A Review of Nosocomial Infections at the Lagos University Teaching Hospital: Problems and Strategies for Improvement

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Abstract

The infection control programme of the Lagos University Teaching Hospital was started in 1974 with an Infection Control Team reporting to an Infection Control Committee. There is currently no functioning Infection Control Committee. An analysis of data of a hospital-wide surveillance obtained between November 1993-November 1996 is presented, highlighting the problems associated with maintaining an effective infection control programme in a developing economy and discussing possible solutions.

The monthly prevalence ranged between 0.11-8.1% for nosocomial infections with a 14:1 ratio of gram-negative to gram-positive organisms. *Pseudomonas aeruginosa, Klebsiella pneumoniae, Proteus mirabilis* and *Escherichia coli* were the most common pathogens accounting for 75% of all organisms isolated. The prevalence of *Staphylococcus aureus* was only 4.8% of all isolates and that of hospital-acquired *Plasmodium falciparum* was 6.2%. Urinary tract infections were the most common nosocomial infections and were often catheter-related. These were followed by wound infections of which 55.2% were surgical site infections. Nosocomial respiratory tract and bloodstream infections appear uncommon. Lack of an Infection Control Committee, lack of an effective antibiotic policy, poor funding, inadequate and ageing infrastructure including poor water supply and a lack of awareness of the cost benefits of an efficient programme have been identified as some of the problems mitigating against an effective infection control programme in the hospital.

Key Words: Nosocomial, Surveillance, Problems.

Introduction

The prevalence rate of nosocomial infections the world over has been put at about 10% while the incidence rate, on the average, has been much lower at about 5%.[1] The most prevalent organisms differ from hospital to hospital, across geographical and developmental divides and depend on clinical practices and antibiotic use but certain organisms like *Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae* and *Pseudomonas aeruginosa* are most commonly involved.[2] In some countries major shifts in the profile of prevalent organisms from gram-positive to gram negative and back to gram positive have been reported which have coincided with the introduction of different antibiotic classes.[3] Since the early 1990's, there has been an increased incidence of nosocomial infections by Candida species in more affluent countries accounting for about 10% of all nosocomial bacteraemic infections in some hospitals. This has been associated with an alarming rate of mortality.[4] In addition, organisms acquired in the hospital tend to be resistant to multiple antibiotics resulting in increased morbidity and mortality which have been estimated to cause an average of four extra days stay in hospital with the attendant increased cost.[2]

There is therefore a need for ongoing surveillance of hospital infections and pathogens and of the trends in antibiotic resistance patterns. This is important for baseline data so that sources and reservoirs of multiply resistant organisms and outbreaks are rapidly detected and contained. Most hospitals in Nigeria neither have an infection control unit nor monitor the presence of nosocomial infections. The Lagos University Teaching Hospital set up an infection control unit in 1974 which was run by the Microbiology Department and reported to an infection control committee. The day to day functions were carried out by an infection control nurse. Twenty years on, there is no infection control com-

mittee but there remains an infection control nurse. This is a retrospective study of three years surveillance of nosocomial infection in the Lagos University Teaching Hospital (LUTH) highlighting the problems associated with hospital infection control in the country.

Materials and Methods

The files containing data of the hospital infection control surveillance for the year 1993-1996 were obtained. This corresponded with the period the present infection control nurse commenced work in the department.

A hospital-wide surveillance method was used. All specimens sent in for culture were recorded and followed up to the wards by the infection control nurse and the relevant information extracted from the patients case notes. All infections which were not present on admission or which were unlikely to have been incubating at the time of admission were defined as nosocomial. All post-surgical or post-instrumentation infections were also classified as nosocomial. In all cases the predisposing factors were sought. For each patient, the following information were recorded: name, age, sex, hospital number, ward, date of admission, diagnosis on admission, date infection was first noticed, date it was cultured, site of the infection, specimen from which the organism was cultured, predisposing factor(s), organism(s) isolated and the antibiotic susceptibility profile.

