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Research Article

IMPACT OF SURVEILLANCE AND PRACTICES OF HEALTH CARE WORKERS ON SURGICAL SITE INFECTIONS IN MINISTRY OF HEALTH HOSPITALS – SAUDI ARABIA

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ABSTRACT

Objectives: Multicenter surveillance regarding the knowledge, attitude and application of precautionary measures and resulting improvement in the surgical site infection (SSI) rate in hospitals of Ministry of Health (MOH) in Saudi Arabia.
Design: Prospective cohort study, from Moharram to Zil Hajj 1434 H. (15/11/2012 to 5/11/ 2013).
Setting: MOH hospitals in four areas of Makkah region, Saudi Arabia.
Study participants and interventions. The surgical healthcare staff in the specified hospitals was subjected to a questionnaire encompassing the important parameters including faculty expertise and hospital policies regarding prevention of SSI. Representative data from 09 hospitals was subjected to regular evaluation for the incidence of SSI.
Results: More than 80% hospitals showed keen interest in preventive measures against SSI and 60-100% (mean 80%) hospitals observed the required practices against nosocomial infections. Average SSI rate remained in the range of 0.39 to 2.12 with the mean value of 0.95. A decreasing incidence of SSI was observed over the time period of study.
Conclusion: Surveillance and participation of all the participants reduced the incidence of SSI during one year period. Our results suggest that continuous surveillance can bring excellent results but this trend need lot of effort for its continuation.

INTRODUCTION

The recognition of impaired wound healing due to inflammatory processes dates back to Hippocrates (460-377 BC) who was a great physician and surgeon, known as the father of medicine.

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He introduced the practice of irrigation of open wounds by vinegar and of wrapped dressings of wounds to prevent progression of further injury (Surajit Bhattacharya, 2012). His medical practices were followed for the centuries to come. Later on Koch (1843-1910), a world known expert in Hygiene and Microbiology, first mentioned in his research regarding the cause of infective foci as secondary minute microbiological growth (Owens and Stoessel, 2008).

Surgery as a therapeutic option became established in 19th century. In 1880s a lot of measures such as sterilization of instruments, practice of wearing the gowns, masks, and gloves became a routine practice of famous surgeons (Darrell *et al*., 2008). The concept of complication of surgical wound by infections was acknowledged very late when large number of deaths was observed in World War I and II after surgery of war inflicted wounds[4]. Now the Surgical Site Infection (SSI) created by an invasive surgical procedure is a well-established phenomenon (Gaynes *et al*., 2001). Despite improvements in the surgical practice, SSI remains a major concern of patent's safety and wellbeing. SSI remains a major cause patient's illness and post-surgery death. Multiple studies suggest that the surgical site infection rate ranges from 0.5% to 20% depending on the type of surgery, accompanying circumstances and characteristics of the patients (Nichols, 1991; Gaynes *et al*., 2001).

The morbidity and mortality is significantly high in patients who witness SSI. These patients are 60-70% more susceptible to occupy the bed of intensive care units. Patients exposed to SSI are about four times more likely to be readmitted in the surgical wards with average hospital stay increased many fold with exposure to the chances of death twice as likely as the patients recovering normally (Reichman *et al*., 2009).

The clinical auditing or surveillance of SSI is a primary step towards patent's care in a hospital setup (de Lissovoy *et al*., 2009). Many risk factors responsible for SSI such as old age, diabetes, cardiovascular compromise and chronic infections are related to the patient himself and cannot be modified totally (Haas *et al*., 2005). The untiring effort of a multi-disciplinary team of experts is needed to implement the preventive and corrective measures for improving the surgical site infection rate. This team may include all the specialists involved in the care of surgical patients including anesthetist, operation room in charge nurse, clinical microbiologist, pharmacist, quality control person and staff nurses. This team should be properly educated for managing SSI respective preventive measures (Young Keun Kim *et al*., 2009).

The very first step to address the risk of surgical site infection to our patients undergoing surgical procedures was the evaluation of the hospital processes for infection prevention and the practice of Health care workers. With guidance from experts of infection prevention from Ministry of Health (MOH), we conducted a survey of specific MOH hospitals, addressing faculty situation, SSI preventive measures and policies and practices being adopted in patient care. The present study was carried out by the department of quality management and patient safety under the direction of General directorate of Health affairs of Makkah Province, Ministry of Health in Kingdom of Saudi Arabia.

