

Extra Charge, Extra Length of Hospitalization and Mortality Associated with Nosocomial Infection

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Abstract

The impact of nosocomial infection on extra charge, extra length of hospital stay, and mortality of the patients were measured by matching 70 patients who acquired nosocomial infections to 70 non-infected patients. Each of cases was matched with a control by discharge diagnosis, operative procedure, sex, and age group.

Patients with nosocomial infections remained in hospital on average 21.5 days longer, incurred hospital charge of average 8,537 bahts more than control patients and also had higher mortality rate than the control (24.3% vs 8.6%).

เรื่องย่อ

ค่ารักษาที่ต้องจ่ายมากขึ้น, ระยะเวลาที่ต้องอยู่โรงพยาบาลนานขึ้น และอัตราการตายที่สูงขึ้นเนื่องจากการติดเชื้อในโรงพยาบาล

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ผู้วิจัยได้ศึกษาถึงผลของการติดเชื้อในโรงพยาบาลในด้านที่ทำให้ผู้ป่วยต้องเสียค่ารักษาพยาบาลเพิ่มขึ้น, ต้องอยู่โรงพยาบาลนานขึ้น และเสียชีวิตมากขึ้น โดยใช้วิธีการศึกษาแบบจับคู่เปรียบเทียบระหว่างผู้ป่วยที่มีการติดเชื้อในโรงพยาบาลและผู้ป่วยที่ไม่มีการติดเชื้อ ปัจจัยที่นำมาใช้ในการจับคู่ได้แก่ การวินิจฉัย, การผ่าตัด, เพศ และกลุ่มอายุที่เหมือนกัน

การศึกษาพบว่าผู้ป่วยที่ติดเชื้อในโรงพยาบาลต้องอยู่ในโรงพยาบาลนานขึ้นกว่าผู้ป่วยที่ไม่มีการติดเชื้อโดยเฉลี่ย 21.5 วัน, เสียค่ารักษาเพิ่มขึ้นโดยเฉลี่ย 8,537 บาท และมีอัตราการตายร้อยละ 24.3 เมื่อเทียบกับผู้ป่วยไม่ติดเชื้อที่มีอัตราการตายเพียงร้อยละ 8.6

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INTRODUCTION

Nosocomial infections are not only life threatening to the patients and compromise the success of the operation or treatment, but also contributes to increase hospital stay and associated excess of medical expense. But in the era of limited finances we cannot spend infinite resources on prevention these infections and we have to make sure that we employ only procedure for which benefit outweighs cost of implementation. Analysis of economic consequences of these infections may improve more cost-effective allocation of resources for control of these infections. And an important prerequisite for performing valid cost-benefit analysis of infection control programs in hospital is to obtain an accurate measurement of the extra cost incurred by patients who acquired nosocomial infections. Although extra charge is only the small portion of extra cost¹ especially in the non-profit and governmental support hospital like Songklanagarind Hospital, these figures can partly reflect the financial burden both of the patient and the hospital.

We utilized the matched-pair analysis in order to measure the impact of the acquisition of nosocomial infection on the length of hospital stay and hospital charges of the patients admitted to Songklanagarind Hospital in 1987.

MATERIALS AND METHODS

Songklanagarind is a university hospital served as a medical school and referral center for the southern part of Thailand.

Nosocomial infection surveillance was conducted continually since January 1987 and covered the patients under the service of medicine, surgery, orthopedic, and pediatric departments. The details of surveillance methods and criteria for diagnosing nosocomial infection has been described elsewhere in the preceding issue of this journal.²

Between January 1, and December 31, 1987, five hundreds and thirty patients were identified by routine surveillance as having at least one nosocomial infection. These patients were then matched with patients admitted into the hospital during the same time period by selecting from data bank in the university computer containing information of all discharged patients. Control subjects were matched individually to infected patients by primary diagnosis, operative procedure, sex, and age group. In the situation which more than one control were found, secondary diagnosis or secondary operation was further used for selection the closest control. The primary diagnosis and primary operative procedure were matched by exact four-digit codes of the International Classification of Disease³ and International Classification of Procedures in Medicine.⁴ Age was matched by age groups

(Appendix). Following these matching schemes 70 matched case-control pairs were identified from 530 infected patients and about 14,000 patients discharged from the hospital.

The hospital charge for each study patient was obtained from hospital summary billing statements. Information of mortality outcome, length of hospital stay, sites of infection were available from either hospital data in computer or nosocomial infection surveillance data.

