

Antibiotic resistance in Burkina Faso

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Running title: Antibiotic resistance in Burkina Faso

Key words: Burkina Faso, antibiotic resistance, African resistance survey, national survey.

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SUMMARY

Burkina Faso is one of the Subsaharan African nations. No national services for monitoring of antibiotic resistance are available consequently the number of reports of resistance patterns among hospital pathogens are inconsistent. In order to evaluate the antibiotic resistance, a total of 1998 valuable microorganisms were analysed during the 2000 at the Medical Centre St. Camille of Ouagadougou, the Burkina Faso's capital. They were isolated as follows: 1012 from urine-culture, 503 from tonsil swabs, 398 from pus, 53 from sputum and 32 from blood-cultures. *Escherichia coli* was the most isolate microorganism from urine (44%); *Enterococcus faecalis* from tonsil swabs (96.4%), *Staphylococcus aureus* from pus (17%) and *K. pneumoniae* (70%) from sputum. In general, resistance to the old antibiotics, such as aminopenicillins and cotrimoxazole was showed. The most active antibiotic was norfloxacin a rarely used antibiotic in this country. In conclusion, our study shows that it is necessary to create antibiotic-resistance surveillance centers in the developing countries in order to adopt an accurate therapy to avoid the exportation of antibiotic resistance in the developed country linked to an increased emigration.

INTRODUCTION

Burkina Faso is a Sub-Saharan African nation of 274,000 Km² and with 12,000,000 citizens of whom 10% live in the capital Ouagadougou. Burkina Faso is one of the unindustrial African nations and the economy is based on agriculture. The sanitary system comprises 2 national and 9 regional hospitals. No national services for monitoring of antibiotic resistance are available, and thus the microorganisms responsible for the principal diseases and their antibiotic susceptibilities in this country are unknown, and in many cases are responsible for the death of these patients because of therapy failure (Murray *et al.*, 1997; Hart *et al.*, 1998).

With this background, the aim of this study was to know the distribution of the microorganisms responsible for documented pathologies collected during 2000 from patients at the Medical Center St. Camille of Ouagadougou. Moreover, in order to have a clear view of this very important problem the antibiotic susceptibility of the isolated microorganisms was also studied.

MATERIALS AND METHODS

Collection of material

During 2000, a total of 1998 microorganisms were isolated at the Medical Center St. Camille at Ouagadougou from outpatients with a documented pathology.

Five hundred and three microorganisms were isolated from tonsillar swabs in patients with pharyngeal-tonsillitis, 1,012 from urine-culture in patients suffering

of urinary infections, 400 from pus, 30 from blood-cultures for high temperature of patients of no malarial nature and 50 from sputum for acute bronchitis.

Each specimen was cultured in specific media, aerobically or in CO₂ atmosphere when required, at 37° C.

Identification

Only Gram-positive and Gram-negative aerobes isolated from pathologic materials, and one microorganism per patient were included in this study. Enterobacteriaceae were identified by API-20E system; Gram-negative non-fermenters rods by API-20NE system; streptococci, enterococci and pneumococci by API-20STREP system (all systems from Bio-Merieux, La Balme les Grottes, France); staphylococci by their Gram-stain and coagulase reaction.

Susceptibility tests

Antibiotic susceptibility studies were performed by the disc diffusion method as recommended by the National Committee for Clinical Laboratory Standards (NCCLS, 1997) using Mueller Hinton agar as the medium; for Streptococcus spp. the medium was supplemented with 5% defibrinated sheep blood. Six antibiotic-containing discs were placed on the agar surface and incubated aerobically for 18 h at 37°C. A variation of this method was adopted for a few groups of microorganisms. Streptococci, were incubated in 5% CO₂ atmosphere. The discs for the susceptibility tests were as follows: coamoxiclav (10+10 µg), amoxicillin (10 µg), cotrimoxazole (30 µg), gentamicin (30 µg), nalidixic acid (30 µg), chloramfenicol and norfloxacin (10 µg). The inoculated plates containing discs were then incubated at 35°C for 18-24 h. After incubation the inhibition zones

around the antibiotic discs were measured by a calliper. Antibiotic breakpoints as suggested by NCCLS 1998, were adopted.

RESULTS

During the 2000, a total of 1998 microorganisms were isolated from specimens collected at the Medical Center St. Camille at Ouagadougou.

