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ASSESSMENT OF MULTIDRUG RESISTANT ORGANISM RELATED PREVENTION AND CONTROL POLICIES AND ENVIRONMENT AT KFHH, SAUDI ARABIA

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ABSTRACT: *Worldwide, Healthcare Associated Infections (HAIs) and Multidrug Resistant Organisms (MDROs) cause a significant clinical and economic burden. One of the strategies that have been implemented to reduce antimicrobial resistance is the development of healthcare settings with specific MDROs control policies and guidelines. The aim of this study was to perform an audit in order to assess whether, at the time of writing, the relevant policies and procedures were in place at the King Fahad Hofuf Hospital. The Carter and colleagues' model, which uses a matrix of acknowledging, auditing, stating of aims, and setting out of actions was used as a model for the assessment of the policies. The researchers conducted site visit rounds of the ICU and the general wards to report on the ratio of rooms for patient care, and the general areas in which hand washing sinks and alcohol-based hand rub products were available. Eight policies related to multidrug resistant organisms were analysed. Inappropriate scientific references were presented in the policies and there were no acknowledgements, auditing, or recommended actions in the majority of these policies according to the Carter and colleagues' method. The sink to bed ratio was 1:6 in the ICU and 1:25 in the general ward. As well, the sinks were not equipped with non-manual control equipment.* ***In conclusion,*** *An audit of policies in the healthcare setting indicated a number of deficiencies regarding best standard policies and guidelines for infection control. Moreover, there were also inadequate environmental control measures for HAIs and MDROs, including hand hygiene facilities.*

KEYWORDS*:* Infection control, MDROs, policies, environment, KFHH, Saudi Arabia

INTRODUCTION

Worldwide, healthcare associated infections and multidrug resistant organisms cause a significant clinical and economic burden (Gastmeier, 2004; Nyamogoba & Obala, 2002). Their management and control are essential to the minimisation of hospital-

related morbidity and mortality (Climo et al., 2013; Harrison, 2004; Pogorzelska et al., 2012) and to improve the quality of life for patients.

A wide range of strategies has been implemented to reduce antimicrobial resistance. One of these strategies is the development of healthcare settings with specific MDRO control policies and guidelines (Boyce, 2001; Shlaes et al., 1997; Zoutman & Ford, 2005). The magnitude to which healthcare institutions have developed strategies to control the resistance of pathogens, as well as the relationship between these strategies and practices is still vague (Larson et al., 2007). Nevertheless, despite a marked variation in organisational approaches to the prevention and control of MDROs, appropriate policies and guidelines can offer assistance in the control of the problem (Siegel et al., 2007).

Several studies have demonstrated significant reductions in HAIs and in the rates of multidrug resistant infections associated with the implementation of MDRO policies and guidelines (Pogorzelska et al., 2012, Thomas et al., 2002; Allegranzi et al., 2002; Shaikh et al., 2002). However, several limitations have also been reported due to a lack of high-level evidence (Gould, 2002).

The extent to which healthcare institutions have developed strategies to control antimicrobial resistance and decrease the spread of MDROs have not been fully identified (Knox & Holmes, 2002). On the other hand however, it has been acknowledged that significant reductions in the rates of MDROs have been achieved where such strategies have been developed (Allegranzi et al., 2002; Burke, 2003; Shaikh et al., 2002).

As best practice in infection control and in reducing/preventing the emergence of MDROs, specific policies and procedures must be instituted in every healthcare setting (Bonten, 2004; Marcel et al., 2008; Moro et al., 2003) across the globe. To our knowledge there has not been similar research conducted in King Fahad Hofuf Hospital and in Saudi Arabia. The aim of this study was four fold including:

- To perform an audit in order to assess whether, at the time of writing, the relevant policies and procedures are in place at the King Fahad Hofuf Hospital.
- To identify the gaps in the policies and practices that are necessary for infection control and MDRO prevention in both the ICU and the general ward setting.
- To conduct an audit and assess the hospital environment regarding infection control and MDRO prevention and control.
- To provide recommendations for effective strategies to address MDROs and infection control in the ICU at KFHH.

