# Staphylococcal infection in the Tropics

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A vast area of the earth lies within the tropics. Habitats range from deserts to rain forests; from snow-capped mountains to palm-fringed beaches and disease patterns change within remarkably short distances. It would be foolish to generalize on the role of the 'tropical' staphylococcus but I will share my experience gained over twelve years in Zambia. The term Central Africa is apt to evoke visions of steaming jungles. Zambia has none. The only patch of rain forest lies within the spray curtain of the Victoria Falls. The climate is wonderful (Zambia in the Sun!), modified by being some thousand miles from the sea, and most of the country is wooded plateau at elevations between 3000 and 4000 feet. Climate seems to influence some of the diseases under discussion so we should briefly consider the seasons. Seven months of drought extend from the end of March to the beginning of November. March and April are warm and sunny, May, June are much cooler with a few frosts at night, but bright sunshine generally produces shirt-sleeve temperatures by noon. From July the weather gets progressively warmer until October when increasing heat and humidity herald the first dramatic thunder storms. Although some 840 mm (33 in.) of rain fall between November and March, mainly as heavy showers, the hot sun makes this a fantastic growing season. Zambia is a little over three times the size of the British Isles with a population of only six million; a large proportion of whom are children and young adults. Many live in the major towns and cities on the line of rail, often in overcrowded townships. The rural areas are very sparsely populated by subsistence farmers living in small towns and scattered villages.

#### THE TROPICAL STAPHYLOCOCCUS

The staphylococcus is ubiquitous. It is the commonest organism isolated from surgical wound infections, burns (Wosornu, et al., 1978) and pelvic sepsis (Grech et al., 1977). Superimposed upon these everyday problems the staphylococcus also produces tropical pyomyositis, septic arthritis and osteomyelitis.

Various theories have been advanced to explain the severity of tropical staphylococcal infections. The hot humid climate, malnutrition, poor living conditions and hygiene, frequent skin trauma in bare-foot people and prevalence of insect vectors, have all been implicated but it is difficult consistently to incriminate any of them. If we knew why osteomyelitis rather suddenly disappeared from Britain in the pre-war years we might perhaps explain its current severity in the developing countries of the tropics. Do we have particularly virulent strains of staphylococci, or does the human subtrate provide a particularly favourable growth medium?

## Sensitivity to antibiotics

In common with Europe, the use and abuse of antibiotics have encouraged the emergence of resistant strains of staphylococci. Buttner & Westhoff (1973) from Uganda, recorded the strains with multiple antibiotic resistance increased from 12 per cent in 1965 to 39 per cent in 1970. In their survey (1970–1) they recorded a 90 per cent resistance to penicillin; 49 per cent to streptomycin and 10 per cent to oxytetracycline. They found that 18 per cent of 60 strains of *Staphylococcus aureus* isolated from patients in Mulago Hospital were resistant to cloxacillin; the first proven heteroresistance to penicillinase-stable penicillins in Uganda.

In Kenya, Mbalu (1978) found that only 1 per cent of S. aureus cultured from burns were penicillin sensitive while over 80 per cent were sensitive to lincomycin, erythromycin, cloxacillin and co-trimoxazole. Our experience in Lusaka is similar. Eighty-six per cent of staphylococci are penicillin resistant (Wosornu et al., 1978), most are sensitive to cloxacillin, while a few are sensitive only to gentamicin among the available antibiotics.

## PYOMYOSITIS

Tropical pyomyositis has been recorded occasionally in temperate regions especially among drug addicts but only rarely is it seen in Europeans living in the tropics. The disease consists of abscesses within the large muscles of

the trunk and proximal areas of the limbs from which S. aureus can be grown in virtually all cases.