Patients that had been discharged before the visit of the infection control nurse were not included in the data. At the end of every month, the infection control nurse collected the number of admissions, discharges and deaths in each ward from the hospital records office and calculated the infection rate using the number of discharges as the denominator. Antibiotic susceptibility tests were obtained from the patients records. The number of isolates found susceptible were recorded as a percentage of the total number of isolates tested.

Results

LUTH is a 674 bed hospital. Between the year 1993-1996 over 23,000 patients were admitted into the wards, with about 18,000 discharges and about 4000 deaths. The outpatient department saw over 375,000 patients in that same period. Table I shows a monthly breakdown of the admission and discharge figures between November 1993 - November 1996 and the monthly prevalence of nosocomial infection. Various gaps occur in the tables which coincide with periods of political unrest in the country, industrial actions by nurses or doctors, lack of stationery to collect data and periods when the

Table 1: Yearly rates of hospital acquired infections in the Lagos University Teaching Hospital from Nov. 1993 to Nov. 1996

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1993													
Total discharges											555	543	1098
No. of Infections											16	40	56
Rate of Infection											2,9	7.4	5.1
1994													
Total discharges	597	565	507	239	319							319	2546
No. of Infections	46	31	19	21	22							2	141
Rate of Infection	7.7	5.48	3.74	8.1	6.9							0.12	5.5
1995													
Total discharges	269	310	415	442	269						310	456	2471
No. of Infections	12	11	14	15	2						15	7	76
Rate of Infection	4.7	3.5	3.4	3.4	0.7						4.8	1.5	3.1
1996													
Total discharges	375	313	471	534				534			555		2782
No. of Infections	4	10	26	3				3			17		63
Rate of Infection	0.11	0.3	5.5	0.6				0.6			3.1		2.3
Total discharges													8897
Total Infection													336
Average Rate													3.78

infection control nurse was on leave. The monthly nosocomial infection rates could not be calculated because there were too many months in which no surveillance activity occurred. In the period November 1993-December 1996 (38 months) surveillance was carried out for only 21 months. From the data, the monthly infection rates were between 0.11-8.1%.

The ward distribution rates of nosocomial infection was determined (Table II). Over the three-year period, the Surgical wards posted the highest infection rates followed by Obstetrics and Gynaecological wards which were followed by the Medical wards except in 1995 when the Medical wards showed a slightly higher rate. The Paediatric wards showed the lowest infection rates over the period. In Table III, the types of nosocomial infections was studied. Urinary tract infections at 174 (52%) of 336 infections recorded, accounted for the greatest number of infections observed in that period followed by wound infections (39%) and malaria (7%). All other infections accounted for less than 3% of all the infections recorded and these were eye, bloodstream, respiratory and ear-nose-throat infections (Table IV).

Table V shows the number of pathogens isolated and their prevalence rates over the study period. A total of 356 pathogens were isolated because some infections were polymicrobial. *Pseudomonas aeruginosa* followed by *Klebsiella pneumoniae, Proteus mirabilis* and *Escherichia coli* were, in descending order, the most frequently isolated organisms and represented 75% of all isolates. Other coliforms accounted for 12% of the organisms and included Serratia *spp* and 'atypical coliforms'. The number of gram-positive organisms recorded was very low with *Staphylococcusaureus* making up only 17 (5%) of all organisms isolated. Twenty-two (6%) of the isolates were *Plasmodium falciparum* and this was recorded from long-stay patients. The gram-negative bacilli, *Ps. aeruginosa, K. pneumoniae, E. coli, P. mirabilis* and 'other coliforms' were isolated mainly from urinary tract infections (171 of 174 isolates) with *E. coli* being the most prevalent at this

Table 2: Distribution of nosocomial infections by ward and year

Wards	1993	1994	1995	1996	TOTAL
	Number (%) infection				
Surgical	22 (39)	60 (43)	39 (51)	49 (63)	161 (48)
OB/GYN	19 (34)	47 (33)	11 (15)	9 (14)	86 (26)
Medical	13 (23)	22 (15)	13 (17)	9 (14)	57 (17)
Paediatric	2 (4)	12 (9)	13 (17)	6 (8)	32 (9)
TOTAL	**56**	**141**	**76**	**63**	**336**

Key: OB/GYN — Obstetrics and Gynaecology.