METHODS

The Carter and colleagues' model which uses a matrix of acknowledging, auditing, stating of aims, and setting out of actions (Carter et al., 2009), was used as a model for the assessment of the policies. In addition, the CDC guidelines for the management of MDROs in healthcare settings (Siegel et al., 2007), the CDC guidelines for isolation precautions (Siegel et al., 2007), the guidelines for ICU design (Thompson et al., 2012), and previous studies (Larson et al., 2007; O'Connell & Humphreys, 2000), were used

as well as models for the environmental assessment. Thus, the assessment examined the following:

(i) The existence and the extent to which infection control policies were disseminated,
(ii) The assessment of the availability of infection control policies and written procedures for the prevention and control of MDROs, and
(iii) An examination of how the surrounding environment - for example, the availability of facilities such as water supply and disinfectants in the ward - supported the ICU staff in controlling infections.

Written policy and procedure documents which were evaluated included the: (i) hand hygiene policy, (ii) antibiotic policy, (iii) antibiotic sensitivity surveillance policy, (iv) nosocomial infection surveillance policy, (v) isolation policy, (vi) sterilisation and disinfection of specific equipment policy, (vii) employee education program policy, and (viii) environmental control.

The researchers conducted site visit rounds of the ICU and the general wards to report on the ratio of rooms for patient care, and the general areas in which hand washing sinks and alcohol-based hand rub products were available.

Data analysis

Each item of the Carter and colleagues' methods was examined separately. The data on the environmental assessment of the availability of sinks and disinfectants was compared against international recommendations, such as those in the CDC guidelines (Boyce et al., 2009; Siegel et al., 2007; Thompson et al., 2012; Wedel et al., 1995; World Health Organization, 2004).

Ethical considerations

The Social and Behavioural Ethics Committee of Flinders University in South Australia, and the King Fahad Hofuf Hospital research and ethics committee approved the study. In addition, the Saudi Arabia Ministry of Health Research Committee endorsed the research.

RESULTS

Policy assessment

Eight policies relating to MDRO prevention and control were identified. These included policies on hand hygiene, antibiotics**,** antibiotic sensitivity surveillance, nosocomial infection surveillance, isolation, sterilisation and disinfection of specific equipment, employee health programs, and environmental control (Table 1).

Acknowledging control of multidrug resistant organisms

Eight policies relating to MDROs were available in all the hospital wards. However, the antibiotics stewardship policy was not identified. However, only three out of the eight policies had information on multidrug resistant organisms. As well, this information was not written in a simple language for ease of understanding. For example:

(i) The nosocomial surveillance policy stated:

"Population at risk (denominator data), total number of admissions per month is used as the denominator to determine the nosocomial infection rate and the patient infection rate, service specific admission /or discharge per month, unit specific admission per month".

(ii) The sterilisation and equipment disinfection policy stated:

"*The use of un-disinfected circuits between patients' increases the risk of chest infection due to gram-negative bacilli, e.g. pseudomonas Aeruginosa and Acinetobacter*".

(iii) The environmental policy stated:

"*The hospital environment is closely related to nosocomial infections and plays a prominent role in other health hazards*".

Auditing or recommending an audit of multidrug resistant organisms

There were three policies that either audit, or recommend the auditing of multidrug resistant organisms. The three policies were:

(i) The antibiotic sensitivity surveillance policy, which stated:

"*Microbiology lab performs antibiotic susceptibility tests and reports results to the infection control department and pharmacy"*;

(ii) The isolation policy, which stated:

"*Healthcare worker with patient contact: should comply policies with the isolation and procedures established. Attending clinician: order the initiation and discontinuation of isolation precautions. Infection Control Committee: reviews and approves isolation policies and procedures submitted by the infection control group";* and

(iii)The environmental control policy, which stated:

"Initiate studies as needed to identify and eliminate potential infections and environmental hazards".