In a clinical study of 109 patients seen over an eighteen-month period at the University Teaching Hospital, Lusaka, Subramanian et al., (1979) recorded that most patients were toddlers and 92 per cent were under 25 years of age. The sexes were equally represented though in a much larger series (800 patients) from Mulago (Horn & Masters, 1968) there was a male predominance of almost 2:1 among adults. The latter authors recorded that all social classes were affected in proportion to the numbers at risk and in Lusaka only 6 of the 109 patients were clinically malnourished and anaemic. Clustering of cases and occasional epidemics occur and in Zambia two peaks have been noted during the cold months (March-July) and in the hot dry months (September and October) just before the rains. In East Africa the disease is said to be rare at elevations above 5500 feet and in hot dry areas such as Khartoum. Muscle pain and tenderness precede swelling and Gelfand (1947) and Adams & McGrath (1964) have claimed that spontaneous remissions may occur.

Most patients present about a week after the onset of their illness. The infection is always beneath the deep fascia and skin changes (shininess and desquamation) are late. Regional lymph nodes do not enlarge. Fluctuation is an unreliable sign and needle aspiration may give negative results despite the presence of up to a litre of thick pus. If muscles are incised early in the disease, only pale oedematous tissue is found and some think that such premature incision increases morbidity.

Many patients have a single abscess and can be discharged from hospital within 24 h of drainage. A few present with extreme toxaemia, jaundice, anaemia and oliguria and die soon after admission. Septicaemia is common and pyaemic complications may occur in the lungs, pericardium and other muscles of these patients but never in the kidneys, spleen, brain or bones. After drainage the abscess cavities may bleed profusely and the pus is often pink from its content of myoglobin. Overall mortality rates range from 1.4 to 3 per cent.

Our standard management is to correct any gross anaemia and dehydration, establish high levels of circulating antibiotics (cloxacillin being the current choice) and then open the abscesses widely leaving large drains in place.

Strangely, pyomyositis does not co-exist with osteomyelitis in the same patient and several theories have been advanced as to why skeletal muscles, usually very resistant to infection, should be attacked by the staphylococcus in this way. Miyake (1904) showed that muscles damaged by pinching or fatigued by repeated electrical stimulation became susceptible to infection

from staphylococcal bacteraemia but in the recent series from Lusaka (Subramanian et al., 1979) only 17 per cent of the patients gave a history of trauma. Very high titres of anti-leucocidins have been demonstrated in patients with pyomyositis and Gladstone et al. (1967) postulated that the marked host response might cause specific necrosis of skeletal muscles. Clustering of cases and the occasional co-existence of acute parotid abscesses (a condition in which Coxsackie virus has been implicated) has prompted the suggestion that this virus may be responsible for primary muscle damage. Histology of non-suppurative cases shows a non-specific hyaline necrosis.

If we accept that another agent, trauma or viral infection, may precede infection of skeletal muscles by circulating *S. aureus*, a further difficulty arises. Where does the staphylococcus come from? In one carefully investigated series of 24 patients with tropical pyomyositis only one patient had a septic focus colonized by staphylococci of the same phage type and only 11 were skin carriers of the same staphylococcus as that cultured from their muscle abscess. One patient had a septic lesion with a different strain, five carried different strains on their skin and from the remaining six patients, no other staphylococci could be cultured. Tropical pyomyositis remains a common disease and an enigma.

#### OSTEOMYELITIS

The term osteomyelitis has been used very loosely and some series have included infections of compound fractures and even deep burns. Haematogenous osteomylitis was a common and virulent disease in Britain before the Second World War, especially prevalent among children of the lower socio-economic classes (Stirling, 1979). In Zambia it is still a major orthopaedic problem and these patients occupy a large proportion of our paediatric surgical beds. Subramanian and her co-workers (1978) from our hospital recorded 69 new cases within eighteen months in contrast to the recent series from two hospitals in Belfast (Mollan & Piggott, 1977) of 93 patients seen over fourteen years. Acute haematogenous osteomylitis is, in Zambia, a virulent disease and many of our patients progress to chronicity with persistent sequestra and sinuses.

