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Original Article

Knowledge, Practices and Prevalence of MRSA among Food Handlers

Kasturwar NB^{a*}, Mohd. Shafee^{b*}

^aProfessor, Dept. of Community Medicine, NKP Salve Institute of Medical Sciences, Nagpur, Maharashtra.

^bAssociate Professor, Dept. of Community Medicine, CAIMS, Bommakal, Karimnagar

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ABSTRACT

Aims: To assess the knowledge and practices among food handlers. Also to find out prevalence of nasal carriers of Methicillin Resistant Staphylococcus aureus (MRSA). **Settings and Design:** In this cross-sectional study, all food handlers including cooks, food servants and cleaners working in the mess and hospital canteen of a rural private medical college were included. **Methods and Material:** This study was performed for the period of three months from Oct. to Dec. 2009. The Data was obtained on a predesigned proforma and nasal swab was taken with the consent of study subject. **Statistical analysis used:** Percentage, Mean, Standard Deviation, Chi-Square Test, Fisher's Exact Test, Odd's Ratio and 95% Confidence Interval of Odds Ratio. **Results:** There are total 85 people working as food handlers in the campus. Total 83(97.64%) subjects gave consent for participation in the study. There were 52(62.7%) males and 31(32.3%) females, 50(60.2%) were involved in food serving, 23(27.7%) in cleaning and 10(12.1%) in food preparation. Total 27(32.5%) subjects knew correctly the names of diseases transmitted through food. The level of knowledge was satisfactory regarding food, food hygiene and personal hygiene. The practices of food handlers were encouraging. Majority of food handlers were practicing safe methods of food preparation and serving, and cleaning of food establishment. The prevalence of nasal carriers of MRSA was found to be 30(36.14%). **Conclusions:** The level of knowledge and practices among food handlers were satisfactory. The prevalence of nasal carriers of MRSA was found to be high.

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1. Introduction

Health is a dynamic process of adjustment and readjustment to the continuous changing environmental conditions. Among the various factors which play a important role in the maintenance of health of which nutrition is one[1]. Diseases spread through food still remain a common and persistent problems resulting in appreciable morbidity and occasional mortality. Food handlers play an important role in ensuring food safety throughout the chain of production, processing, storage and preparation [2]. The available statistics for food borne illness do not give the extent of

the problem. However, the current statistics in various industrialized countries shows that about 60% cases may be caused by poor food handling technique and by contaminated food served in food service establishments.

In most of the public catering establishments in our country the present arrangements of food are woefully inadequate. Besides, lack of appreciation of nature & extent of food safety measures and consequence of contaminated food, lack of organized consumer demand for food safety, lack of periodic evaluation and lack of updating of food safety policies to meet the contemporary problem play an important role in spread of food borne illness [1].

A high standard of personal hygiene among individuals engaged in the handling, preparation and cooking of food is needed. Those suffering from infected wounds, boils, diarrhoea, dysentery, throat infection etc. should be excluded from food handling.

* Corresponding Author : Dr. Mohd. Shafee
Department of Community Medicine
Chalmeda Anand Rao Institute of Medical Sciences,
Peddapalli Road
Bommakal Village,
Karimnagar - 505001
E.mail: mohdshafee2008@gmail.com

Staphylococcus aureus is the most important nosocomial pathogen and can be a problem in hospital infection control because of asymptomatic carriage and cross contamination. Methicillin resistant *S. aureus* (MRSA) form a major part of nosocomial *S. aureus* and are typically resistant to multiple antibiotics. These *S. aureus* including MRSA are resident in the nasal and / or skin flora of health care personnel and are transferred to patients by various diagnostic and / or therapeutic procedures [3]. About 10-30% of healthy persons carry bacteria in the nose and skin, axilla, perineum and throat. In hospital more than 50% of nursing staff are carriers of *S. aureus*.

Therefore, this study is undertaken to explore the pattern of Socio-demographic distribution and to determine knowledge and practice of food handlers towards food-borne diseases and food safety among food handlers working in the mess and canteen of a rural private medical college. Also it is important to detect the MRSA and monitor its antibiotic susceptibility.