Specimens from pharyngeal showed that the microorganism isolated with high frequency was *Enterococcus faecalis* (485 patients, 96.4%) and in only 18 patients (3.6%) *Streptococcus pyogenes*. Figure 1 shows the percentage of susceptibility antibiotics against these microorganisms. Both species were totally susceptible to norfloxacin.

Staphylococcus aureus and *Pseudomonas aeruginosa* were the most isolated microorganisms from pus (194 patients, 24.4%, respectively), followed by *E. faecalis* (80 patients, 20.1%) and *Klebsiella pneumoniae* (28 patients, 7.0%). *S. aureus* isolates were susceptible to coamoxiclav, norfloxacin and gentamicin and showed high resistance to cloramphenicol and cotrimoxazole (table 1).

Table 1: Susceptibility to antibiotics of the principal microorganisms isolated from pus.

| Antibiotics | Susceptibility (%) | | | |
|----------------|---------------------------|------------------------------|----------------------------|------------------------------|
| | <i>S. aureus</i> (97)* | <i>K. pneumoniae</i> (28) | <i>E. faecalis</i> (80) | <i>P. aeruginosa</i> (97) |
| Amoxicillin | 70 | 5 | 100 | 0 |
| Coamoxiclav | 100 | 100 | 100 | 0 |
| Cotrimoxazole | 10 | 100 | 100 | 22 |
| Cloramphenicol | 10 | 100 | 100 | 90 |
| Nofloxacin | 100 | 100 | 100 | 100 |
| Gentamicin | 100 | 100 | 100 | 100 |

* Number of isolates

Klebsiella pneumoniae was frequently isolated from sputum (35 patients, 67.3%) and its antibiotic susceptibility is showed in figure 2.

Escherichia coli (440 patients, 43.4%) was the most isolated microorganisms from urine cultures, followed by *K. pneumoniae* ((205 patients, 20.2%) and *S. aureus* (195 patients, 19.3%). Table 2 shows the percentage of antibiotic susceptibility. High resistance was showed by *E. coli* to amoxicillin (34%), and the addition of clavulanate decreased its resistance of only 22%. Excellent activity was showed by gentamicin, cloramphenicol and norfloxacin (100%). The latter was more active than nalidixic acid. With the exception of *S. aureus* the activity of cotrimoxazole against isolates from urine culture was very low.

Table 2: Susceptibility to antibiotics of the principal microorganisms isolated from urine-cultures.

| Antibiotics | Susceptibility (%) | | | |
|----------------|--------------------------|-------------------------------|---------------------------|-----------------------------|
| | <i>E. coli</i> (440)* | <i>K. pneumoniae</i> (205) | <i>S. aureus</i> (195) | <i>Streptococci</i> (92) |
| Amoxicillin | 34 | 0 | 70 | 100 |
| Coamoxiclav | 56 | 62 | 70 | 100 |
| Nalidixic acid | 89 | 100 | 100 | 71 |
| Cotrimoxazole | 56 | 40 | 80 | 20 |
| Cloramphenicol | 100 | 70 | 100 | 100 |
| Nofloxacin | 100 | 100 | 100 | 100 |
| Gentamicin | 100 | 100 | 90 | 66 |

* Number of isolates

K. pneumoniae, *Flavobacterium* spp., *Acinetobacter* spp. and *Salmonella* spp. were isolated at the same frequency (25%) from blood cultures. Norfloxacin and gentamicin were the most active antibiotics against these microorganisms, as illustrated in table 3, whereas, high resistance was showed to the other antibiotics.

Table 3: Susceptibility to antibiotics of the microorganisms isolated from blood-cultures.(32).

| Antibiotics | Susceptibility (%) | | | |
|----------------|---|------------------------------------|-------------------------------------|--|
| | <i>Flavobacterium</i> <i>spp.(8)</i> * | <i>K. pneumoniae</i> <i>(8)</i> | <i>Salmonella</i> <i>spp.(8)</i> | <i>Acinetobacter</i> <i>spp.(8)</i> |
| Amoxicillin | 40 | 0 | 33 | 33 |
| Coamoxiclav | 40 | 83 | 44 | 33 |
| Cotrimoxazole | 22 | 30 | 22 | 83 |
| Cloramphenicol | 75 | 83 | 60 | 50 |
| Nofloxacin | 75 | 100 | 100 | 50 |
| Gentamicin | 83 | 83 | 83 | 83 |

* Number of isolates

DISCUSSION

During 1990 has been demonstrated that 78% of the world population lives in the third world. 9.2 million out of the 39.5 million people who die every year die for infectious disease of bacterial or parasitic nature.