Table 3: Types of nosocomial infection

Type of Infection	1993	1994	1995	1996	TOTAL
	Number(%)				
Urinary tract	32 (57)	82 (58)	33 (43)	27 (43)	174 (52)
Wound	21 (37)	50 (35)	34 (45)	27 (43)	132 (39)
Malaria	3 (5)	6 (4)	6 (8)	7 (11)	22 (7)
Eye		2 (1)	1 (1)	1 (2)	4 (1)
Bood stream		1 (0.7)			1 (0.3)
Respiratory			1 (1)	1 (2)	2 (0.6)
ENT			1 (1)*		1 (0.3)
TOTAL	**56**	**141**	**76**	**63**	**336**

Key: ENT — Ear-Nose-Throat.

Table 4: Microbial agents isolated from noxocomial infections in Lagos University Teaching Hospital from November '93 - December '96

Microbial agent	1993	1994	1995	1996	TOTAL
	Number (%)				
Escherichia coli	12 (20)	28 (19)	15 (19)	2 (3)	57 (16)
Klebsiella pneumoniae	13 (20)	26 (18)	15 (19)	18 (26)	72 (20)
Pseudomonas aeruginosa	17 (29)	31 (21)	14 (17)	13 (19)	75 (21)
Proteus mirabilis	13 (22)	30 (20)	13 (16)	9 (13)	65 (18)
Other Coliforms	1 (2)	18 (12)	12 (15)	12 (17)	43 (12)
Staphylococcus aureus		5 (3)	6 (7)	6 (9)	17 (5)
Coagulase negative Staphylococcus		2 (1)		1 (1)	3 (0.8)
B-haemolytic Streptococci				1 (1)	1 (0.3)
Enterococcus *spp.*		1 (0.7)			1 (0.3)
Plasmodium falciparum	3 (5)	6 (4)	6 (7)	7 (10)	22 (6)
TOTAL	59	147	81	69	356

Ratio gram negative : gram positive — 14: 1.

Table 5: Distribution of pathogens by site of infection

Pathogen	UTI	LRTI	Blood	WOUND SWABS			Others	TOTAL
				Burns	Surg.	Others		
E. coli	45							57
K. pneumoniae	35		1		3		4	72
P. aeruginosa	28			5	21		3	75
P. mirabilis	35	1	1		20	11	2	65
Other Coliforms	28			7	16	18	1	43
S. aureus				3	6	9		17
Coag. Neg.. Staph.	2	1		2	10	6	1	3
β-haem. Strept.				2	1	4		1
Enterococcus *spp.*	1						1	1
P. falciparum			22					22
TOTAL	174	2	24	14	80	51	12	356

Key: UTI — Urinary tract infections; LRTI — Lower respiratory tract infections; SURG — post surgical wound infections; Coag. Neg. Staph. — coagulase negative staphylococci; β-haem. Strept. — β-haemolytic streptococci.

site. Surprisingly gram-negative bacilli predominated in SSI's with *K. pneumoniae*, *Ps. aeruginosa* and *P. mirabilis* (69 of 80) being the most prevalent organisms. *S. aureus* accounted for only 10 out of 80 isolates from surgical site infections. The predisposing factors for acquiring a nosocomial infection were divided into intrinsic and extrinsic factors (Table VI). Intrinsic factors referred to autogenous infections and accounted for only 20% of cases while extrinsic factors were most often implicated (79%). Urinary bladder catheterisation was the single most important factor followed by surgery and environmental factors. In a few cases the predisposing factor could not be determined.