2. Materials and Methods

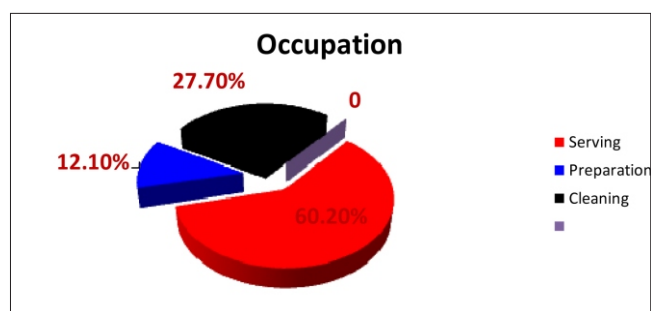
The permission from Head of institution and clearance from Ethics Committee was obtained before starting the study. This cross-sectional study was performed from Oct. to Dec.2009. The sample size required for studying the prevalence of MRSA was found to be 348 but as this study was done in medical college campus all workers employed in hostel mess and hospital canteen and engaged in food preparation, serving and cleaning are included in this study. The consent was obtained after explaining the purpose of this study and data was collected on pre-designed proforma by face to face interview. The proforma contains data regarding socio-demographic information and questions related to knowledge and practices regarding food, food hygiene and personal hygiene. The complete physical examination was performed. The nasal swab was collected from each subject and sent to Microbiology department for culture and drug sensitivity. The culture for *S. Aureus* was performed on Nutrient Agar and drug sensitivity was performed by Muller Hinton Agar for eight drugs (Methicillin, Ciprofloxacin, Linezolid, Piperacillin/Tazobactam, Amoxicillin / Clavulanic acid, Ampicillin, Erythromycin and Vancomycin).

The data was analyzed using mean, range, percentages, Chi-Square Test, Fisher's Exact Test, Odds Ratio (OR) and 95% Confidence Interval (CI) using SPSS 14 statistical software for windows.

3.Result

There were total 85 workers working in the boys and girls hostel mess and hospital canteen. Total 83 (97.64%) subjects gave consent for participation in this study. There were 52 males (62.7%) and 31 females (37.3%) with mean age 28.62 years (Std. Dev. 12.23) and with range of 15 - 65 years. There were 50 (60.2%) subjects involved in food serving, 23(27.7%) in cleaning and 10(12.1%) in food preparation [Fig. No.1]. The educational level of study subjects was up to primary school 32(38.6%), middle school 16(19.3%), high school 18(21.7%) and having degree 17(20.5%). Out of total 83 subjects, 46(55.4%) were residing in rural area, 32(38.6%) in mess & canteen and 5(6%) in urban area.

Fig. 1 Distribution of food handlers according to occupation



The majority of study subjects 56(67.5%) were not having any idea about the diseases transmitted through food, only 27(32.5%) were knowing that food can lead to diarrhoea, vomiting and abdominal pain. There was no significant difference among both groups. ($\chi^2=1.019, df=1, P=0.3127, OR=1.655, 95\% CI=0.6194-4.424$). All the study subjects knew that hands should be washed with soap and water before food preparation and serving. All the study subjects knew that utensils used should be thoroughly washed except males 02(2.4%) (Fisher's Exact Test (FET), $P=0.526, OR=0.32, 95\% CI=0.02-6.9$). All females said it should be washed thoroughly.

All the study subjects considered habit of fingering nose is dangerous but 4(4.8%) females were not having idea about it. This knowledge was significantly higher among males than females (FET $P=0.017, OR=17.2, 95\% CI=0.89-33$). Total 48(57.8%) males and 23(27.7%) females correctly knew that licking fingers can contaminate the food whereas 4(4.8%) males and 8(9.6%) females said that it will not contaminate the food. It was found to be statistically significant. ($\chi^2=5.153, df=1, P=0.023, OR=4.17, 95\% CI=1.13-15.3$). All the study subjects said that floor, roof and walls should be kept clean, hands should be washed after defaecation and micturition and persons with skin infection can contaminate the food.

