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Economic evaluation of infection control activities

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SUMMARY

Background: Healthcare-associated infections by drug-resistant bacteria affect a patient's prognosis. Infection control activities at medical institutions in Japan are increasingly focused on the threat from these bacteria.

Aim: To undertake a full cost analysis that included the costs of consumables and labour required for infection control activities.

Methods: The cost of infection control activities undertaken by the infection control team (ICT) at Nishimino Kosei Hospital in Japan was surveyed from January 2013 to December 2015. The evaluation index of infection control activities used the meticillin-resistant *Staphylococcus aureus* detection rate. The cost:effectiveness ratio (CER) of each intervention was calculated.

Findings: Consumables and labour costs increased over time, as did the ratio of labour cost to total cost over time. However, the CER of interventions was found to have decreased, from ¥164,177 in 2014 to ¥57,989 in 2015. There were increases not only in the amount of consumables, but also in ICT time, suggesting the possibility of improvements in the economic efficiency of infection control.

Conclusion: Increasing the amount of consumables and the time input of the ICT could help improve the economic efficiency of infection control. Our research suggests the possibility for improvements in the economic efficiency of infection control.

Introduction

Healthcare-associated infections by drug-resistant bacteria affect a patient's prognosis [1]. In addition, they bring increased medical expenses [2]. Therefore, Suzuki *et al.* stated that infection control activity to prevent hospital infection is important from the perspective of the medical economy as well as medical safety [3].

In recent years in Japan, it has become possible to calculate the healthcare fee for the prevention of hospital infection, and various types of infection control activity have been conducted in many medical institutions [4]. Many studies have reported that infection control activities reduce the rate of detection of drug-resistant bacteria and shorten the length of hospital stay of inpatients [5,6].

However, in order to improve infection control in hospitals, it must be considered that the cost of consumables, including disposable personal protective equipment and alcohol-based hand rubs (ABHRs), will increase. Therefore, cost analyses for these consumable expenses have been reported [7,8]. In

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addition, the healthcare fee for the prevention of hospital infection is calculated based on an infection control team (ICT) that undertakes a weekly hospital round to review infection cases and to carry out monitoring and guidance of hospital infection prevention measures. The Ministry of Health, Labour and Welfare states that it is better for all team members to participate in the rounds [9]. For this reason, the time costs of all ICT staff, as well as consumable expenses, are necessary to calculate the actual cost of infection control activities.

This study undertook a cost analysis of the total costs of consumables and labour required for infection control activities, with the aim of investigating the cost-effectiveness of ICT activities.

Methods

Subjects and period

Nishimino Kosei Hospital is a 315-bed hospital with a focus on acute beds. In the three years from January 2013 to December 2015, the infection control activities undertaken by the ICT were surveyed. The hospital ICT comprises two doctors, two pharmacists, four nurses, and one clinical laboratory technician. The ICT undertakes rounds in the hospital once a week. The ICT rounds reported in this study developed to include therapeutic interventions, intended to promote antimicrobial stewardship (AMS), as well as educational activities to improve management of problems observed in compliance with infection control of each department [10,11]. We observed only compliance with infection control up to 2012; therapeutic interventions were introduced in 2013. The purpose of the ICT round is promotion of antibiotic stewardship and general education of staff. The intended outcome is to prevent the appearance and spread of hospital-associated bacteria.

The survey was carried out on the basis of the activity recorded at the time of implementing the infection control activities.

Required cost for infection control activities

Consumable costs

We investigated the usage of plastic aprons and gloves, which the ICT has recommended for proper use. These consumables are used for contact with all patients. According to Suzuki *et al.*, the usage of gloves, aprons, and ABHRs for contact with all patients correlates with the meticillin-resistant *Staphylococcus aureus* (MRSA) detection rate [3]. Therefore, we also costed the use of ABHRs. Consumption in the hospital ward was calculated using the following equation:

$$\text{Usage per single month} = \text{Previous month inventory} + \text{Purchase} - \text{Stock}$$

The costs of consumables were the billed costs to the hospital.

Labour costs

Labour costs of the ICT round for the work undertaken by all members of the ICT were included, as it was a new intervention from 2013. The salaries per hour for doctors, pharmacists, nurses, and clinical laboratory technicians were calculated from the "2014 Basic Survey on Wage Structure" [12]. Doctors earned ¥6606 per hour, pharmacists ¥2069 per hour, nurses ¥1885 per hour, and clinical laboratory technicians ¥1692 per hour.

Cost per 1000 patients

For each item under the consumable costs and labour costs, the sum of the cost required for every six-month period from January 2013 to June 2013 until July 2015 to December 2015 was multiplied by 1000 after dividing by the total number of inpatients for the same period. The total cost comprised the costs of both consumables and labour.

Evaluation index of infection control activities

The evaluation index of infection control activities used the meticillin-resistant *Staphylococcus aureus* (MRSA) detection rate. The MRSA detection rate was defined as MRSA detected per 1000 patients according to the method of Watanabe *et al.* [4]. The total number of MRSA detections from the hospitalized patients was calculated every six months for the whole period, using the following equation:

$$\text{MRSA detection rate} = \frac{\text{MRSA detection number}}{\text{Total number of inpatients}} \times 1000$$

There was no MRSA screening programme in the hospital; only samples from patients with suspected infection were identified.

Amount of carbapenems and anti-MRSA drugs

Antimicrobial use density

Defined daily dose (DDD) was used as defined by the World Health Organization. The method of Umemura *et al.* was used to calculate antimicrobial use density (AUD), using the following formula [13]:

$$\text{AUD} = \text{Amount of the antimicrobial agent / DDD / Total number of inpatients} \times 1000$$

Comparison of the amount of carbapenems and anti-MRSA drugs

For each of the carbapenems and anti-MRSA drugs, the AUD of a single month was calculated for each of the years 2013 and 2015, and this was compared with the average value.

Six-monthly carbapenem usage

The carbapenem antibiotic AUD was calculated for each six-month period from January 2013 to June 2013 through July 2015 to December 2015.

Correlation with the MRSA detection rate

By using a value of 1000 patients calculated by the method described above, we determined the correlation between the MRSA detection rate in each of consumable costs, labour costs, and carbapenem usage.

Cost-effectiveness analysis

Overview of the ICT intervention and intervention details

Interventions were carried out once a week during ICT rounds, using electronic medical records, drug selection, and diagnosis support. These were focused on patients prescribed carbapenems and anti-MRSA drugs. Interventions were carried out for new cases and follow-up cases. As the number of follow-up cases increased, so the overall number of interventions