Stating the aims

It was interesting to note that all the policies related to the prevention and control of MDROs had clearly stated purposes. For example:

(a) The hand hygiene policy stated the following aim: *"to prevent the transmission of pathogens to patients and employee by contaminated hands".* Here the pathogens, which were mentioned in the aim statement, referred to all microorganisms, whether they were MDROs or non-MDROs.
(b) The nosocomial infection surveillance policy outlined the following aims: *"surveillance systems provide for the ongoing collection, analysis, and dissemination of data to prevent and control nosocomial infections, to monitor changes in infectious agents (e.g. antibiotic resistance, emerging infections), to detect changes in health practice, to facilitate planning (e.g. allocations of program resources, policy development), to detect outbreak epidemics and*

generate appropriate interventions, to estimate the magnitude of a health problem, to identify cases for investigation and follow up".

Setting out actions on multidrug resistant organisms

The setting out of actions was addressed in the following two policies:

(i) The antibiotic sensitivity surveillance policy stated the following aims: *"Infection control department disseminates reports to infection control committee, physicians, drug utilization committee clinical laboratory services division assesses the clinical significance of any pattern change and advises physicians", and*

(ii) The nosocomial infection surveillance policy stated: *"Infection Control Committee members distribute information to the functional areas they represent".*

Evidence

Of concern was that all the policies failed to consider a local evidence-base for every section. In addition, only a single reference in one part of the nosocomial infection surveillance policy was based on international evidence. In addition, most of the referencing was inadequate. For example, some policies had references to the *MOH, CDC,* and the *CBAHI guidelines,* as well as to a range of Internet resources. However they did not qualify exactly which MOH (or other) guidelines they were referring to.

Summary of findings

Eight policies relating to multidrug resistant organisms were found to exist in this healthcare setting, all of which had clearly stated aims. Three out of the eight policies had acknowledgment statements, and three were either audit policies or had recommendations for an audit, while the setting out of actions was addressed by two policies. All the selected and analysed policies were written without scientific references or a local and/or international evidence-base.

Environmental assessment

Hand hygiene facilities in the general and ICU wards

The hospital consists of several wards, each of which has five rooms with five patients per room. It is considered that the best standard for each room is to have one sink in each, while two sinks to one room for healthcare workers and patients is optimal for hand hygiene. However, in this setting, there was only one sink for hand washing at the nurses' station. Although there was a hand washing sink and a toilet in each room (i.e. one sink per five patients), in each room there was no hand washing facility for healthcare workers to use. This means that for each ward, the ratio of sinks to patients was 1:25. In addition, there were no soap dispensers or paper towels in the hand washing sink areas.

The ICU was partitioned into two main parts:

Part 1: this had 12 beds and only two sinks for hand washing were available.

Part 2: this had 13 beds with patients divided into three rooms, each with 3-5 patients. Here there was one sink at the nurses' station, and one sink per room. Therefore, the hospital had a ratio of 1:6 of sinks to beds in the ICU, and 1:25 in the general wards.

While sinks and water supply were not available in every room, hand hygiene disinfectant (alcohol rub) was available in all wards and rooms. Each patient's room had at least one disinfectant alcohol hand rub product for healthcare workers to use. The ICU had one alcohol hand rub product by each patient's bed, as well as just outside of the rooms. There were also additional alcohol rub bottles available in the nurses' stations.

DISCUSSION

Policies

Healthcare-Associated Infections (HAIs) occur within acute systems. These systems are very diverse in terms of medical scope, resources, and style of management, reflecting socio-economic and cultural differences (Marcel et al., 2008). Commonly, health policies are understood as the formal, written documents, rules, and guidelines that outline policy-makers' decisions about what actions are appropriate and necessary to strengthen the health system, and to improve healthcare provision. However, these formal documents are translated through the decision-making of policy actors (such as middle managers, health workers, patients, and citizens) into daily practices (for example, management, service delivery, and interactions with others). Ultimately, these daily practices become health policies as they are experienced, which may differ from the intentions of the formal documents. Therefore, policy can be seen not only as formal, but also as informal, unwritten practices (World Health Organization, 2012).