Out of 83 total subjects, 69(83.1%) [55.4% males and 27.7% females] knew that nose, mouth and hair should be covered when coming in contact with food. Total 14(16.9%) said it is not necessary ($\chi^2=2.82, df=1, P=0.093, OR=2.66, 95\% CI=0.8267-8.602$). All 31 females and 48 males (57.8%) said that food should be stored in refrigerator except 4(9.8%) males said it can be kept at room temperature. (FET $P=0.292, OR=0.171, 95\% CI=0.0089-3.291$). [Table No.1]

Regarding practices of food handlers, 79(95.2%) study subjects washed hands with soap and water before food preparation and serving, only 4(4.8%) male did not practice it. (FET $P=0.2916, OR=0.17, 95\% CI=0.008-3.2$). Only 12(14.5%) male washed utensils daily with hot water and 40(48.2%) and all females did do it. (FET $P=0.003, OR=19.44, 95\% CI=1.107-341.4$). Only 4 study subjects (2 males & 2 females) were having habit fingering nose whereas others are not having this habit (FET $P=0.629, OR=0.58, 95\% CI=0.077-4.34$). All females (31) and 50(60.2%) males used disinfectant to wash floor and walls (FET $P=0.526, OR=0.32, 95\% CI=0.015-6.9$).

Total 60(72.3%) study subjects were not having habit of licking fingers (26.3% females and 45.8% males). Total 14(16.9%) males

and 9 (10.8%) females were having habit of licking fingers ($\chi^2=0.043$, $df=1$, $P=0.835$, $OR=0.9$, $95\% CI=0.36-2.42$). All females and 48(57.8%) males stored food in clean utensils and covered it. Only 4(4.8%) males could not practice it. (FET $P=0.292$, $OR=0.17$, $95\% CI=0.008-3.2$). Regarding storage of food majority 53(63.9%) stored food in refrigerator and 30(36.1%) at room temperature ($\chi^2=0.362$, $df=1$, $P=0.569$, $OR=0.76$, $95\% CI=0.30-1.95$).

All study subjects washed hands with soap and water after defaecation and micturition before resuming work. Majority of study subjects i.e. 50.6% males and 22.9% females covered mouth, nose and hair while handling food ($\chi^2=3.783$, $df=1$, $P=0.052$, $OR=2.65$, $95\% CI=0.98-7.21$). All food handlers had habit of taking bath daily and wearing clean cloths before coming to work. [Table No.2]

Table 1. Assessment of Knowledge among Food Handlers

Knowledge	Male No. (%)	Female No. (%)	Odds Ratio	95% C.I.	P Value
Hands should be washed before food handling	52(62.7)	31(37.3)	-	-	-
Utensils should be washed ^a	50(60.24)	31(32.3)	0.32	0.02-6.9	0.526
Habit of fingering nose is dangerous ^a	52(62.7)	27(32.53)	17.2	0.89-33	0.017
Licking fingers can contaminate food ^b	48(57.83)	23(27.71)	4.17	1.13-15.3	0.023
Mouth, nose and hair should be covered ^b	46(55.42)	23(27.71)	2.667	0.8267 to 8.602	0.093
Floor, walls and roof should be kept clean	52(62.7)	31(37.3)	-	-	-
Hands should be washed after defaecation and urination	52(62.7)	31(37.3)	-	-	-
Skin infections can contaminate food	52(62.7)	31(37.3)	-	-	-
Food should be stored in refrigerator ^a	48(57.83)	31(37.3)	0.171	0.008894 to 3.291	0.2916

(All percentages are calculated from 83, a = Fishers Exact Test, b = Chi Square test)

Table 2. Assessment of Practices among Food Handlers

Practices	Male No. (%)	Female No. (%)	Odds Ratio	95% C.I.	P Value
Do you wash hands before food handling ^a	48(57.83)	31(37.3)	0.17	0.008-3.2	0.2916
Utensils should be washed with hot water ^a	12(60.24)	00	19.44	1.107-341.4	0.003
Have habit of fingering nose ^a	2(2.4)	2(2.4)	0.58	0.077-4.34	0.629
Do you Lick fingers to pick paper ^b	14(16.86)	09(10.84)	0.9	0.36-2.42	0.835
Do you keep floor, walls and roof clean ^a	50(60.24)	31(37.3)	0.32	0.015-6.9	0.526
Do you wash Hands after defaecation and micturition	52(62.7)	31(37.3)	-	-	-
Do you store food in clean utensils and cover ita	48(57.83)	31(37.3)	0.17	0.008-3.2	0.2916
Do you store food in refrigerator ^b	32(38.55)	21(25.30)	0.76	0.30-1.95	0.569
Do you keep mouth, nose and hair covered ^b	42(50.6)	19(22.89)	2.65	0.98-7.21	0.052
Do you take bath and wear clean cloths	52(62.7)	31(37.3)	-	-	-