METHODS

Participants

The Makkah province in Saudi Arabia is administratively divided in to four regions including Makkah city (العاصمه المقدسه), Jeddah (جده), Taif (الطاءيف) and Al Qunfudhah(القنفده). A total of sixteen hospitals were enrolled in the study for conduction of surveillance regarding knowledge and attitude of healthcare workers in preventing surgical site infections and collection of regular data of incidence of SSI from all the hospitals at monthly basis. All the working surgeons/doctors and health care staff involved in the care of surgical patients such as anesthetics, surgeons, gynecologists, experts in microbiology along with members of infectious control committee and administrators of quality control department were invited to participate in this study named Project 32- "Surgical site infection rate". The survey was in the form of a questionnaire which was distributed in the selected hospitals of Makkah region working under the supervision of General directorate of health affairs Makkah, Ministry of Health in Kingdom of Saudi Arabia. This questionnaire was formulated according to the guidelines of US Centers for disease control and prevention (CDC) (Talaat *et al*., 2006).

Survey design

The design of the study was planned to be implemented in two parts. First of all a survey was carried out in all the targeted hospitals to assess beliefs, knowledge and practices of attending surgeons and concerned staff related to patient care. The second part of our study was continuous feedback from all the hospitals on monthly basis regarding SSI rate (total number of wound infections after surgical procedure/total number of patient undergoing operations x 100) in all the surgical patients being entertained in the hospitals during the year 1434 Hijri (15/11/2012- 5/11/2013). The present study reports the answers of 40 questions in 3 domains pertaining to SSI prevention. (The surveys included various question types (yes/no responses, questions with multiple answers). These 3 domains included details of faculty situation, SSI preventive measures and practices / methods used to prevent SSIs in surgical patients.

The questions regarding the preventive measures of SSI coved the pre operation preparation of the patient and practices related to the antiseptic measures such as by the use of antibiotic prophylaxis. It is very important which antibiotic should be considered in prophylaxis. The selection of timing of antibiotic infusion and duration of antibiotics and other measures which should be taken care of to reduce SSI rates. The survey questionnaire was distributed by a paper copy of survey to each participant. Reminder emails were sent after every fortnight. Non-responding health care workers were finally excluded from the study. Completed questionnaire was collected individually from each participant. Results were collected and compiled by a web-based program. Responses were then transferred to a Microsoft Access database for analysis. Ethical approval was granted by the appropriate authorities of Ministry of Health, Kingdom of Saudi Arabia. Quality control teams from Ministry of Health visited the hospitals regularly to ensure that all the committed precautionary measures being followed. All the data provided by hospitals on monthly basis was collected and statistical evaluation was carried out on the responses from all facilities and compared the results based on the region and hospital size. The hospitals were grouped according to the administrative regions.

Statistical Analysis

For Analysis; as we opted for ANOVA test. It is mainly used when we compare three or more variables; in case of our topic we are making comparison among three different regions i.e.

Makah, Jeddah and Taif plus Al Qunfudhah. We excluded all those hospitals from the study due to inconsistent data provision. Date of nine hospitals was analyzed with respective months (Moharram to Zil-Hajj).

RESULTS

Representative hospitals from the four regions, participated in our study. Names of participating hospitals with bed strength are shown in table 02 which reveals the incidence of surgical site infection on monthly basis.

Faculty Situation and hospital facilities

Out of the participating hospitals, 05 had ≤ 100-200 beds (mean, 124.8; range, 100-200), 7 had 250-500 beds (mean, 325.2; range, 250-500), and 2 had > 500 beds (mean, 785; range, 621-949). The intensive care beds constituted 7.5% of all beds in small, 14.1% in medium, and 9.7% in large hospitals.
7 out of 9 (73.3%) participating hospitals had teaching faculty.Majority of the hospitals reported using different sources but almost all the participants agreed to accept guidance from Association of Professionals in infection Control and epidemiology (APIC)

Table 1.

Month	Makkah		Jeddah					Taif&Quanzafah	
	621MCH	255KAH	Al-noor 500	120Rabigh	400Almsa	Oncology &KAH 500	949KFH	Qun 150	500SH.KA
1	0.614	0.535	2.721	1.724	3.774	4.192	1.689	0.9	0.687
2	0.412	0.4	1.85	1.613	1.779	1.894	1.735	0.439	0.527
3	0.3	1.13	0.862	1.24	0.794	1.984	1.073	0.41	0.538
4	0.208	1.485	0.98	0.85	1.739	0.87	1.285	0.422	0.605
5	1.064	1.087	1.03	1.089	2.429	2.083	1.399	0.417	0.307
6	1.149	0.521	1.163	1.077	1.659	1.97	0.841	0.431	0.309
7	1.66	0.538	1.408	1.31	0.383	0.8	0.644	0.858	0.394
8	0.651	0.483	0.263	1.04	0.725	0.429	0.735	0.83	0.336
9	0.333	0.571	0.984	1.282	1.015	0.351	1.402	0.562	0.52
10	0.19	0.504	0.762	0.9	1.681	0.271	0.295	0.446	0.83
11	0.763	0.703	0.4	0.4	0.553	0.361	0.3	0.42	0.712
12	0	0.33	0.3	0.2	0.778	0.37	0.475	0.855	0.468
Avg. SSI	0.61	0.69	1.06	1.06	1.44	1.30	0.99	0.58	0.52

