



Adherence to infection control guidelines in surgery on MRSA positive patients : A cost analysis

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In surgical units, similar to other healthcare departments, guidelines are used to curb transmission of methicillin resistant *Staphylococcus aureus* (MRSA). The aim of this study was to calculate the extra costs for material and extra working hours for compliance to MRSA infection control guidelines in the operating rooms of a University Hospital.

The study was based on observations of surgeries on MRSA positive patients. The average cost per surgery was calculated utilizing local information on unit costs. Robustness of the calculations was evaluated with a sensitivity analysis.

The total extra costs of adherence to MRSA infection control guidelines averaged €40.46 per surgical procedure (range €07.76- €73.15). A sensitivity analysis based on a standardized operating room hourly rate reached a cost of €66.22.

The extra costs of adherence to infection control guidelines are considerable. To reduce costs, the logistical planning of surgeries could be improved by for instance a dedicated room.

Keywords : MRSA ; nosocomial infections ; cost analysis ; surgical guidelines.

INTRODUCTION

The burden of MRSA is not only healthcare related, but also economically arising from increased length of hospitalization, morbidity and mortality (5,6). Consequently, most institutions have imple-

mented infection control and prevention guidelines to contain the spread of MRSA. In the Operating Room (OR), clean air systems, pre-operative antibiotics with proper dose and correct timing as well as proper skin preparation are standard of care steps taken to minimize the occurrence of surgical site infections (7). Additionally, in the OR and Post Anesthesia Care Unit (PACU) of our tertiary care university hospital, specific measures are taken when surgery is planned on known infected or colonized MRSA patients. These precautions include, amongst others, removal of unnecessary equipment from the room, coverage of surfaces of stationary equipment, use of one additional circulating nurse to hand over supplies and removal of unused disposables left in the room after surgery. Additionally, these surgeries are often planned at the end of the OR schedule to save time and to facilitate convenient cleaning afterwards.

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Although exact figures are scarce, all these interventions are considered costly since extra material and personnel time are needed (1). Consequently, the aim of this study was to calculate the extra hospital costs associated with the handling of MRSA positive (colonized or infected) patients in the OR of a Belgian 1,900 bed tertiary care university hospital. This descriptive analysis gives the clinician a clue about how much these extra precautions cost compared with standard OR procedures on patients not colonized/infected with nosocomial microorganisms. Moreover, a one-way sensitivity analysis was carried out to explore the generalizability of costs as different studies employ different cost calculation methods.

MATERIALS AND METHODS

Surgeries performed between May 2012 and June 2012 were included in the study if they met the following inclusion criteria: the surgery had to be on a current MRSA positive patient and designated infection prevention guidelines were to be followed. Further criteria such as length, type and reason for surgery were excluded as the focus was on the guidelines. No distinction was made between colonized and infected patients. Patients were retrieved in a consecutive way to avoid selection bias. The studied patient group accordingly was limited to currently MRSA positive patients undergoing a surgical procedure.

The data collection methods utilized included: time-and-motion studies, patients medical records, hospital databases and informal interviews with staff. The institution's infection control guidelines for surgery on colonized/infected MRSA patients were used for the creation of a 38-items checklist. This checklist facilitates registration of observation such as the number of items used and time spent on certain tasks. Direct healthcare costs were categorized in staff, material cost and sanitation costs in accordance with the Belgian Healthcare Knowledge center costing guidelines and Belgian guidelines for pharmaco-economic evaluations (2,9). The observations to measure these extra resources used in comparison with non MRSA positive patients were carried out by a qualified nurse trained in health economics and an infection control nurse. The starting point was set at preparation of the OR before the patient's arrival until the patient's transport and installation in the PACU (9). Extra material used for transport, treatment and cleaning was included. Time-and-motion studies revealed the extra working

hours needed to clean and prepare the room. For the evaluation of resource use, the market prices of materials were obtained from the hospital's purchasing department and working hours were multiplied with nurse and cleaning personnel wages (2).

RESULTS

After 16 observations, saturation of data was reached. The average surgery time observed was 3.75 hours and the average number of personnel present at each surgical procedure at any given moment was seven, including staff members and the additional circulation nurse. Twelve out of the 16 surgeries were performed last, at the end of the daily surgical timetable.