(All percentages are calculated from 83, a = Fishers Exact Test, b = Chi Square test)

The prevalence of MRSA was found to be 30(36.14%) among 83 food handlers. Majority of food handlers i.e. 22(26.5%) belong to age group of 15 - 45 years and it is statistically significant (FET $P=0.0002$, $OR=0.26$, $CI=0.0014-0.465$). Out of 30 nasal carriers of MRSA, 20(24.10%) were males and 10(12%) were females. There was no significant difference in prevalence among males and females ($\chi^2=0.324$, $df=1$, $P=0.569$, $OR=1.313$, $95\% CI=0.513-3.353$). The prevalence of MRSA was found to be higher among food handlers involved in serving 16(19.30%) followed by those involved in food preparation 8(9.6%) and cleaners 6(7.2%).

The servants were having significantly higher prevalence of MRSA than preparators and cleaners ($\chi^2=9.713$, $df=2$, $P=0.008$, $OR=0.64$, $95\% CI=0.26-1.6$). According to educational status, the prevalence of MRSA was higher in food handlers educated up to primary school 10(12.04%), middle school 08(9.6%), high school 06(7.2%) and up to degree 06(7.2%). When Chi-Square test for independence was applied, it was found to be statistically not significant ($\chi^2=1.73$, $df=3$, $P=0.640$). Majority of nasal carriers of MRSA among food handlers were residing in rural area 28(33.73%) and two carriers were living in urban area (FET, $P=1.00$, $OR=0.84$, $95\% CI=0.132-5.334$). [Table No.3]

All positive cultures were subjected to drug sensitivity including Methicillin (Oxacillin). It was found that Staphylococcus aureus was sensitive to Ciprofloxacin in all samples 30(100%), Linezolid in 28(93.33%), Piperacillin/Tazobactam in 26(86.6%) and Amoxicillin/Clavulanic acid 26(86.6%). S. aureus was also resistant to Methicillin/Oxacillin in all samples 30(100%) followed by Ampicillin in 28(93.33%), Erythromycin in 24(80%) and Vancomycin in 22(73.33%). [Table No.4]

Table 3 .Association of MRSA with Socio-demographic factors among Food Handlers

Factor	MRSA +ve No. (%)	MRSA -ve No. (%)	Odds Ratio	95% C.I.	P Value
Age 15 – 45 years ^a	22(26.5)	51(61.44)	0.26	0.0014-0.465	0.0002
Sex [†] Male	20	32	1.313	0.513-3.353	0.569
Female	10	21			
Occupation ^b Serving	16	34			
Preparation	08	02	0.64	0.26 - 1.6	0.008
Cleaning	06	17			
Education ^b Primary School	10	22			
Middle School	08	08	-	-	0.640
High School	06	12			
Degree	06	11			
Address ^a Rural	28	50			
Urban	02	03	0.84	0.132-5.334	1.000

(All percentages are calculated from 83, a = Fishers Exact Test, b = Chi Square test)

Table4. Pattern of Antibiotic Sensitivity among nasal carriers of MRSA

Antibiotic	Sensitive Pattern
Ciprofloxacin	30 (100)
Linezolid	28 (93.33)
Piperacillin / Tazobactam	26 (86.6)
Amoxicillin / Clavulanic acid	26 (86.6)
	Sensitive Pattern
Methicillin / Oxacillin	30 (100)
Ampicillin	28 (93.33)
Erythromycin	24 (80.00)
Vancomycin	22 (73.33)

4. Discussion

This study assessed knowledge and practices of food handler in a setting of medical collage which serves as a centre for tertiary medical care. Food handlers working in such settings are also responsible for health of medical students and patients of the Hospital. Our study found that among 83 Food handlers 52 (62.7%) were males and 31(37.3%) females involved in food preparation food, serving and cleaning of the food eating area. These findings are in contrast to the finding of Maizun Mohd. Zain[2] & Isara AR[4], who found that majority food of handlers are females that is 69.5% & 65.1% respectively. Employer mostly employ female because they maintain proper personal and food hygiene.

The mean age of food handlers was found to be 28.63 years (Std. Dev.=12.23 years) and mode as 18 years. The most of the food handlers were of young age. The mean age of males was 25.88 years and of females was 33.22 years. In Bijapur city, 73.2% of food handlers were below 30 years of age[1].