In Table VII the antibiotic susceptibility patterns of the gram-negative isolates from 1994 and 1996 are shown. The information obtained from the records were incomplete and those for gram-positives were even more incomplete and were therefore not presented. The results for the gram-negative isolates

Table 6: Factors associated with nosocomial infections in the Lagos University Teaching Hospital

	1993	1994	1995	1996	
Factors	**Number(%)**				**TOTAL**
INTRINSIC	**13 (23)**	**16 (11)**	**19 (25)**	**20 (32)**	**68 (20)**
EXTRINSIC (Total)	**43 (77)**	**124 (88)**	**57 (75)**	**40 (63)**	264 (79)
—Surgical	9 (16)	38 (27)	21 (28)	10 (16)	78 (23)
— Urinary catheter	31 (55)	78 (55)	29 (38)	23 (37)	161
—Dialysis		1 (0.7)			1 (0.3)
— IV Infusions		1 (0.7)			1 (0.3)
—Chest tube			1 (1)		
— Environmental	3 (5)	6 (4)	6 (8)	7 (11)	22 (7)
UNKNOWN		1 (0.7)		3 (4.8)	4 (1.2)
TOTAL	56	141	76	63	336

Key: Intrinsic = endogenous infections; Extrinsic = exogenous factors.

Table 7: Percentage susceptibility of gram-negative organisms to various antibiotics: Comparison of 1994 and 1996

	E. coli		*K. pneumoniae*		*Ps. aeruginosa*		*P. mirabilis*	
Antibiotic	**1994**	**1996**	**1994**	**1996**	**1994**	**1996**	**1994**	**1996**
Ampicillin	—	42					15	0
Gentamicin	100	60	43	75	45	60	80	60
Cotrimoxazole	20	20	93	0			10	0
Nitrofurantoin	93	100	100	—			44	0
Nalidixic	100	100	100	100			100	67
Co-amoxiclav	—	—	---	—	0	0		50
Cefuroxime	71	—	85	50	25	33		75
Cefotaxime	100	—	100	70			100	100
Ceftriaxone	100	—	100	85	50	50	100	100
Ceftazidime	100	—	100	87	83	75	100	75
Ofloxacin	100	—	100	100	77	71	100	83

have been included because they show a trend in the susceptibility patterns. No isolate of *P. mirabilis*, only 42% of *E. coli* were susceptible to ampicillin by 1996. Both *E. coli* and *P. mirabilis* showed decreased susceptibility to gentamicin in 1994 and 1996 while *K. pneumoniae* and *P. mirabilis* isolates were sensitive to cotrimoxazole. No results were available for *E. coli* for the third generation cephalosporins and ofloxacin in 1996.

Discussion

Between November 1993 and December 1996, surveillance of nosocomial infections was carried out for only 21 months and there were many periods when surveillance was interrupted (Table 2) due to political upheavals in the country, lack of stationery or when the infection control nurse was away on leave. Between 1974-1975, the nosocomial infection rate obtained over an 18-month period was 7.5% which was at the time considered an underestimate[5]. The estimated yearly prevalence rates in this study ranged between 2.3%-5.5% with an average prevalence rate of 3.78% which is an underestimate because of under reporting and inadequate surveillance. Also the peak periods for nosocomial infections, between May and August, reported in the 1974-5 study were mostly unaccounted for in this study because no infection control activity occurred during the three years in these months. Since then, the economy of the country has dropped significantly with a concomitant breakdown in hospital infrastructure (including water supply) and staff morale which are all factors likely to increase noso-

comial infection. Likewise, independent studies within the hospital suggest higher figures[6, 7]. The Lagos University Teaching Hospital with an inpatient capacity of 674 beds has only one infection control nurse and therefore requires more dedicated staff to maintain an effective hospital infection control programme. Another factor contributing to the unrealistic low rate is that cases were followed up from the microbiology laboratory so that unreported or uninvestigated nosocomial infections did not appear in the records. This probably also accounted for the low rates obtained for *S. aureus* from surgical site infections (Table 6) because these tend to be treated empirically in the hospital and are therefore not often bacteriologically investigated. In cases where wound infections were investigated, higher rates were obtained[6, 8, 9, 10].