The total extra direct healthcare costs credited while adhering to MRSA guidelines for an MRSA positive patient in the OR totaled 340.46€ (207.76-473.15€) per surgery (Table I). This total amount, obtained from the extra material cost and extra working hours needed in the OR/PACU, was largely (69.5%) taken up by extra time and therefore personnel, i.e. an extra circulating nurse. The minimum and maximum amounts are a reflection of how varied the costs of adhering to the protocols in the OR can be (Table I). Probably, variation in complexity of patients' pathology, surgery type, duration of the surgical procedure and number of personnel needed all influence the total costs. Additionally, the differences in staff adherence to the protocol may have played a role in this variation.

A one-way sensitivity analysis was carried out using data from the Belgian Healthcare Knowledge center (9). Direct healthcare costs of extra resources used in the OR due to the management of an MRSA positive patient amounted to 366.2€/surgery. The minor cost difference compared with our base case (340.46€) supports the fact that our findings are generalizable.

DISCUSSION AND CONCLUSION

To the best of the authors' knowledge, this is the first study to calculate the costs of adherence to MRSA guidelines in the OR and PACU. The extra costs to comply with these extra measures when

Table I. — Volume, unit price and total extra costs for resources per surgery on MRSA positive patients

Items	Mean Volumes (range)	Unit Cost In Euros/piece or hr	Mean extra costs in Euro (range)	Mean extra costs in US Dollar (range)
Materials				
Gowns	7 (5-9)	0.71	4.97 (3.55 – 6.39)	6.90 (4.93-8.87)
Gloves	50 (10-90)	0.57	28.55 (5.71-51.39)	39.62 (7.92-71.31)
Alcogel	1.25 (0.5-2)	3.29	4.11 (1.64-6.58)	5.70 (2.28-9.13)
Masks	3.5 (2-5)	0.06	0.21 (0.12-0.30)	0.29 (0.17-0.42)
Trionic wipes	0.16 (0.16-0.16)	8.07	1.01 (1.01-1.01)	1.40 (1.40-1.40)
waste bag blue	2 (0-4)	0.036	0.07 (0.00-0.14)	0.10 (0.00-0.19)
Waste bag white	1 (1-1)	0.065	0.07 (0.07-0.07)	0.10 (0.10-0.10)
Yellow waste can	1.5 (1-2)	5.034	7.55 (5.03-10.07)	10.48 (6.98-13.98)
Clean flat sheet	2 (1-3)	2.65	5.30 (2.65-7.95)	7.36 (3.68-11.03)
Ventilator tubing	1 (1-3)	9.29	9.29 (9.29-9.29)	12.89 (12.89-12.89)
Aspiration catheters	12.5 (0-25)	0.27	3.38 (0.00-6.75)	4.69 (0.00-9.37)
Aspiration drainage bags	2 (2-2)	1.09	2.18 (2.18-2.18)	3.03 (3.03-3.03)
Protective paper	2.5 (2-3)	0.67	1.67 (1.33-2.00)	2.32 (1.85-2.78)
Clean pillow Case	0.5 (0-1)	0.26	0.13 (0.00-0.26)	0.18 (0.00-0.36)
Incidin cleaning Liquid	1 (1-1)	0.53	0.53 (0.53-0.53)	0.74 (0.74-0.74)
Incidin cleaning foam	0.25 (0.25-0.25)	1.32	0.33 (0.33-0.33)	0.46 (0.46-0.46)
Suma cleaning tabs	4 (4-4)	0.067	0.27 (0.27-0.27)	0.37 (0.37-0.37)
Sharps container	1 (1-1)	1.82	1.82 (1.82-1.82)	2.53 (2.53-2.53)
Under-sheet	0.5 (0-1)	0.60	0.30 (0.00-0.60)	0.42 (0.00-0.83)
OR Scrubs shirt	5.5 (4-7)	2.57	14.14 (10.28-18.00)	19.62 (14.27-24.98)
OR scrubs Pants	5.5 (5.5-7)	2.62	14.43 (10.49-18.36)	20.02 (14.56-25.48)
Steri-Drape	2.5 (1-4)	2.35	5.86 (2.35-9.38)	8.13 (3.26-13.02)
Disposable Materials used in PACU				
Emesis basin	2 (2-2)	0.04	0.08 (0.08-0.08)	0.11 (0.11-0.11)
2.5 ml syringe	1 (1-1)	0.025	0.03 (0.03-0.03)	0.04 (0.04-0.04)
5 ml syringe	1 (1-1)	0.035	0.04 (0.04-0.04)	0.06 (0.06-0.06)
10 ml syringe	1 (1-1)	0.045	0.04 (0.04-0.04)	0.06 (0.06-0.06)
(pink)gauge needle	1 (1-1)	0.016	0.02 (0.02-0.02)	0.03 (0.03-0.03)
black gauge needle	1 (1-1)	0.016	0.02 (0.02-0.02)	0.03 (0.03-0.03)
green gauge needle	1 (1-1)	0.016	0.02 (0.02-0.02)	0.03 (0.03-0.03)
IV (tubing) cap	1 (1-1)	0.056	0.06 (0.06-0.06)	0.08 (0.08-0.08)
Non-sterile compress	10 (10-10)	0.009	0.09 (0.09-0.09)	0.12 (0.12-0.12)
sterile compress pads	1 (1-1)	0.043	0.04 (0.04-0.04)	0.06 (0.06-0.06)
Durapore	1 (1-1)	1.16	1.20 (1.20-1.20)	1.67 (1.67-1.67)
Mepore (small)	1 (1-1)	0.14	0.14 (0.14-0.14)	0.19 (0.19-0.19)
Time/Labor Costs				
Cleaning Crew OR (time – hrs)	0.75 (0.5-1)	32.4	24.30 (16.20-32.40)	33.72 (22.48-44.96)
Cleaning crew PACU (time – hrs)	0.16 (0.16-0.16)	32.4	5.18 (5.18-5.18)	7.19 (7.19-7.19)
Nurse Preparation OR (time – hrs)	0.36 (0.25-0.5)	46.9	17.59 (11.73-23.45)	24.41 (16.28-32.54)
Nurse Preparation PACU (time – hrs)	0.50 (0.83-0.17)	46	22.98 (7.64-38.32)	31.89 (10.60-53.18)
Nurse Clear up OR (time – hrs)	0.75 (0.5-1)	46.9	35.18 (23.45-46.90)	48.82 (32.54-65.08)
Nurse Clear up PACU (time – hrs)	0.13 (0.08-0.17)	46.9	5.84 (3.89-7.79)	8.10 (5.40-10.81)
Additional Circulating nurse (time – hrs)	3.75 (1.5-6)	32.4	121.50 (48.60-194.40)	168.59 (67.44-269.75)
Total cost			340.46 (207.76-473.15)	472.42 (288.30-656.58)