Practical experimental scientific literature formed the bases for the guidelines or policies for the control and prevention of multidrug resistant organisms (Cooper et al., 2004; Harris et al., 2005). These guidelines provide MDRO infection control measures and their evaluation for the healthcare institutions, in spite of whether these guidelines are applied or not (Strausbaugh et al., 2006).

This study has assessed the existence and dissemination of most MDRO control policies, and the findings are not dissimilar to previous studies. For example, a study conducted by Larson et al., (2007) reported that less than one-third (10/30) of hospitals surveyed had antibiotic control policies. As well, Diekema et al., (2004) reported lower rates of policy availability in a survey of 494 US hospital laboratories, and 60% reported that they had implemented antimicrobial guidelines.

Although the KFHH does not have written antibiotic stewardship policies, and this study could not establish the extent to which existing policies were implemented at KFHH, it is not possible to conclude that the lack of such policies has had a significant impact on the prevention and control of HAIs. Diekema and colleagues (2004) and Larson and others ((2007) have expressed similar sentiments. On the other hand, epidemiological studies have provided solid evidence of the effectiveness of infection and antibiotic control measures, especially at the time of any outbreaks (Gould, 1999; Meyer et al., 1993).

The lack of evidence of informed policies found in this study is consistent with Pang &Tharyan's (2009) review. In this review they attributed the deficiency in policies to be the dearth of systematic reviews relevant to health in developing countries, as many of the noted interventions could not be implemented in resource-poor situations. This

is partly due to the limited amount of primary research conducted in developing countries, especially in the health policy field, with a focus on "gold standard" evidence from randomised controlled trials, and limited access to an evidence base (Pang & Tharyan, 2009).

Despite the available evidence on the value of regular education for health workers on HAI prevention and control (World Health Organization, 2012), the findings of this study have shown that there is a lack of educational programs and training policies for healthcare workers.

Environment

The most effective strategy for HAIs control, and the measure of personal hygiene, is hand washing with soap and water (Boyce et al., 2009; Jumaa, 2005; Michael et al., 2003). Despite evidence that hand antisepsis reduces the incidence of HAIs, the availability of hand washing facilities in this hospital was far below the gold standard. However, these findings are not unique to this setting, as studies conducted in the U.S. and European hospitals have shown that rates of adherence to hand hygiene guidelines are consistently lower than 50% (Larson & Kretzer, 1995; Watanakunakorn, Wang, & Hazy, 1998). Additionally, varying rates have been reported in studies, including 27.6% in the Mediterranean area, 52.8% in Egypt, 32.3% in Tunisia, and 18.6% and 16.9% in Algeria and Morocco, respectively (Amazian et al., 2006).

A number of studies have reported two sinks in each room as a minimal requirement for an Intensive Care Unit, and that hand washing facilities per bed are essential (Ferdinande, 1997; Simmons et al., 1990). The relationship between the availability of sinks and hand hygiene compliance has been evaluated in several studies with varying results (Bischoff et al., 2000; Lankford et al., 2003; Michael et al., 2003; Whitby & McLaws, 2004). For example, Boyce and John reported a high compliance rate where the sink to bed ratio was 1:1. Boyce and John's findings showed that healthcare workers complied with hand washing measures 76% of the time, while in the surgical ICU, where the sink to bed ratio was 1:4, compliance decreased to 51%, demonstrating that improved access to hand washing facilities increases hand washing compliance (Boyce, 2001). Furthermore, Preston and colleagues showed that healthcare workers' compliance with hand washing improved with the availability of sinks (Preston et al., 1981).