SSI rate: total number of cases of wound infection/total number of patients who undergone operations
Performance indicators in MOH hospitals in 1434 H (**15/11/2012- 5/11/2013**) Name of participating hospitals:
Makkah region: Maternity and Children (MCH), King Abdulaziz hospital (KAH).
Jeddah region: alnoor hospital (Al-Noor), King abdulaziz hosp and oncology ctr (KAH and oncology) Almasaia Children and Obstetric hospital (Almsa), King Fahad hospital (KFH), Rabigh General Hospital (Rabigh).
Taif and AlQunfudhah region: King Abdulaziz spec hospital (KASH), Al Qunfudhah General hospital (Qun) The figures bellow the name of hospital show strength of hospital beds

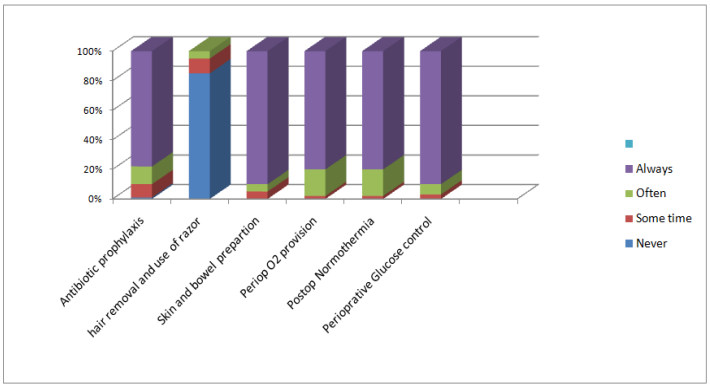
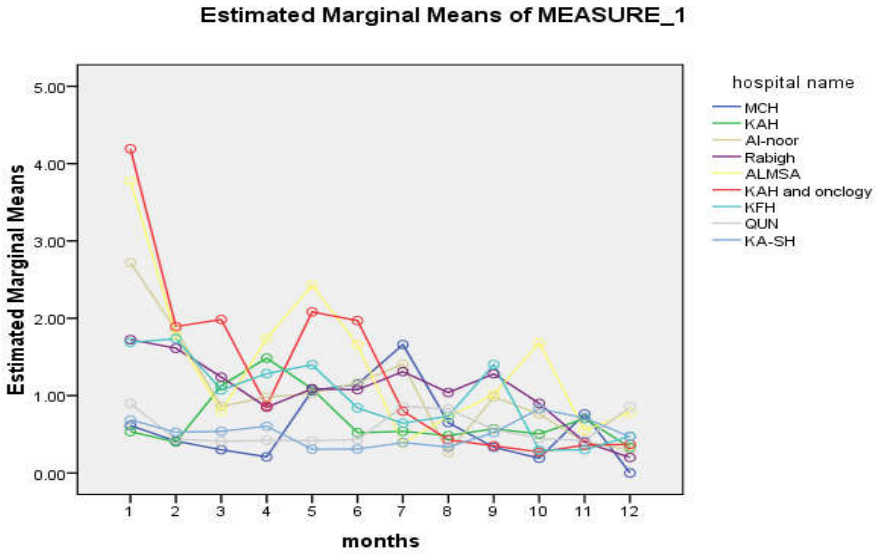


Fig 01. Bar chart showing comparative proportion of various measures being adopted by the surgical health care workers

All the participating hospitals provided monthly data for twelve months in 1434 H starting from Moharram till Zil Hajj (15/11/2012- 5/11/2013) and reported the incidence of surgical site infection rate. Hospitals reported cumulated data of all the patients undergoing surgical procedure in the all the major and minor surgical fields during the above mentioned period.Nine hospitals completed the survey. We evaluated their survey responses: The topics of the survey included faculty situation, preventive measures and policies and practices in respective faculties.