The primary objective of antibiotic treatment is to eradicate the causative microorganism. However, antibacterial treatment is complex with many factors interacting, including local epidemiology and resistance patterns. Sometimes the choice of antimicrobial is appropriated, but the clinical and epidemiological knowledges are wrong. In some countries, where the antibiotic availability is reduced, doctors use often drugs no active for that infection. Guidelines generally take clinical and epidemiological data into account.

In Burkina Faso the number of reports of resistance patterns among hospital pathogens are inconsistent, moreover, laboratory support is available only in a few sanitary structures and many patients are cured empirically; for example, cotrimoxazole has been regarded as the drug of choice for a long period of time for the empirical treatment of several infections without sensitivity testing (John

et al., 2000). The incorrect use of antibiotics has determined a very high incidence of resistance with bacterial resistance rates to this drug of more than 80%.

The general policy utilized in the developing countries is to use the available antibiotic. This has conducted to high incidence of resistance to old antibiotic and a relatively susceptibility to the new ones. Indeed, inappropriate antimicrobial use has been identified as the most important factor leading to the emergence of resistance among bacteria. Prescribing of antibiotics whether necessary or not, may also have collateral effects on microbial flora elsewhere in the body, notably the bowel. As the prevalence of bacterial resistance to many antibiotic has increased, there has been a simultaneous increase in interest in the identification of the specific reservoirs of antimicrobial resistance genes. The faecal flora is recognized to be a reservoirs of resistance genes both in the developed and the developing countries (Shanahan *et al.*, 1997; Shanahan *et al.*, 1998). The microorganisms responsible and their antibacterial-resistance of strains coming from faecal specimens in Burkina Faso have already been published (Bonfiglio *et al.*, 2002).

One important epidemiological data coming from this study was that specimens from respiratory tract showed, with surprise, as our common pathogens isolated in Europe (Felmingham *et al.*, 2000), such as *Moraxella catarrhalis*, *Streptococcus pneumoniae* and *Haemophilus influenzae* were rare in patients living in Burkina Faso. On the contrary, the microorganism isolated with high frequency was *E. faecalis* (96.4%) and in only 18 patients (3.6%) *S. pyogenes*.

Comparative of antibiotic susceptibility in strains isolated at Ouagadougou and those coming from near villages indicates that the spread of antibiotic resistance is equally distributed and not an urban condition (data not shown).

Quinolones have been shown to be much safer in term of bacteriological and clinical cure, in fact, the high susceptibility of norfloxacin, a very low used drugs is a further confirmation. However, with the increasing use of these modern drugs, there is a need for both local and global surveillance resistance in order to avoid the appearance of further resistance. The antibiotic resistance problem, already very important in the developed countries, has to be solved as soon as possible specially in the developing country, in order to avoid that the resistance could be exported, also clandestinely, giving further problems.

The spread of resistant clones throughout a population may also be favoured by the failure to eradicate bacteria. Moreover an incorrect policy of the use of antibiotics in developing countries could determine a repercussion in other countries in view of the opening of the borders due to imports and also to a free circulation of the strains with high antibiotic-resistance. The increase of the surveillance units in these developing countries is important in view of the globalization of public sanity systems not only to address to the problems of the equilibrium of the economic status but also to fight and to control infectious diseases.

At present is very difficult to establish quantitative relationship between the frequency of resistance to a defined antibiotic and the volume of drug abuse, because of the scarcity of studies which record resistance and drug use. There is some evidence that resistance can be reduced by decreasing antibiotic selective pressure in the hospital environment. One way to reduce the rate of development of resistance is to ensure the dose and the activity of an antibiotic will minimize the risk for selection of resistant mutants.

In conclusion, many questions regarding emerging resistance remain unresolved, continuous efforts to monitor resistance rates at both local and

national levels are of paramount importance. Since a small part of available antibiotics are used in an appropriate way in developing countries, it could be optimistic to think that it is possible to change the tendency by decreasing antibiotic prescriptions and address their use only for infections sustained by susceptible microorganisms. However, it is unlikely that any antimicrobial-restriction policy can succeed if widespread cross-infection due to poor infection control practices is present. General strategies could be adopted to support this criteria, in particular: i) to adopt a correct guideline for the use of antibiotics in order to avoid the development and selection of resistant microorganisms ii) to improve the hygiene conditions of the population in order to prevent the diffusion of antibiotic resistance and iii) to monitor the antibiotic resistance of microorganisms locally, nationally and internationally in order to contrast widespread resistance.