The finding of this study also suggests that the majority of food handlers 66(79.51%) obtained education less than tenth standard and residing in rural area are 78(93.75%). The understanding of these food handlers towards food & food borne diseases will be low due to low level of education and their rural residence. In one of the Chinese study, the educational status of food handlers (74%) up to secondary level[5].

Majority of food handlers i.e. 50(60.2%) were involved in serving the food to the customers. These are the core group among food handlers who are mainly involved in transmission of food borne diseases.

The level of knowledge regarding the diseases transmitted through food was low in both male & female groups. Only 27(32.5%) knows that food can lead to diarrhoea, vomiting and abdominal pain. There was no significant difference in knowledge among males & females. ($\chi^2=1.079, df=1, P=0.3127, OR=1.655, 95\% CI=0.6194-4.424$). In Kota Bharu dist. Malaysia, reported that 48.4% food handlers had poor knowledge [2]. In Delhi, after training to food handlers 91.9% named gastroenteritis, 55.9% worm infestation, 42.7% cholera and 28.7% typhoid as food borne diseases [3]. In Portugal, food handlers displayed a reasonable knowledge.[4] Usually food handlers have food knowledge regarding the diseases transmitted through food. All study subjects were knew that hands should be washed before food preparation and serving. In a medical college in Delhi, 65.4% food

handlers knew that hands should be washed and 57.4% said that nails should be cut & kept clean [6]. In Kolkata, Ray SK found that 82.6% respondents showed desirability to wash hands before food handling [7]. It is a good sign that food handlers have knowledge regarding hand washing and also food handlers said that utensils used for food preparation and storage should be washed.

All study subjects knew that fingering nose is dangerous and can lead to transmission of staphylococcal infection of food. Only 4(4.8%) females were not having any knowledge regarding this habit. This knowledge was significantly higher among males than females (FET $P=0.017$, OR=17.2, 95% CI=0.89 - 33). If the nasal carriers of MRSA have this habit, then it can lead to contamination of food.

Food handlers also know that licking fingers also contaminate the food but 4(4.8%) males and 8(9.6%) females said it will not contaminate ($\chi^2=5.513$, df=1, $P=0.015$, OR=4.17, 95% CI=1.13-15.3). This knowledge was significantly higher to some extent in males than females. All food handlers said that food preparation and serving environment should be kept clean. Also food handlers were knew that hands should be washed with soap and water after defaecation and micturition. In one study 63% of food handlers were having knowledge of hand hygiene [8]. In another study significant portion of food handlers had knowledge of washing hands after defaecation and micturition[9].

All study subjects knew that those who are having skin infection can contaminate the food. Therefore, they should be excluded from work during illness. The study by Environmental Health Specialists Network (EHS-net) revealed that 5% food handlers had worked while suffering from vomiting and diarrhoea and skin infection [10].

Total 62.7% females know that mouth, nose and hair should be covered while handling the food. There was no significant difference of knowledge in males & females ($\chi^2=2.82$, df=1, $P=0.093$, OR=2.66, 95% CI=0.83-8.6). In Portugal, significant portion of food handlers lacked basic knowledge of personal hygiene.[9] Total 48(57.83%) and all females knew that food should be stored in refrigerator. In one study only 43% food handlers knew the temperature danger zone & temperature in refrigerators[11].

Overall our study subjects had fair knowledge regarding food, food hygiene and personal hygiene. This was also reported by many studies like 100% knowledge in food handlers at Selangor, Malaysia,[5] reasonable level of knowledge in Portugal[12], 73% food handlers at Multicenter study[12]. On the contrary, two studies reported lack of knowledge among food handlers[9,13].

Regarding practices 48(57.83%) males and all females washed their hands before food handling but none of them had washed it with warm water. There was no significant difference among males & females. (FET $P=0.2916$, OR=0.17, 95% CI=0.008-3.2.). No study reported that food handlers washed their hands with warm water but there many studies who reported hand washing with cold water. In Delhi, 65.4% food handlers washed their hands[6], at Kolkata 70.2%[7]. Two studies also reported low level of hand washing practice like 33%[14] and 28.6%[10].