### Neonatal osteomyelitis

This is usually of staphylococcal origin but streptococci and coliform organisms are sometimes cultured. The disease pattern is very similar to that recorded from Britain by Khazenfer et al. (1977) and similarly most cases

remain under the care of paediatricians until a very late stage. Multiple sites of osteomylitis and septic arthritis may be discovered in a desperately ill baby after the pneumonia, pericarditis and septicaemia have been controlled. More often a presumed bacteraemia is followed by septic arthritis and associated osteomyelitis of the pelvis, hip or knee presenting as diffuse swelling of the leg and monoplegia. The delay before referral for surgical treatment can often be measured in weeks rather than days. Destruction of epiphyses and hip dislocation are common. There is usually a history of umbilical sepsis and less commonly of intravenous feeding which are presumed to provide the portals of entry for bacteria into the blood stream.

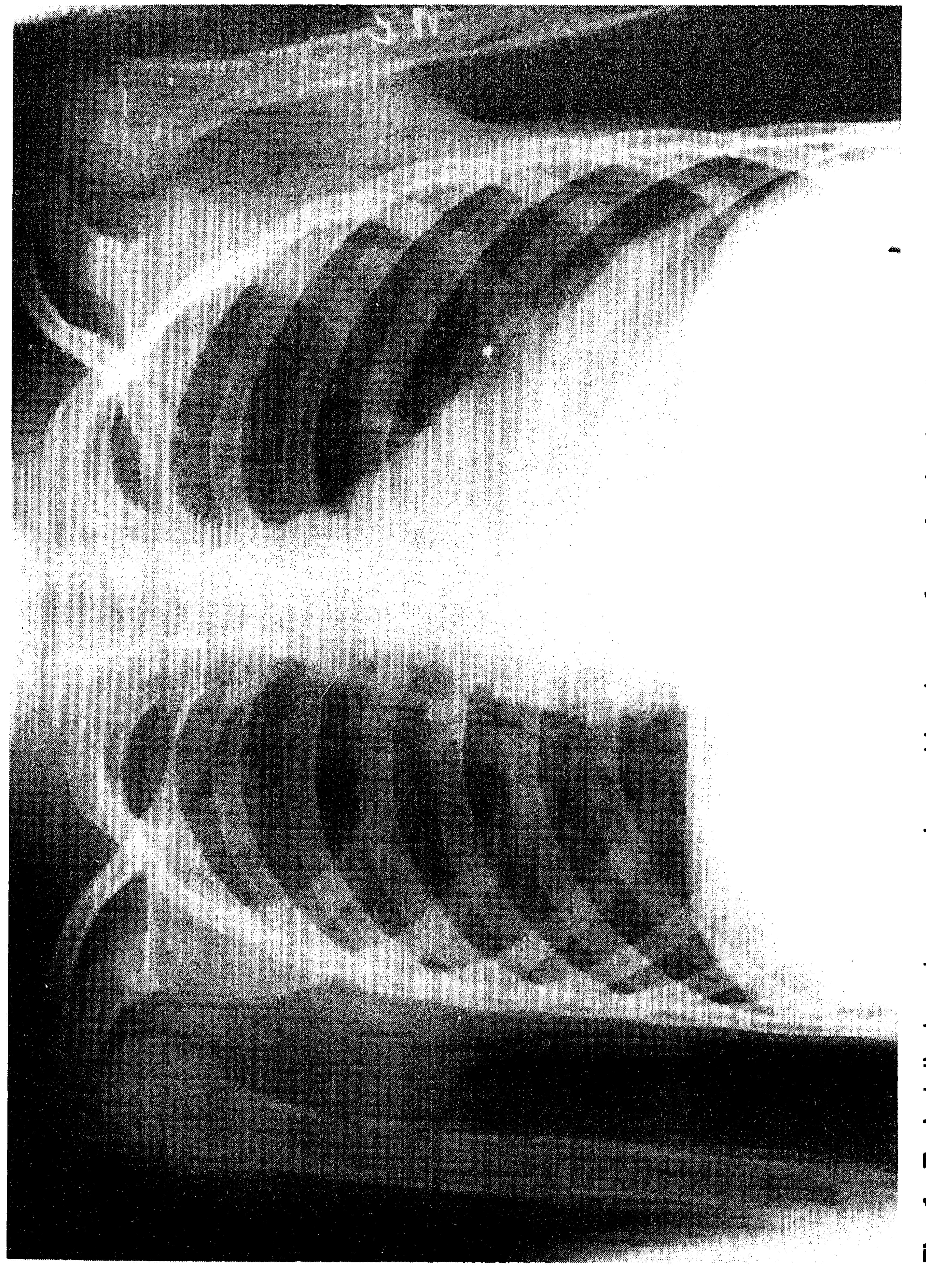
## Childhood osteomyelitis

Haematogenous osteomyelitis is very common amongst Zambian children but rare in the Asian and European communities. Penicillin-resistant staphylococci are almost invariably grown from positive blood cultures although pus swabs from sinuses may grow a variety of other organisms. Three modes of presentation can be recognized; the acute, postacute and subacute types.

The acute stage. It is notoriously difficult to establish the time of onset of the disease but only 30 per cent of patients reach hospital within the first 72 h and in only a proportion of these are truly acute cases with pus still confined within the medullary cavities of affected bones. A history of trauma may be elicited in approximately half the patients, but few show signs of malnutrition. Boys are more commonly affected than girls in a ratio of 2.5:1. High fever is accompanied by increasing pain and exquisite bone tenderness which can best be elicited by percussion over subcutaneous areas of the bone. There is little or no soft-tissue swelling. A primary focus of infection is rarely demonstrable but some patients have frank septicaemia with pneumonia or pericarditis at first presentation. The most commonly affected bones are the tibia, femur and humerus but none are immune and multiple bone involvement is quite common. Septic arthritis of contiguous joints develops if the epiphysis is intracapsular. There are no radiological signs at this stage and careful clinical examination is needed to exclude cases of sickle-cell bone infarction (affecting the diaphysis of long bones), early pyomyositis (without bone tenderness) or direct trauma in a febrile child. Theoretically, as in hand