delivered and ready for use when required. Furthermore, cyclotron-produced radio-isotopes are relatively expensive.

The preliminary results of thyroid A-P diameter determination are promising and this investigation is being continued to determine not only the thyroid thickness, but also the depth of tissue above it. A knowledge of the thyroid A-P diameter at selected points would enable one to determine thyroid volume more accurately and this information is important for thyroid therapy with radioactive iodine. Correction for self-absorption can also be made for large thyroids during uptake measurements.

As a result of the ideal physical properties of $^{131}$I, conventional thyroid studies can be performed more accurately, with a significant decrease in radiation doses to the patient. In addition, a new method of thyroid A-P diameter determination is made possible. Should contamination-free $^{131}$I become available at a reasonable cost, its use would ensure safer and more reliable thyroid investigations.

We should like to thank the Medical Superintendent of Tygerberg Hospital, for permission to publish the results of our investigations.

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The Incidence of R Factors Among Coliform Bacteria

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**SUMMARY**

The resistance spectra and incidence of transferable drug resistance were determined among coliform bacteria isolated from urban White and Xhosa populations from East London and from a remote Xhosa population from Butterworth. Drug resistance was encountered in $46.4\%$ of $112$ coliform bacteria from urban Whites, in $85.1\%$ of $49$ strains from urban Xhosa and in $58.1\%$ of $93$ strains from remote Xhosa. Transferable resistance was demonstrated in $50\%$ of resistant strains from urban Whites, in $60\%$ of resistant strains from urban Xhosa and $48.8\%$ of resistant strains from Butterworth. No coliform strains carrying F-type sex factors were isolated from $176$ strains tested for sensitivity to MS$_2$ bacteriophage.


The benefits of chemotherapy and antibiotics have been considerably offset by the emergence of drug-resistant bacterial strains. Of particular importance has been the discovery that resistance to one or more drugs can be transferred by conjugation between Gram-negative strains, especially among the Enterobacteriaceae. Numerous reports on the ecology, mechanism and possible origin of resistance transfer factors (R factors) have been published. Little, however, has been achieved in their control other than numerous appeals to the medical and allied professions for a more controlled usage of antimicrobial agents. So far this appears to have proved the most successful approach to the problem.

The incidence of R factors was reported by Maré and Coetzee among *E. coli* strains in the Pretoria area and by Watson among Shigella strains in Cape Town. Maré reported the low incidence of R factors among Kalahari Bushmen and wild animals in the Kruger National Park. The incidence of drug resistance in coliform bacteria from the Ciskei and Transkei is being investigated, because these areas contain urban populations which have been much exposed to drugs as well as remote populations which have had little or no contact with drugs. Furthermore, the Transkei is changing rapidly and these remote populations will soon come into greater contact with drugs. It is important to monitor any developments regarding drug resistance as this may provide further information as to its evolution and control.
The present study was undertaken to determine the resistance spectra and incidence of R factors of coliform bacteria isolated from an urban White and an urban Xhosa population from East London and a remote Xhosa population from Butterworth in the Transkei.

**MATERIALS AND METHODS**

**Bacterial Strains**

Coliform bacteria were isolated from faecal and urine specimens from 112 urban Whites, 47 urban Xhosa and 93 remote Xhosa. Non-mucoid red colonies isolated on MacConkey's agar (Difco), which produced acid and gas at 37°C in brilliant green lactose bile broth, were regarded as coliform bacteria.

**Resistance Spectra**

The sensitivity disc method was used to determine the resistance pattern of each strain to the following drugs: ampicillin (25 µg), cephaloridine (15 µg), chloramphenicol (30 µg), gentamicin (10 µg), nalidixic acid (30 µg), nitrofurantoin (200 µg), streptomycin (25 µg) and tetracycline (50 µg). Selective media were prepared by incorporating these drugs in nutrient agar (Difco).

**Transfer of Resistance**

Transferable resistance was determined by conjugation experiments with an *Escherichia coli* K12 F- recipient strain which was resistant to nalidixic acid. All the potential donor resistant strains were sensitive to nalidixic acid. One millilitre of an overnight broth culture of a resistant strain and 1 ml of an overnight broth culture of the recipient strain were both inoculated into 5 ml nutrient broth (Difco). The mixed culture was incubated overnight at 37°C and then plated on selective media containing one of the drugs and nalidixic acid.

**Non-transferable Resistance Plasmids**

Resistant strains which did not transfer their resistance to the F- recipient were tested for the presence of non-transferable resistance plasmids by treatment and growth in acriflavine which eliminates cytoplasmic DNA. Fifty colonies from overnight broth cultures containing 50 µg/ml acriflavine and no acriflavine (control) respectively were tested for resistance on selective media. A decrease in the number of resistant colonies of a particular strain after acriflavine treatment would indicate the elimination of a cytoplasmic resistance plasmid.

**Sex Factors**

The presence of F-type sex factors was determined by plaque formation using male specific MS₂ bacteriophage.

**RESULTS**

Drug resistance was encountered in 51.8% of strains from urban Whites, in 82.9% of strains from urban Xhosa and in 58.1% of strains from remote Xhosa subjects. Transferable resistance was demonstrated in 44.8%, 61.5% and 48.1% respectively of these resistant strains. Resistance patterns to each drug and the incidence of resistance transfer are shown in Tables I and II. No elimination of resistance was observed after growth in acriflavine of re-
sistant strains which did not show transfer. Doubt has been expressed, however, as to the effectiveness of acridine dyes in curing R factors. Neither these strains nor any of the sensitive strains (176 strains) were lysed by MS₂ phage, suggesting the absence of F-type sex factors.

DISCUSSION

The over-all results indicate that there is little difference between the incidence of resistant strains and R factors among coliform strains from urban White and remote Xhosa populations. The only exception is the high degree of streptomycin resistance in the remote Xhosa population. Streptomycin is extensively used to combat the high incidence of tuberculosis among the Transkei Xhosa. We attribute this high frequency of streptomycin resistance to the haphazard treatment of patients who often fail to report for regular control. The high degree of resistance (82.9%) and R factors (61.5%) in strains from urban Xhosa is striking. This could be the result of the use of drugs among an overcrowded, poor and uneducated population with inadequate domestic hygiene facilities and sewage treatment. The unhygienic neighbourhood would serve as a reservoir for resistant strains. Due to the low level of education and unfavourable economic position, the situation would be aggravated by patients failing to complete a course of drugs on discharge from hospital or on feeling better. These results illustrate the undesirable effects that can arise from the uncontrolled use of drugs in crowded, underdeveloped countries.

The similarities in resistance between remote Xhosa and urban White populations suggest that, when drugs are used with educated, affluent populations, the incidence of resistance need not rise above that found in untreated populations. It is interesting to note that, with careful control, decreased incidence of resistance to drugs amongst E. coli and Klebsiella enterobacter was observed over a 10-year period at a hospital in Seattle, USA. The origin of R factors is envisaged as occurring either via recombination between a chromosomal resistance gene and a sex factor, or via recombination between a non-transferable resistance plasmid and a sex factor. Previous reports have shown that sex factors are widespread in nature and two main types of sex factor, the F-type and the I-type, are thought to be involved in the recombination event resulting in an R factor. Since no coliform strains (176 tested) carrying F-type sex factors were isolated, it is suggested that the I-type sex factor may be implicated in the origin of R factors in coliform bacteria. It is interesting to note that Mitsuhashi et al reported that 25 out of 56 Escherichia coli strains tested contained sex factors which were shown to be different epimorphs from the F-type sex factor.

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Boeke Ontvang : Books Received