Only 12 males and no females washed utensils with hot water. This practice was significantly higher among males than females. (FET $P=0.003$, OR=17.44, 95% CI=1.107-341.4). All utensils should be washed once in a day with hot water but unfortunately low level of this practice is found in our study. No study reported regarding washing of utensils with hot water. Only two males & two females had habit of fingering nose. This is a good sign and application of knowledge they had. Total 14(16.86%) males and 9(10.84%) females had habit of licking fingers while picking papers. This habit may contaminate the food.

All food handlers always tried to keep floor, walls and roof clean in food establishment except two males due to ignorance. In Bijapur city, only 5% food establishment were having good hygiene and majority (70%) of had poor sanitation[1]. Food handlers working in food establishments are responsible for the maintenance of sanitation in food establishment.

All the study subjects had habit of washing hands after defaecation and micturition and this is a good sign to prevent transmission of various diseases. In Delhi, 82.4% of food handlers were having habit of washing hands after defaecation and micturition[6].

Total 48(57.83%) males and all females stored food in clean containers and covered it but 38.55% males and 25.3% females' stored food in refrigerator. There was no significant difference among males and females regarding this habit. The practice of storing food in refrigerator was low in this study. In Turkey, 9.6% food handlers stored food in uncovered utensils[13]. In Portugal, there was most worst practice of storing food[15]. In Iran, there was poor practice of food hygiene[16].

Regarding covering mouth, nose and hair during food handling, 42(50.6%) males and 19(22.89%) females covered it. There was no significant statistical difference ($\chi^2=3.783$, df=1, $P=0.052$, OR=2.65, 95% CI=0.98-7.21). Even though there was no significant difference, but this practice is encouraging and will promote other food handlers also to practice it.

All Study subjects were taking bath daily and wearing clean cloths before coming to the work. One study found the same encouraging behaviour of food handlers wearing clean cloths daily[10].

Overall in this study the knowledge and practice of food handlers was satisfactory. There are many studies reported same findings by Narhasmah S[5], Santos MJ[17] Isara AR[4], Udgiri R[1], Bolton DI[18], and Albrecht JA[11].

The prevalence of nasal carrier of Methicillin Resistant staphylococcus aureus (MRSA) among food handlers was found to be 30(36.14%) out of 83. This prevalence is higher. Other studies who reported higher MRSA Prevalence are 37.53%[3], 22.4%[19], 10.62%[12], 30%[20], 24%[10], 9.4%[21]. The factors which were significantly associated with MRSA positivity were age between 15 - 45 years and food handlers involved is serving food. The sex, educational status and residence of food handlers were not associated significantly with it. Regarding drug sensitivity, the sensitivity was done for eight antibiotics. All Staphylococcus aureus were resistant to Methicillin / Oxacillin (100%). Other

drugs to which resistance was found were Ampicillin 93.3%, Erythromycin 80% and Vancomycin 73.3%. The sensitivity pattern was found among Ciprofloxacin (100%), Linezolid (93.3%), Piperacillin/Tazobactam (86.6%) and Amoxicillin/Clavulanic acid in (86.6%). In Botswana antibiotic resistance was found among 53% strain of *S. Aureus* [19], In Hubli district of Karnataka, multidrug resistance was found for Erythromycin, Gentamicin, Ciprofloxacin, Tetracycline and Cotrimoxazole[3].

Other study found sensitivity to Vancomycin, Oxacillin, Gentamicin, Rifampicin Chloramphenicol and Ofloxacin[20].

All nasal carriers of MRSA were given 2% Mupirocine ointment to be applied in nose for ten days twice a day. The nasal swabs were collected again after 3 weeks. It was found that two carriers were still positive for MRSA.

5. Conclusions

1. The level of knowledge among food handlers was satisfactory.
2. The Practice used by food handlers in this study was also encouraging.
3. The Prevalence of nasal carriers of MRSA among study subjects was high.

Recommendations

1. Health Education intervention program should be developed in order to have improvement in knowledge, attitude and practices towards food-borne diseases and food safety.
2. Regular periodic health examination of food handlers for presence of food-borne disease should be done.
3. In medical college, Medicine and Microbiology department should be given responsibility for screening of food handlers.

Limitations of Study

1. Sample size is less for studying prevalence of MRSA.
2. Attitude of food handlers is not taken into consideration.
3. Only food handlers working in medical college campus were included.
4. Only nasal carriers of MRSA were studied.

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