infections, there may be a stage of cellulitis during which elevation and antibiotics may abort the disease. Unfortunately, as in hand infections, it is extremely rare for patients to present before pus is present and we advocate decompression of the bone by drilling as soon as the child can be made ready for operation. It is extremely important not to interfere with the venous drainage of the bone by stripping the periosteum during drilling. Afterwards the wound is washed out with saline containing antibiotics and only when the soft tissues appear normal have we had any success with primary wound closure, with or without continuous irrigation. Staphylococci can often be cultured from the tissue fluid and secondary closure of the wound after a period of high elevation gives better results. Despite early treatment some cases still progress to chronic osteomyelitis. High elevation and adequate doses of antibiotics, usually cloxacillin, are continued for from four to six weeks.

The postacute stage. This is the common mode for presentation. Pus has now burst through the metaphyseal cortex, stripping the periosteum to leave dead cortical bone and a subperiosteal abscess. The history tends to be longer and the limb is swollen but pain and fever are often less severe than in acute cases. X-ray changes are not usually evident within the first 10 days but erosion of metaphyseal bone and new subperiosteal bone may then appear, preventing misdiagnosis as pyomyositis. Treatment is by high doses of intravenous antibiotics and open drainage of the subperiosteal abscess. Symptomatic relief is immediate. The area of periosteal stripping indicates the amount of sequestration to be expected. If closure of these wounds is attempted the limb remains swollen much longer, the wound usually breaks down, and multiple sinuses remain. We therefore leave the wound widely open and any exposed muscle is covered by split skin grafts when healthy granulations appear. Antibiotics are usually stopped when all systemic signs of infection subside at about two weeks, but the limb may need elevation for rather longer. Protection, usually by a plaster cast, windowed for dressings, must be provided until the involucrum is strong enough to allow sequestrectomy. At times the whole diaphysis may sequestrate and no involucrum may form. The dead bone should then be left to maintain length until the infection has subsided enough to allow bone grafting. We have recently acquired external fixators which may be useful to maintain limb length after removal of large sequestra. Fibula transposition cannot be performed in the presence of infection. Virtually all these patients presenting at the postacute stage progress to chronic disease.