This study shows that the sink to bed ratio was much lower than that reported in previous studies, i.e. 1:6 in the ICU, and one per general ward (1:25 beds), and that the sinks were not equipped with non-manual control equipment. However, an alcohol-based gel dispenser was available by each bed in the ICU and in each room on the general wards. Similar findings have been reported elsewhere; for example, in a study conducted by Kesavan et al, it was reported that 12% of sinks in healthcare facilities were without soap (Kesavan et al., 1998), and by Amazian et al, who reported facilities with only 42.2% of the required number of sinks (Amazian et al., 2006; Kesavan et al., 1998; Ward, 2000).

The evidence suggests that the presence of soap and water, as well as alcohol gel systems, is required for maximum hand hygiene adherence (Thompson et al., 2012; Zaragoza et al., 1999).

Boyce and John suggest that better access to hand hygiene facilities results in improved compliance. For example, hand hygiene compliance improved from 41% to 48% when an alcohol dispenser was made available for every bed, compared to where one was available for every four beds (Boyce, 2001).

LIMITATIONS

The findings of this study, regarding policy and guideline assessments, should be interpreted with care because the assessment examined only the ICU policies and not those of the entire hospital. The relationship between the existence of MDRO control policies and MDRO rates was not investigated. Additionally, the study did not examine the compliance of healthcare workers with hand hygiene, nor did it attempt to study the impact of this compliance on the rate of MDROs in the ICU and the hospital. Moreover, the relationship between the existence and quantity of environmental control measures, such as sinks and HCW hand hygiene compliance, has not been measured.

IMPLICATIONS

- Strict adherence to guidelines is necessary in order to prevent disease outbreaks.
- Further studies are recommended including to assess actual HCW compliance with hand hygiene, and prevention and control measures.
- Evidence-based policies should be developed and should be aligned with best practice.
- Educational programs for healthcare workers must be developed and implemented in the hospital. Thereafter, the effectiveness of these programs has to be measured through a prospective project assessing HCWs' KAP.
- Environmental MDRO control measures, such as hand washing sinks and accompanying resources, need to be available in all wards, as recommended by the CDC and the WHO.
- A further study is needed to assess the relationship between environmental control measures and HCWs' compliance rate with hand hygiene needs to be conducted at KFHH.
- A detailed empirical study is required in order to understand a process as complex as policy-making in the KFHH and in all other hospitals in Saudi Arabia.
- This study adds to the knowledge gap because it is the first of its kind in KFHH of Saudi Arabia.
- Issues of infection control are pertinent for quality of life of patients and for administration of health care services.

CONCLUSION

Eight policies related to multidrug resistant organisms were analysed based on the Carter and colleagues' method. It was found that the antimicrobial stewardship policy and the healthcare workers' educational program were deficient. Furthermore, inappropriate scientific references were presented in the policies, and there were no acknowledgements, auditing, or recommended actions in the majority of these policies according to the Carter and colleagues' method. The sink to bed ratio was 1:6 in the

ICU and 1:25 in the general ward. As well, the sinks were not equipped with non-manual control equipment. Meanwhile, there was a distinct lack of consumables, with the hand disinfectant to bed ratio being 1:1 in the ICU and 1:5 in the general wards. A detailed empirical study is required to understand a process as complex as policymaking in the KFHH and all other hospitals in Saudi Arabia.

Conflicts of interest

There are no conflicts of interest.

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Table 1 MDROs policies assessment

	Policy	Present/ not	Acknowledgement of MDROs	Auditing of MDROs	Stating aims regarding MDROs	Setting out actions on MDROs	Issues that need evidence
1	Hand hygiene	Present	-	-	To prevent the transmission of pathogens to patients and employees through contaminated hands.	-	-Antimicrobial indicated for hand washing -Indications of hand washing -How to wash hands correctly -Duration of hand washing -Surgical hand scrub should take at least 10 minutes -Using alcohol-containing antiseptic hand rub -Factors that influence hand washing behaviour
2	Antibiotic policy	Present	-	-	-To control use of antibiotics and prevent abuse in using antimicrobials in clinical area.	-	-Indications for surgical prophylaxis -Principles of antimicrobial drug action and origin of