operating on patients colonized or infected with MRSA is 340.46€/surgery with a range between 207.76 and 473.15€. It is important to emphasize that these results reflect a fraction of the total costs for an MRSA positive patient. The majority of the burden of disease studies conducted for MRSA, were based on a more holistic approach including a patient's hospital stay in its entirety (3,6). Factors such as antimicrobial therapy, decontamination, extended hospital stay and isolation are included. A search and destroy protocol at a University Hospital in Belgium with an MRSA prevalence rate of 3.95 per 1000 patients, led to savings of 16.058€ for the hospital, over a period of three months (8). In another cost burden study, an estimated cost for MRSA treatment and isolation during a hospital stay was found to be 6.000-10.000€ for each affected patient (3).

Some limitations in this study should be addressed. The perspective of this study did not take into account costs incurred by patients and the society as a whole such as loss of productivity. Reduced quality of life caused by inconvenience through the postponement of a surgery, and even mortality associated with MRSA infection were not included (4). Also, we did not include a control group of MRSA negative patients in this study. However, we only calculated the extra costs needed according to the institution's OR guidelines for surgery on MRSA positive patients.

The intangible cost of the occasional interruption of surgery, when the surgical team waits for the extra circulation nurse to hand over required material could be considered in future studies. Additionally, these surgeries are mostly scheduled towards the end of the day in a shorter-staffed department which can lead to a less safe work environment. It could be worthwhile considering a designated room for surgeries on patients colonized or infected with MRSA. This room could assist in streamlining work flow by its organization and basic equipment, thereby reducing costs. On the contrary, as each surgical specialty requires its own particularities for an OR, such a universal dedicated OR is hardly attainable in a tertiary care center. Another possibility could exist in the decontamination of patients before elective surgery.

The intent of this study was to draw attention to the costs of adhering to MRSA prevention guidelines in the OR from a hospital's perspective. The results obtained from this study are significant for hospital managers and the infection control department. The costs in terms of material and working hours spent for the OR department per surgery on an MRSA positive patient are substantially less than the total costs that would be incurred by the hospital in case of cross contamination to other patients. In order to reduce these costs, the logistical planning of surgeries could be improved. A dedicated room is one of these possibilities.

Author's contributions

VS wrote the manuscript based on data from VN, SS performed statistical analysis and AS revised and gave intellectual input in the organization of the manuscript.

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