Subacute haematogenous osteomyelitis. It has been reported (Harris & Kirkaldy-Willis, 1965) that in Nairobi two thirds of children with osteomyelitis present with this type and reports from Britain (Blockey & Watson, 1970) would suggest that such cases are common. This is not our experience in Lusaka. Bone abscesses without a history of a previous acute episode (Brodie, 1836) and the sclerosing non-suppurative hypertrophic osteomyelitis of Garré (1893) are both rare. A few patients present with very mild symptoms and can be successfully treated by elevation and antibiotics alone



ig. 1 Typical diaphysed sequestration and involucrum formation in chronic staphylococcal osteomyelitis

but may then progress to a hypertrophic state with drainage sinuses and small sequestra or granulation-filled cavities. These are then treated by 'saucerization', curettage of the cavity and open drainage. Bone grafting is unnecessary and the granulating cavities can soon be covered with split skin grafts.

## Sickle-cell disease

Heterozygous (AS) patients with sickle-cell trait show no definite predisposition to osteomyelitis but those with the homozygous (SS) disease often die from such infection. Aseptic diaphyseal infarction often accompanies sickling crises and when osteomyelitis occurs in these patients the diaphysis is usually severely affected.

These children usually present with septicaemia and severe anaemia (Hb<5 g/100 ml) and preliminary resuscitation and transfusion of packed cells must precede anaesthesia. They are twice as likely to have multiple limb involvement and the upper limbs are affected in over 50 per cent of cases (Huckstep, 1968). The causative organism is usually *S. aureus* and we have never cultured *Salmonellae*. These children have poor resistance to infections and we assume that the reports of salmonella osteomyelitis from Kampala and West Africa reflect the prevalence of salmonella species in those communities. Haematogenous osteomyelitis is comparatively rare in the adult, usually follows pelvic sepsis and affects the pelvis and spine rather than the limb bones. Again most cases are staphylococcal but a variety of other organisms have been found.

#### Septic arthritis

Septic arthritis may occur following direct spread from osteomyelitis or as a haematogenous infection without bone involvement. The diagnosis is easy in superficial joints and difficult in the hip where early dislocation may occur. The cardinal sign is severe pain on rotation which distinguishes it from iliac adenitis or pyomyositis of the ileopsoas muscle which also present with painful flexed hips.

Aspiration should be used only for diagnosis and we recommend wide arthrotomy and thorough lavage of the joint. We now leave the arthrotomy wound open and, if the joint surfaces are not obviously destroyed, exercise the limb in traction. The flow of pus is soon replaced by clear synovial fluid and the synovial membrane seals the joint within two weeks; the wound is then skin grafted or closed by suturing. We have never seen superinfection with other organisms and more joints are salvaged by this method than by repeated aspiration or by early closure of arthrotomies.



Fig. 2-5 Staphylococcal osteomyelitis of multiple sites in a child with sickle-cell anaemia.