					-To prevent emergence of resistance to antibiotics in different microorganisms.		drug resistance, mechanism of action
3	Antibiotic sensitivity surveillance	Present	-	Microbiology lab performs antibiotic susceptibility tests and reports results to the Infection Control Department and pharmacy.	-To provide guidance to clinicians in the selection of drugs for treatment of bacterial infections. -To provide drug utilisation quality control monitoring tool.	Infection control department disseminates reports to Infection Control Committee, Physicians, Drug Utilization Committee Clinical Laboratory Services Division and assesses the clinical significance of any pattern change and advises physicians.	-
4	Nosocomial Infection Surveillance	Present	-Population at risk (denominator data).		-Surveillance systems provide for the ongoing collection, analysis, and dissemination of data to prevent	Infection Control Committee members distribute information to the	-Surveillance system definition and classification -Definitions of nosocomial infection (international reference present)

	-Total number of admissions per month is used as the denominator to determine the nosocomial infection rate and the patient infection rate. -Service specific admission /or discharge per month. -Unit specific admission per month.	and control nosocomial infections. -To monitor changes in infectious agents (e.g. antibiotic resistance, emerging infections). -To detect changes in health practice, to facilitate planning (e.g. allocation of program resources, policy development). -To detect outbreak of epidemics and generate appropriate interventions. -To estimate the magnitude of a health problem.	functional areas they represent.

				-To identify cases for investigation and follow-up.		
5	Isolation policy	Present		-Healthcare workers with Patient Contact. -Comply policies with the isolation and procedures established. -Attending Clinician order the initiation and discontinuation of isolation precautions. -Infection Control Committee reviews and approves isolation policies and	To establish individual responsibilities in order to minimise the transmission of infectious agents to, from, and between patients and all other people in the KFHH.	-When possible, a single room is indicated for the following: -Patients with highly transmissible or epidemiologically important microorganisms (e.g. Vancomycin resistant Enterococcus, Methicillin resistant S. Aureus, tuberculosis, chicken-pox, respiratory syncytial virus). -Patients whose personal hygiene habits are poor, who contaminate the environment, or who cannot be expected to assist in maintaining infection control precautions to limit transmission.

			procedures submitted by the Infection Control Group.		-Transmission-based precautions. -Precautions for preventing the spread of vancomycin resistant enterococci. -Precautions for preventing the spread of MRSA. -Clinical syndromes or conditions warranting additional empiric precautions to prevent transmission of epidemiologically important pathogens pending confirmation of diagnosis. -Type and duration of precautions needed for selected infections and conditions.
6	Sterilisation and disinfection of	Present	The use of un-disinfected circuits between patients	-	To provide supplies and equipment safe for patient care.	-Methods for disinfection of bedpans -Anaesthesia mouthpiece disinfection

		specific equipment	increases the risk of chest infection due to Gram-negative bacilli, e.g. pseudomonas aeruginosa.		-Biopsy forceps and instrument sterilisation -Dental instrument sterilisation -E.N.T. equipment disinfection -Surgical instrument sterilisation
7	Employee health program	Present		-To provide as safe an environment as possible for both employees and patients. -To educate personnel about the principles of infection control. -To monitor and investigate infectious diseases.	

				-To provide care to personnel for work-related illnesses or exposure. -To identify infection risks related to employment. -To contain costs by eliminating unnecessary procedures and by preventing disease.		
8	Environmental control	Present	The hospital environment is closely related to nosocomial infections and plays a prominent role in other health hazards.	Initiate studies as needed to identify and eliminate potential infections and environmental hazards.	-To disseminate information on how to prevent and control infections and environmental hazards. -Provide guidelines for effective microbiological sampling and avoid unnecessary costly	-Indications for environmental sampling -Monitoring performance of sterilizers: must be conducted weekly with live bacterial spores (Bacillus, Stearothermophilus) -Routine microbiological sampling of patient-care

9. Antibiotics stewardship	Not present	and time-consuming practices.	objects purchased as sterile is not recommended

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