The national healthcare expenditure constitutes about 4% of Singapore Gross Domestic Product (GDP) in 2013 and is projected to increase as the population ages (Costs and Financing, 2014).

In 2011, healthcare expenditures constituted about 18 percent of the Gross Domestic Product (GDP) in the United States (Pfuntner et al., 2011). As an important variable contributing to cost, increased LOS exerts substantial financial burden on the healthcare system. Extensive studies have also found that reduction in LOS is associated with cost savings. National Health Service (NHS) Institute for Innovation and Improvement in the United Kingdom projected an annual saving of approximately £8 million if the average LOS was shortened by one day (Length of Stay – Reducing Length of Stay, 2008). A study conducted in the United States also showed that with a 1-day and 2-day reduction in LOS, the estimated cost savings could amount to $680 and $1408 respectively (Fine et al., 2000). Reducing LOS will increase the capacity such as inpatient beds and manpower in the healthcare system, improving its productivity and efficiency (Length of Stay – Reducing Length of Stay, 2008). Besides, with an increase in LOS, unplanned rehospitalization and a rise in the adverse drug reactions of all severities could be resulted (Lazarou et al., 1998; Morandi et al., 2013). A 6.1% probability of adverse drug reactions, 20.6% probability of infections and 2.5% probability of ulcers were correlated with a LOS of 8 days 7 nights (Hauck and Zhao, Dec 2011). As patients' LOS increase, patients are exposed to a greater risk of an adverse event (Hauck and Zhao, Dec 2011). LOS therefore, has notable implications on patients' health and the usage of healthcare resources.

While physician and hospital affect LOS, patient characteristics and their medications prior to hospitalization play significant roles in influencing LOS as well (Berki et al., 1984; Lawton and Wholey, 1991; Wuerz and Meador, 1992). A study on the medication use in Singapore nursing homes found that on average, the residents were on 5.32 medications (Mamun et al., 2004). Patients' extended LOS due to drug related causes are often preventable and their drug related problems (DRPs) can be attributed to polypharmacy (Viktil et al., Feb 2007; Colley and Lucas, 1993). Non-compliance, a commonly cited DRP can be ameliorated through the reduction of pill burden and simplification of regimens (Colley and Lucas, 1993). Although the reduction of pill burden could potentially improve patients' disease control and thereby lead to a reduction in LOS, no direct association has been clearly shown between such an intervention and LOS. Furthermore, previous studies had presented varied responses on the relationship of polypharmacy and LOS (Nobili et al., 2011; Campbell et al., 2004; Incalzi et al., Mar 1992). Studies conducted by Campbell et al. and Incalzi et al. showed that polypharmacy is significantly related to extended LOS (Campbell et al., 2004; Incalzi et al., 1992). On the other hand, Nobili et al. suggested otherwise as polypharmacy was found to be unrelated to LOS in their study (Nobili et al., 2011).

2. Aim of the study

Our study aimed to explore the association between patients' pill burden, more specifically in terms of Total Daily Doses (TDD) and their LOS upon readmission. We hypothesized that higher TDD is associated with longer patient's LOS, potentially due to non-compliance.

3. Methods

3.1. Study design

A retrospective, cross-sectional study was conducted at a regional hospital in Singapore. This study was performed using the electronic medical databases shared by healthcare institutions across Singapore.

Institutional board review and waiver of patients' written informed consent were obtained from the National Healthcare Group, Singapore.

3.2. Subjects

Patients aged above 18 who were first admitted to the regional hospital and subsequently readmitted to any healthcare institutions in Singapore between 1st January and 31st March 2013 were included in this study. Readmission was defined as any unscheduled admission within 15 days of any discharge during the study period.