

Methicillin-resistant *Staphylococcus aureus* (MRSA) in nursing homes in a major UK city: an anonymized point prevalence survey

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SUMMARY

An anonymized point-prevalence survey of methicillin-resistant *Staphylococcus aureus* (MRSA) carriage was conducted amongst a stratified random sample of nursing home residents in Birmingham, UK, during 1994. Microbiological sampling from noses, fingers and the environment was undertaken. Information about potential risk factors for the acquisition of MRSA was gathered. MRSA was isolated from cultures of the nose or fingers of 33 of the 191 residents who took part in the study (17%) but only 1 of the 33 positive residents had a clinical infection. Although just 10 of the 87 environmental samples were MRSA positive, there was some environmental contamination in most homes. Risk factors for MRSA carriage were hospital admission within the last year (relative prevalence 2.09, 95% CI 1.13–3.88; $P < 0.05$) and surgical procedures within the last year (relative prevalence 4.02, 95% CI 2.18–7.43; $P = 0.002$). Phage-typing of the strains revealed similarities with those circulating in Birmingham hospitals. These findings suggest that the prevalence of MRSA in nursing homes in Birmingham was high, and that the strains may have originated in hospitals.

INTRODUCTION

The isolation of methicillin-resistant *Staphylococcus aureus* (MRSA) was first reported in 1961 soon after the introduction of methicillin. Over the next 10 years these strains became increasingly antibiotic resistant, spreading to most European countries including the UK [1]. The resistant strains were present in most large hospitals in the Birmingham region but declined in the late 1970s [2].

Epidemic strains emerged again in the 1980s, initially in Australia and the USA, and later spreading to most countries [3, 4]. The UK epidemic was originally confined to London and the South East [5] but new epidemic strains have emerged in the last few years in different parts of the UK.

In 1993 and 1994 there was an unprecedented increase in the number of patients colonized with the epidemic strain designated EMRSA-15 in hospitals in Birmingham and throughout the surrounding area.

The outbreaks principally involved elderly patients with colonized pressure sores or urinary tract infection and, less frequently, with nasal colonization. There was a feeling that outbreaks in acute wards were often initially due to admissions from elderly care nursing homes and, infrequently, from the community or staff carers. However, although the problem of MRSA in nursing homes has been recognized for several years in the USA [6, 7] little has been published in the UK [8]. Therefore the objectives of this study were to determine the point prevalence of MRSA carriage in a random sample of nursing home residents in Birmingham and to describe the associated morbidity, if any.

MATERIALS AND METHODS

Patient population

A random sample of 10 nursing homes was selected from the 84 registered with Birmingham Health

Authorities. A random sample of 20 residents within each of these homes was selected and their written consent to take part in the study was sought. The target study population therefore comprised 200 nursing home residents. The study was performed on an anonymous basis so that individual residents could not be identified and took place over a 4-week period.

Microbiological samples

Nasal swabs and finger plates were obtained from each of the residents who consented to take part in the study. Swabs of any lesions present were also taken. Floor plates were used in order to detect environmental contamination and were obtained from communal lounges, sitting rooms and bedrooms. These environmental samples were taken after the patient sampling was complete.

Microbiological methods

The specimens were processed by incubation for 18 h on nutrient agar (Bacteriological agar No 1, Oxoid, Basingstoke, UK) supplemented with 0.01% phenolphthalein diphosphate pentasodium solution and 1% defibrinated horse serum. Colonies with the morphological appearance of *S. aureus* were examined for phosphatase activity by exposure to ammonia vapour as previously described [9]. Phosphatase positive colonies were examined for DNase activity by subculturing onto DNase agar (Oxoid, Basingstoke, UK), incubation for 18 h and flooding with 1 M HCl. Colonies were examined visually and lack of surrounding precipitation was taken as evidence of DNase activity. Susceptibility to methicillin was performed by incubation for 18 h at 30 °C on 5% blood agar overlaid with methicillin 25 µg strips (Mast Diagnostics, Merseyside, UK). Strains identified as MRSA were forwarded to the Central Public Health Laboratory (CPHL), Colindale, London for phage typing.