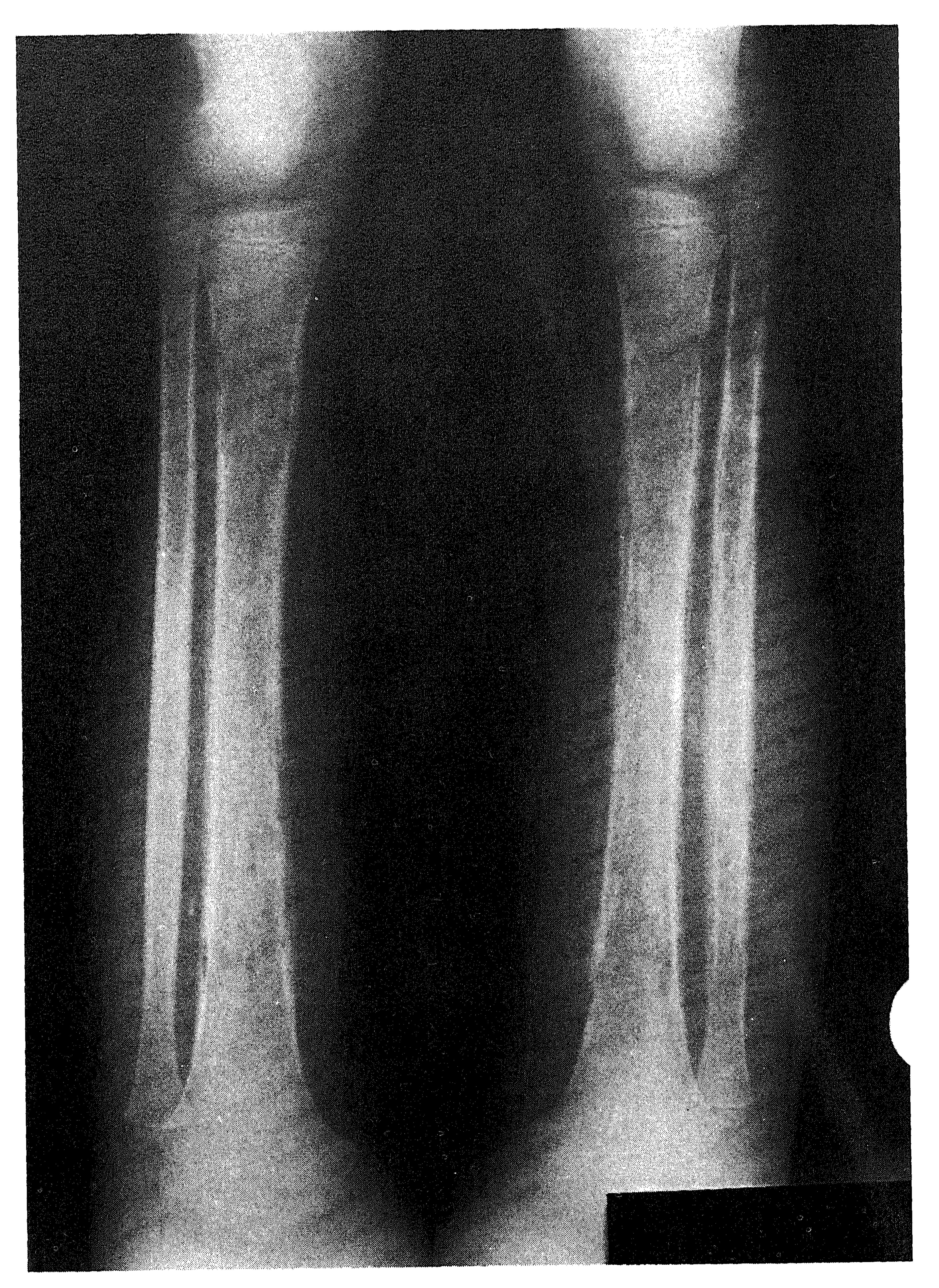


Fig. 3.