Only adopting these suggestions, we will be able to keep the world of microorganisms under control avoiding the diffusion of antibiotic resistance.

There is no certainty that the current extent of resistance can be reversed, the point of no return may already have been reached for certain antibiotic-bacterial combinations. Once resistance begins to affect clinical efficacy, it may indeed be already too late to implement measures which may make a difference. What is clear is that to limit the development and spread of resistance there must be judicious use of antibiotics. Drugs with the greatest potential for rapid eradication of susceptible bacteria and more resistant populations should be chosen as first-line therapy.

Moreover localized studies, such as ours, are useful in local trends and to have relevance to an individual physician's prescribing habits seen the scarcity of data. However, the need for national studies remains clear to maintain knowledge of

overall trends, facilitating general prescribing recommendations and to enable local data to be considered in the national perspective. Both local and national data need to be analysed constantly to maintain vigilance for any emerging problems of resistance.

REFERENCES

BONFIGLIO, G., SIMPORE', J., PIGNATELLI, S., SOLINAS, M.L., and MUSUMECI, S. (2002). Epidemiology of bacterial resistance in a tropical area. *International Journal of Antimicrobial Agents*, **20**, 387-389.

FELMINGHAM, D., and GRUNEBERG, R.N. (2000). The Alexander Project group. The Alexander Project 1996-1997: latest susceptibility data from the international study of bacterial pathogens from community acquired lower respiratory tract infections. *Journal of Antimicrobial Chemotherapy*, **45**, 191-203.

HART, C.A., and KARAIUKI, S. (1998). Antibiotic resistance in developing countries. *British Medical Journal*, **317**, 647-650.

JOHN, J.F.Jr., and RICE, L.B. (2000). The microbial genetics of antibiotic cycling. *Infection Control Hospital Epidemiology*, **21**(suppl), S22-S31.

MURRAY, C.J.L., and LOPES, A.D. (1997). Mortality by cause for eight regions of the world: global burden of disease study. *Lancet*, **349**, 1269-1276.

NATIONAL COMMITTEE FOR CLINICAL LABORATORY STANDARDS. (1997). Performance Standards for antimicrobial disk susceptibility tests. 6th ed. Approved Standards; M2-A6. NCCLS, Wayne, Pennsylvania.

NATIONAL COMMITTEE FOR CLINICAL LABORATORY STANDARDS. (1998). National Committee for Clinical Laboratory Standards: Performance standards for antimicrobial susceptibility testing; 8th informational supplement; M100-S8. NCCLS, Wayne, Pennsylvania.

SHANAHAN, P.M.A., THOMSON, C.J., and AMYES, S.G.B. (1994). Beta-lactam resistance in aerobic faecal flora from general practice patients in the UK. *European Journal of Clinical Microbiology and Infectious Diseases*, **13**, 760-763.

SHANAHAN, P.M.A., WYLIE, B.A., ADRIAN, P.V., KOORNHOF, H.J., THOMSON, C.J., and AMYES, S.G.B. (1993). The prevalence of antimicrobial resistance in human faecal flora in South Africa. *Epidemiology and Infection*, **111**, 221-228.