Epidemiological methods

Epidemiological information about potential risk factors for acquisition of MRSA in the nursing home setting was gathered using a standard, structured questionnaire administered by interview. The data collected included length of stay in the home, hospital admission within the last year, surgical procedures within the last year, antibiotic treatment and sharing a bedroom with another resident.

Data analysis

The data were analysed using non-parametric methods (Fisher's exact test and Yates' corrected chi-square test) and *P* values of less than 0.05 taken as significant. The sizes of effects were reported as relative prevalences with 95% confidence intervals.

RESULTS

Patient population

A total of 191 residents from 10 randomly selected nursing homes (number of beds: range, 23–57, mean, 35) took part in the study out of the 200 residents originally recruited. Three residents had died in between giving consent and samples being taken and six refused to take part on the day of testing. There was a preponderance of females (female to male ratio 3.8:1). MRSA was isolated from 33 of the 191 subjects (17%); 27 of these were female and 6 were male. The MRSA positivity rate in individual homes ranged from zero to 44%. Only one of the 33 positive residents had a clinical infection (a female resident with an infected leg ulcer). Sixteen out of the 33 positive residents had MRSA isolated from nose swabs and fingers, 7 had MRSA in nose swab only and the other 10 had MRSA isolated from fingers alone.

Thirty-one of the 33 isolates were either reactive with phage 75 (22 isolates) or non typeable (9 isolates). Other phage types (PTs) were 77, 83A, 85, 81 (one strain) and 52A, 79 (one strain). Four PT75 strains also reacted with phage 29 (and one with 29, 95).

Epidemiological characteristics

The risk factors for MRSA carriage are shown in Table 2. Those significantly associated with MRSA carriage were hospital admission within the last year (relative prevalence 2.09, CI 1.13–3.88; *P* < 0.05) and surgical procedures within the last year (relative prevalence 4.02, CI 2.18–7.43; *P* = 0.002). The proportion of MRSA positive residents who had recently received antibiotics compared to MRSA negative residents approached, but did not reach statistical significance. The prevalence of wounds in the two groups did not differ and there was no statistical association with sharing a room with another resident.

The level of environmental contamination was low. Only 10 out of 87 environmental samples were positive. There was, however, some environmental

Table 1. *Phage typing results of strains of MRSA colonizing or infecting nursing home residents in Birmingham, UK, 1995*

Nursing home	No. of isolates typed	No. non-typeable	No. PT 75	Other reactions
1	5	3	2	One PT 75 also reacted with phage 29
2	5	0	5	
3	6	2	4	One PT 75 also reacted with phage 29
4	5	3	2	One PT 75 also reacted with phage 29, one further strain PT 29, 95
5	1	0	0	One isolate PT 77, 83A, 85, 81
6	0	0	0	
7	1	0	0	One isolate PT 52A, 79
8	0	0	0	
9	7	1	6	One PT also reacted with phage 29
10	3	0	3	

Table 2. *Risk factors associated with MRSA colonization/infection in nursing home residents in Birmingham, UK, 1995*

Risk factor (<i>n</i> = 191)	MRSA +ve	MRSA -ve	Relative prevalence	95% CI	<i>P</i> Value
Inpatient within the last year	12/33	29/158	2.09	1.13–3.88	> 0.05
Surgical procedures during the last year	6/33	4/158	4.02	2.17–7.43	0.002
Antibiotics	5/33	9/158	2.26	1.03–4.93	0.07 (NS)
Wound present	10/33	36/158	1.37	0.71–2.66	0.5 (NS)
Multiple occupancy	12/70	21/88	0.76	0.4–1.45	0.5 (NS)

contamination in most homes. Environmental contamination with MRSA was found in 6 out of the 10 nursing homes studied and MRSA positive residents were identified in all of these homes, the mean number of positive residents being 5. Forty-six lounges/sitting rooms were sampled and 5 (11%) were found to be positive, while 41 bedrooms were sampled and 5 (12%) were found to be positive. The 4 homes without detectable environmental contamination had either no positive residents (2 homes) or just one positive resident (2 homes).