Infections were most prevalent over the three years in the surgical wards followed by the obstetric and gynaecological wards, the medical wards except for 1995 when the medical wards posted slightly higher rates while the paediatric units consistently had the lowest rates (Table 3). This appears to be the general trend in previously reported studies in this hospital[5, 9, 11]. Worldwide, nosocomial infections tend to be highest in surgical wards[12] which can be attributed to the higher incidence of invasive procedures carried out on surgical patients and the greater probability that the patients are more likely to have breaks in their local defence systems. This would also account for the fact that urinary catheters and surgery are the most common predisposing factors associated with nosocomial infections in this hospital.

The predominant organisms causing nosocomial infections can best be understood in terms of the selective pressure exerted on the organisms based on the current antibiotic use and has been well documented[3]. In LUTH today the predominant nosocomial pathogens are the gram-negative bacilli: *E. coli, P. aeruginosa, K. pneumoniae* and *P. mirabilis* and this can be attributed to two factors, the upsurge in the use of third generation cephalosporins and the fact that UTI's, which are most often caused by gram-negative bacilli are the predominant nosocomial infections in the hospital.

Surgical site infections (SSI) and urinary tract infections account for most nosocomial infections worldwide[1, 2, 13] and next to UTI's, wound infections represented the second largest group in the hospital accounting for 145 (45%) of all nosocomial infections. Of this group SSI's made up the largest number of cases followed by other wounds (ulcers, traumatic injuries and soft tissue infections) while burns accounted for only 10% of all wound swabs. Unfortunately, it was impossible to obtain the total number of burns cases treated in the period to determine what percentage of the burns became infected in the hospital. The rates obtained for nosocomial bacteraemia were very low and do not reflect the true picture. Other studies carried out in the hospital, within the same period, have shown higher rates especially from the paediatric wards[7, 13]. Malaria was the third most common infection and was verified as nosocomial only in long stay patients. All cases were caused by *P. falciparum*. This high rate was not unexpected because malaria is endemic in the country and many of the protective nets are torn so that mosquitoes have access to the patients. The true incidence of nosocomial malaria or any other nosocomial infection in this environment will be difficult to assess because discharged patients are not always adequately followed up.

The result of the antibiotic resistant profiles were inadequate as many of the results could not be found or had not been carried out because of a lack of the appropriate antibiotic disc. This occurred due to a lack of funds or due to its unavailability in the country at the particular period. In general, it would appear that there is a trend of increasing resistance by nosocomial pathogens in LUTH to antibiotics over the years. This has been borne out by studies carried out on individual nosocomial pathogens in the hospital[6, 7, 8, 14, 15].

Surveillance is the backbone of a good infection control programme. The Lagos University Teaching Hospital has an infection control team carrying out hospital wide surveillance but no functioning infection control committee to which to report. This is representative of what happens in many Nigerian hospitals (personal information) while in others there is no infection control programme at all. In many industrialised countries, apart from the hospital infection committee, there exist national bodies e.g. Centre for Disease Control (CDC) in the USA, that collect, collate and analyse data on hospital infection nationwide. No such institution exists in Nigeria though there is an urgent need for it. The problems working against a good hospital infection control programme are numerous and include poor or absent infrastructure, lack of awareness of the activities of the infection control team or the cost benefits of an effective infection control programme, absence of an infection control committee to enact policies that will be binding on all departments and make infection control effective, inadequate funding of the nosocomial infection programme, poor laboratory backup and ineffective and largely ignored antibiotic policies which is due to the fact that often times these policies are written without due consultation with those that will prescribe and without taking into consideration the antibiotic resistance profile of local organisms. Oft times, unfortunately, this information is unavailable

in many developing nations due to poor or absent antibiotic resistance surveillance programmes which is part of the functions of the infection control team.

The solutions will include the setting up of an infection control committee with the powers to implement infection control policies, staff training, funding, effective antibiotic guidelines, research to determine cheaper and locally available alternatives for disinfection, continuous surveillance of the changing antibiotic susceptibility profiles of local strains. To be effective and carry every member of the health team along, there must be prompt dissemination of the information obtained to all who need to know.

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