SSI Preventing measures

Evaluation survey revealed very strong commitment of hospital's staff of all the hospitals in adopting the measures which could reduce the SSI incidence. Fig 01 shows that more than 80% of the hospitals have strict criteria for Antibiotic prophylaxis during pre and post- operative periods. The questionnaire included inquiry regarding preoperative antibiotic prophylaxis, selection of antibiotic according published recommendations, suspected organism, or based on knowledge



Statistical analysis revealed that over the period of 12 months; with delivering proper set of knowledge to the staff and the person's associated with surgery there was a significant decrease in surgical site infection cases (Fig 2). We applied ANOVA test and the analysis showed that there is a significant variance in the decline of SSI through health care knowledge and infection prevention program. P value = .001. Effect size = .089 showed a large effect of health care knowledge in the decline of SSI.

Fig. 2. Incidence of SSI over the month in hospitals of Ministry of Health, KSA

pertaining to common SSI pathogens, and dose adjustments according to the body weight and in post-operative period. As hair removal at the site of operation by using razors is associated with high incidence of SSI, more than 85% of health care staff in hospitals of MOH had clear concepts in this regards (Fig 01). Around 80-90% of surgical staff showed strong acknowledgement of role of skin and mechanical gut preparation, maintenance of normothermia in immediate post-operative period along with the value of maintaining glucose levels in the immediate post-operative period.

SSI Policies and practices

A vast majority of health care workers strongly agreed with need of constant surveillance of anti-SSI measures and provision of feedback of SSI rate to the central authorities. (Table 1)

DISCUSSION

The surveillance of health care workers in provision of best medical services and care for reduction in avoidable adverse effects of different invasive procedures is essential to improve patient safety (Haas *et al*., 2005). Although constant surveillance is extremely time-consuming but compared with the miseries and cost involved in case of complications such as surgical site infections, this preventive measure is very much justifiable in the clinical practice (Burke, 2003). Our survey aimed at the assessment of policies, practices, and attitude of health care workers concerned with the surgical treatment of patients in the four specified regions of Mecca province in Ministry of health hospitals, KSA. With our questionnaire provided, all participating hospitals provided monthly data for twelve months in 1434 H starting from Moharram till Zill Hajj (15/11/2012- 5/11/2013). We evaluated their survey responses: the topics included faculty situation, preventive measures and policies and practices in respective faculties. Surgical site infections (SSIs) are a significant public health problem and have a major impact on the cost of health care (de Lissovoy et al., 2009).

The role of trained and motivated staff involved in patient care can never be under emphasized. Talaat *et al* highlighted the role of dedicated and motivated infection control staff in bringing down the SSI rate (Talaat *et al*., 2006). It was seen that the availability of infection control team was an integral part of fight against hospital acquired infections. An important and decisive factor is the availability of recommended infrastructure of the hospital (Hollenbeak et al., 2002). Prolonged and complicated surgeries should be avoided in small and rather ill equipped hospitals where the essential facilities may not be available with ease. Such cases must be planned in tertiary care hospitals where the availability of ICUs and acute care beds is in hand (Anderson *et al*., 2008). The administration of preoperative antibiotic agents has been established as a major effort against SSI in almost all the surgical procedures except in few cases when clean surgical field is available without any foreign material such as removal of implant material, cosmetic dermatology surgery and hernia repair (Engemann *et al*., 2003). The timing and selection of antibiotic is of immense importance and the prophylactic infusion should be administered within one hours before starting the operative procedure (Evans *et al*., 2009).

Recently a lot of studies identified that the best time of starting the antibiotic infusion 5- 30 minutes before the incision (Sureshchandra and YadavAnurag, 2012). In majority of cases when the operative procedure is not expected to be prolonged only one initial dose is considered sufficient but if the operation is prolonged i.e. more than 4-5 or if lot of blood loss occurs intra-operatively then a continuous infusion in the optimal dose is recommended (Hollenbeak *et al*., 2002). In few circumstances when emergency surgery is planned on dirty wound or on large burn wounds then it is a better practice to prolong the prophylactic antibiotic exposer beyond 24 hours (Young Keun Kim *et al*., 2009). Prolonged use of single antibiotic is often associated with development of resistance especially in case of Gram negative pathogens (Glass *et al*., 2011).

It is recommended that the selection of antibiotics must be based on the published data and antibiotic sensitivity patterns of local area (HranjecTjasa *et al*., 2010). A recent study reveals that in case the normothermia is maintained, one must discontinue the antibiotic within 24 hours postoperatively (Glass *et al*., 2011). It is recommended that the dose enhancement must be carried out routinely in overweight or obese individuals especially when the BMI of more than 25 kg/m^2 is expected (Liau, 2010). One must careful to administer antibiotic in optimal recommended dose according to age, sex and weight of individual as suboptimal dosing is a strong risk factor for SSI and it leads mostly to development of resistance against the given antibiotic (Alexander *et al*., 2009).