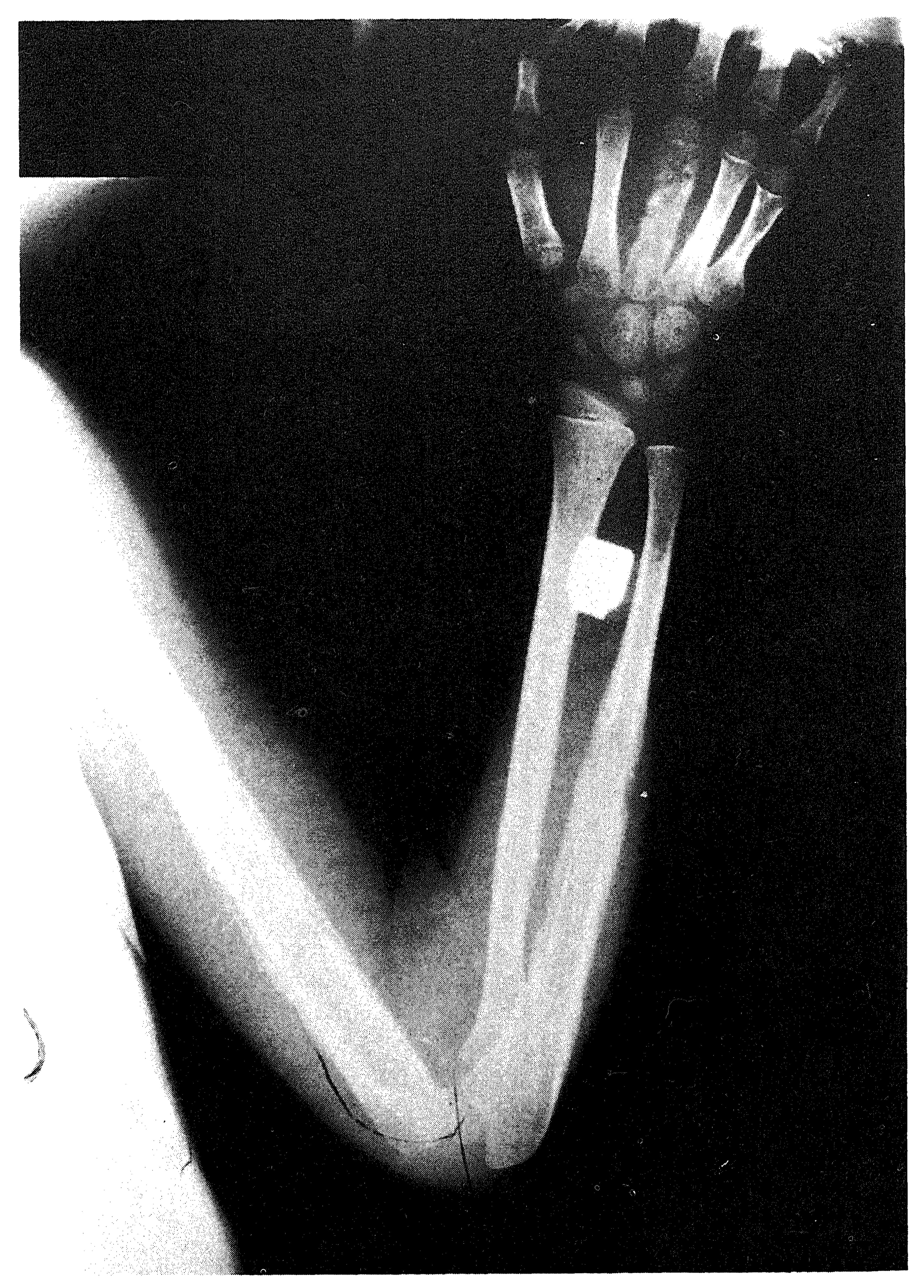


Fig. 4.



Fig. 5.

#### CONCLUSION

S. aureus causes most of the surgical infections seen in our part of Africa and many children continue to be crippled by osteomyelitis and septic arthritis. Tropical pyomyosites caused by S. aureus affects the large skeletal muscles of numerous young children but why and how it occurs remain an enigma. A high proportion of staphylococcal strains now show multiple antibiotic resistance.

Zambia has six orthopaedic surgeons for our six-million population and we still rely heavily on doctors trained outside Africa. The virulence of the staphylococcus, late presentation and poor resistance to infection in the patients, and the inexperience of their medical attendants, often combine with disastrous results. Birth rates are very high and primary health care has reduced childhood mortality from contagious diseases. Families are larger and without a significant rise in living standards it is possible that such infections may become even more common in future years.

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