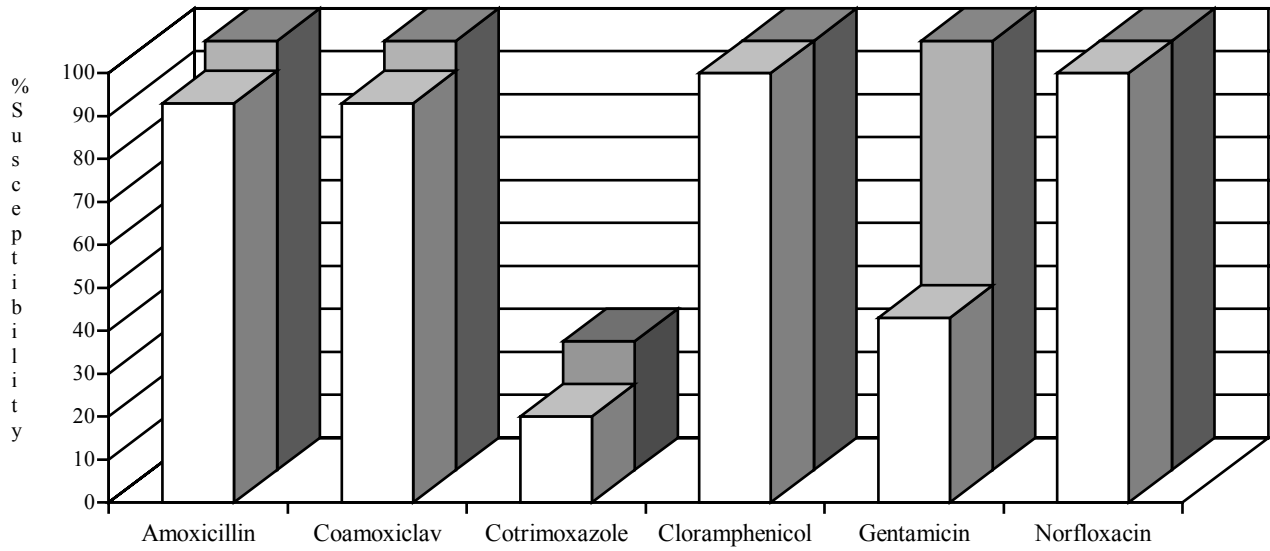


Figure 1: Susceptibility of microorganisms to antibiotics isolated from tonsil swabs
(white bar *E. faecalis*, black bar *S. pyogenes*).

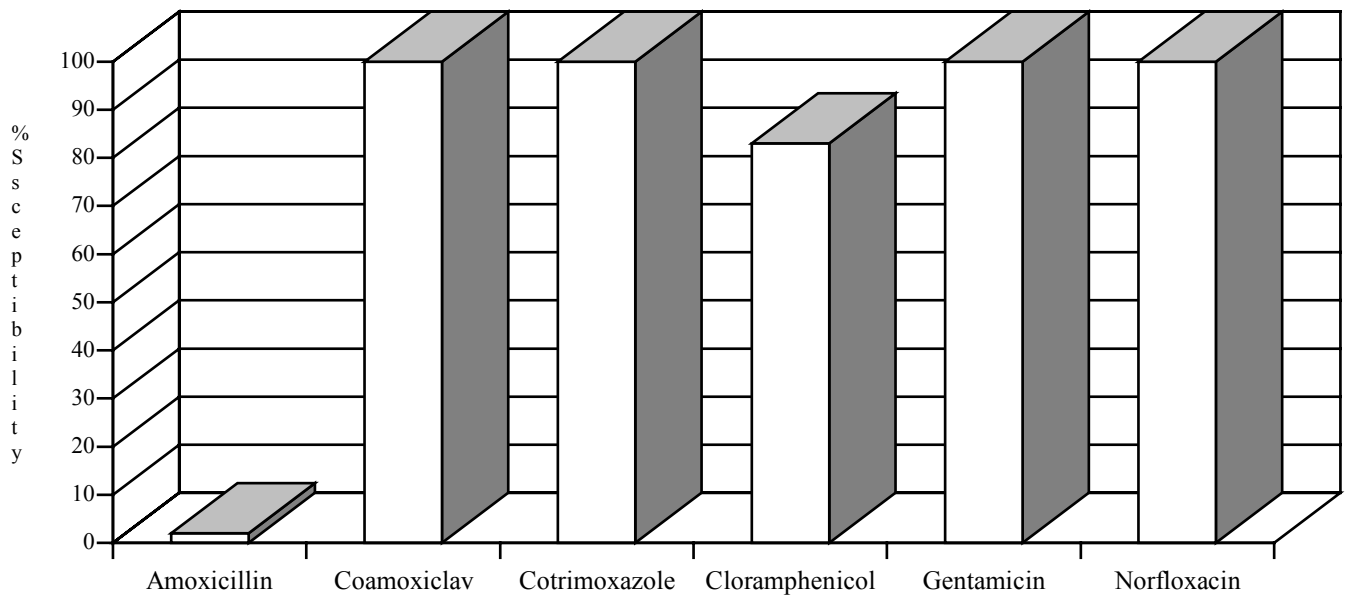


Figure 2: Susceptibility of *K. pneumoniae* to antibiotics isolated from sputum