Another issue of significance is the policy to postpone a surgical procedure in presence of any other remote infection in the body. At times in case of remote infection there is strong probability of silent or asymptomatic bacteriuria (Surajit Bhattacharya, 2012). If the hematogenous spread of infection cannot be ruled out then a better practice would be the postponement of planned oprative procedure but in case of an emergency operation an infusion of appropriate antibiotic would be a safe practice (HranjecTjasa, 2010). Hair removal prior to surgery especially with the razor has been a practice in preparation of a patient before surgery since decades. CDC guidelines in 1999 revealed that the incidence of SSI is escalated in patients exposed to this practice (Sureshchandra and Yadav Anurag, 2012). It is recommended that if hair removal is necessary than it should be carried out with the help of clippers instead of razor. Numbers of studies have revealed significantly more SSIs when individuals were shaved rather than clipped and more so when the shaving was carried out a night before operation [27]. In our study a great majority of our participants were fully aware of this issue and only few of them committed that hair removal is carried out only in necessary conditions and clipping remained a favor technique than using of the razors.

Other major issues of our query included the opinion regarding avoidance of intraoperative hypothermia, avoiding of hyperglycemia and provision of supplemental Oxygen during operation and even postoperatively (Owens and Stoessel, 2008). Hypothermia during the perioperative period is a very common finding and according to a rough estimate is seen in almost half of the surgical procedures. All the functioning systems of the body are tuned to work optimally at 37 C^0. Exposure to low temperature is known to adversely affect various interactions in a number of systems, such as blood coagulation, immunity, endocrine activity, and body responses in acute stress state (Glass *et al*., 2011). Sajid *et al.* carried out a randomized trial on surgical patients who underwent planned surgery; one group enjoyed perioperative warming, while no care was taken in the second group (Alexander *et al*., 2009).

It was observed that the risk of SSI got doubled in the second group as compared to patients who were kept warm during operation. Similarly keeping intraoperative normoglycemia is a very important step for the wellbeing and speedy recovery of the patient (Back and Martin, 2008). Number of studies have detected that normoglycemia is associated with low incidence of SSI and additionally the risk other complications such as Urinary tract infection, stroke and post-operative hemorrhage is also reduced (Sajid Muhammad Shafique *et al*., 2009).

A convincing majority of our participants were strongly convinced to keep intraoperative normoglycemia resulting in extraordinarily low SSI in our study. A number of surveys have shown positive effect of continuous surveillance on the rate of SSI since 1960s (Sureshchandra and Yadav Anurag, 2012; Liau *et al*., 2010; Alexander *et al*., 2009). Similar effects were observed in almost all of our hospitals where despite of the fact that a variety of surgical procedures were being performed ranging from road traffic accident to complicated gynecological procedures to surgeries on the patients having malignant disorders. We evaluated our participants according to the administrative region i.e. Makkah, Jeddah, Taif and Al Qunfudhah. There were variations in all these regions, Makkah and Jeddah being the largest, most developed and having bigger hospitals in these regions, where asTaif and Al Qunfudhah represented only a small number of participant hospitals. The surgical staff of all the hospitals observed all the precautionary measure so over all the SSI rate remained at very low level (Makkah region 0.90, Jeddah 1.40, Taif and Al Qunfudhah 0.34). In some of the hospitals like Al Noor in Makkah and Childbirth and Children hospital in Jeddah SSI remained relatively higher because of dealing gynecological malignant case surgeries. In lot of studies SSI rate ranges from 5-20% in acute care hospitals (Back and Martin, 2008; Alexander *et al*., 2009; Ata *et al*., 2010).

There are certain limitations in our survey as the collection of data is mostly self-reported and no specified specialty was considered. It is well known that certain surgical branches like Gynecology especially in emergency cases and road traffic accidents; the SSI is much higher as compared to planned surgical procedures in Orthopedics, Neurosurgery etc. But on the other hand, all surgical faculties responded enthusiastically to our survey and tried to strictly adopt the required precautionary measures thus bringing uniformity to representation for the whole system. We identified several areas for improvement in infection prevention practices that may be used as a guide for further planning.

Conclusion

Effective surveillance and education of health care workers, supplemented by participation of all the participants in a specified setup, reduced the incidence of SSI in surgical patients during one year period. Our results suggest that continuous surveillance and vigilant health care can bring in the excellent results but this trend need lot of effort for its continuation.

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