DISCUSSION

In a preliminary communication we reported the prevalence of MRSA in nursing homes in the Birmingham area [10]. In this report we describe the full findings of our survey.

This study showed a relatively high prevalence of MRSA carriage (17%) amongst nursing home residents in Birmingham. In view of the association between MRSA carriage and recent hospital admissions, and in particular the strong association with recent surgical procedures, it is probable that the bulk of the MRSA carriage in nursing homes originally came from hospitals. This is supported by the phage typing data – 31 out of the 33 isolates from residents were either non-typeable (9 isolates) or reacted with phage 75 (22 isolates). This is the phage typing pattern of EMRSA15 which is the prevalent EMRSA strain in Birmingham hospitals. If residents had acquired these strains elsewhere, phage types other than that of EMRSA15 would have been found as these other types are prevalent in other parts of the country.

Although phage typing has been largely superseded by highly discriminating molecular methods such as

plasmid or chromosomal DNA typing these newer methods suffer from the lack of international standards and inter laboratory variability. They are therefore very useful for establishing cross infection during an outbreak but less so in comparing strains with previously described epidemic strains. Furthermore the Laboratory of Hospital Infection, Central Public Health Laboratory, Colindale, London has experience of phage typing all prevalent epidemic strains of MRSA in the UK and regards phage typing as the most appropriate way of reliably differentiating between these strains. For these reasons we chose phage typing as the preferred typing method for this study.

Much of the published work on MRSA in nursing homes has been done in the USA and has concentrated on institutions managed by the Department of Veterans Affairs (VA). These homes are populated by elderly males and tend to be much larger than community nursing homes. The applicability of the data from VA homes to community homes has therefore been questioned and recent data have confirmed that VA homes have higher rates of MRSA carriage [11]. The average number of beds in the homes in our study was 35. This is quite typical of homes in the UK although nursing homes in the US often have larger numbers of residents. As number of residents has been suggested as an important factor in MRSA colonization [12] this could limit the applicability of our data to larger institutions. Furthermore the nature of our study (point prevalence) differs from the study of VA homes in which data were collected longitudinally. This could explain the higher incidence of carriage in our study (17%) compared with the data reported by Mulhausen and colleagues [11] where the MRSA carriage rate in community homes was only 9.9%.

Previous studies have identified risk factors for MRSA colonization such as presence of open wounds, antibiotic use, poor functional status, chronic disease and previous hospital admission [13–15]. Although the study by Hsu did not identify previous hospital admission as an independent risk factor our study clearly shows hospital admission, and particularly surgical procedures within the last year, to be major risk factors for MRSA colonization. Unfortunately data on functional status were not collected and this could be a reason for the variation in the rates of carriage between different homes. Nevertheless, we believe that the main finding, i.e. that there is a substantial carriage rate of MRSA amongst residents

of nursing homes, is still valid as the number of patients in the study is large enough to ensure that the overall functional status would be representative of UK nursing homes in general.

The environment was not heavily contaminated in the homes; only 10 out of 87 environmental samples were positive; however, there was some environmental contamination in 6 of the 8 homes with MRSA positive residents. The significance of this finding is debatable as previous workers have failed to demonstrate a causative role for environmental colonization in outbreaks [15]. Indeed, our low level of environmental contamination coupled with the fact that the environment was only contaminated in homes with positive residents is consistent with the environmental contamination being an effect rather than a cause of MRSA carriage in the nursing home. Only one of the 33 MRSA positive residents had a clinical infection, which confirms the frequently held belief that MRSA in this setting rarely causes clinical problems and that intensive infection control measures are less justified than in an acute setting [15]. MRSA-colonized patients discharged from hospital are thought not to pose a great risk to healthy household contacts [16] and these data would tend to support that view. Nevertheless, the high prevalence revealed by this study suggests that nursing homes are a significant reservoir for MRSA and a potential source for hospital outbreaks following admission of patients from these establishments.

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