The extra day and extra charge were calculated from the arithmetic mean of the differences of length of hospital stay and hospital charge between case and control. Statistical significance test were carried out using paired t-test.

RESULT

Mean length of hospital stay and mean hospital charge of patients with nosocomial infections were 38.0 days and 16,220 bahts respectively. While mean length of hospital stay and mean hospital charge of

**APPENDIX
AGE GROUPS CATEGORIES**

Groups	Age Interval
1	0 day - 6 days
2	7 days - 13 days
3	14 days - 20 days
4	21 days - 27 days
5	28 days - 1 month
6 - 16	1 month - 1 year
17 - 20	2 years - 4 years
21	5 years - 9 years
22	10 years - 14 years
23	15 years - 19 years
24	20 years - 24 years
25	25 years - 29 years
26	30 years - 34 years
27	35 years - 39 years
28	40 years - 44 years
29	45 years - 49 years
30	50 years - 54 years
31	55 years - 59 years
32	60 years - 64 years
33	65 years - 69 years
34	70 years - 74 years
35	75 years - 79 years
36	80 years - 84 years
37	85 years and over

Table 1 Comparison between proportion of site specific nosocomial infections of all infected cases and the matched group. No significant difference between the two group ($P > 0.05$).

Sites of infections	All infected patients (n = 530)	Matched cases (n = 70)
Urinary tract	39.8	34.7
Surgical wound	18.6	13.7
Lower respiratory tract	14.4	14.7
Blood stream	13.5	22.1

control patients were 16.4 days and 7,683 bahts. Mean difference of hospital stay and mean difference of hospital charge were 21.5 days ($P < 0.0001$) and 8,537 bahts ($P = 0.0003$) respectively. When stratified by multiplicity of infection, there were 43 cases of single infection with average 19.67 extra days and 7,254 bahts extra charge. Twenty seven patients with multiple infections had an average 24.59 extra days and 10,676 bahts extra charge.

Mortality rate of patients with nosocomial infections (24.3%) was nearly three times of mortality rate of controls (8.6%).

The inability to find adequate controls for the majority of cases may limit the extent to which the result can be generalized. Since only 70 from 530 patients could be matched, the analysis may be restricted to a small nonrepresentative subset of the infected patients. This phenomenon may produce the gross selection bias. One potential source of bias is the site of infection because not all infections produce the same cost.⁵ To figure out whether the matched cases can be the representative of the infected patients, we compared the proportion of site specific nosocomial infection of the subset and of all infected patients. There were no statistical significant of difference of the proportion of site of infection (Table 1).

Of the total 1,135,415 bahts of hospital charges of 70 infected patients, the hospital actually received only 558,817 bahts or 49% of the charges.

DISCUSSION

Nosocomial infection has become a subject of interest in the fields of economics and hospital management as an avoidable additional cost. In the context of budget shortage, this new interest is the source of growing number of economic studies of nosocomial infections, but, so far we knew, there have been no previous such studies of this type in Thailand before.

Several investigators,⁶⁻¹⁴ using a variety of methods, have published the estimate extra cost or hospital stay associated with nosocomial infection. Most of them have confined themselves to measuring the portion of direct costs represented by prolongation of hospitalization and the resulting charges that would not have been incurred in the absence of nosocomial infection. There are in general three methods that has been employed in estimating the extra costs. First of them is unmatched comparison between infected patients and noninfected patients. Second, is the matched paired analysis as ours. And third is the subjective impression of physician. The validity of these three methods were criticized by some authorities.¹³⁻¹⁵ The value derived from matched paired comparison was between the value derived from the other two methods.

The bias inherent in the comparison method and the effects of matching on the bias were more extensively studied.^{13,14} The inability to find adequate controls for sizable segments of our study population may have introduced a gross bias in the selection of our 70 cases. But the proportion of site specific infection of the total infected patients and of the matched subgroup seem comparable.

Consider that the extra charge and extra days incurred by each patient with nosocomial infection were 8,537 bahts and 21.5 days, then the estimate total extra charge and extra days of 530 infected patients in the year 1987 would be 4.5 millions bahts and 1.1 thousands days. Since only one half of the hospital charge could be paid by the patients, the hospital was forced to take the financial burden of at least 2.2 million bahts per year.

We do not intend to imply that the figures are accurate estimates of the real cost of nosocomial infection. However, even these figures are probably the lowest crude estimate of cost, they can show the considerable impact of nosocomial infection. To obtain the truly accurate cost estimate, further well designed studies will be needed.

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