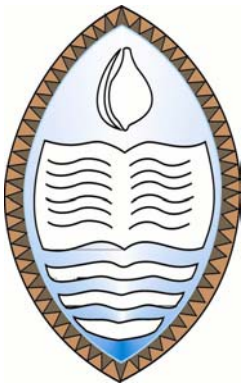
Med. Sci. Bull. ISSN 1991 – 5101

MEDICAL SCIENCES BULLETIN



SCHOOL OF MEDICINE AND HEALTH SCIENCES
UNIVERSITY OF PAPUA NEW GUINEA

DIVISIONS OF BASIC MEDICAL SCIENCES, HEALTH SCIENCES AND DENTISTRY

Volume 4: November 2007

MEDICAL SCIENCES BULLETIN: Volume 4, 2007

A multidisciplinary journal for publication of medical and biomedical research findings on issues pertinent to improving family health and related issues of public health

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A multidisciplinary journal for publication of medical and biomedical research findings on issues pertinent to improving family health and related issues of public health

NOVEMBER 2007; ISSN 1991 – 5101 VOLUME 4

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RESEARCH PAPERS

ANTIBACTERIAL ACTIVITY OF PLANTS FROM VARIRATA NATIONAL PARK IN PAPUA NEW GUINEA

Martha Y. Mungkaje[1] and Prem P. Rai[2]

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ABSTRACT

In continuing search for bioactive constituents from plants in Papua New Guinea, antibacterial activity of five plant extracts *(Macaranga subpeltata, Mallotus philippensis, Antidesma polyanthum, Flindersia laevicarpa var. heterophylla and Evodia xanthoxyloides)* were evaluated against bacterial strains Escherichia coli, Salmonella typhi, Staphylococcus aureus, Enterococcus faecalis, Pseudomonas aeruginosa, Streptococcus pneumonia, Enterococcus aerogenes and Mycobacterium tuberculosis. There were significant differences in the inhibition of these pathogens at different concentrations of the extracts. The Gram (+) bacteria were more susceptible to all extracts than the Gram (-). The hexane extract of F. laevicarpa var. heterophylla exhibited the highest potency against all pathogens (MIC >50 ug/mL). Alkaloids borreverine and a hydroxylated analogue of borreverine were isolated from the bark of F. laevicarpa var. heterophylla by HPLC using a reverse-phase column and gradient elution method; identities were confirmed using MS data. These two compounds are new inclusions to the compounds that have been isolated from this plant.

Key Words**:** *Macaranga subpeltata, Mallotus philippensis, Antidesma polyanthum, Flindersia laevicarpa var. heterophylla, Evodia xanthoxyloides*, antibacterial activity.

(Submitted: October 2007, Accepted November 2007)

INTRODUCTION

According to World Health Organization (WHO) more than 80% of the world's population relies on traditional medicine for their primary healthcare needs. Use of herbal medicines in Papua New Guinea represents a long history of human interactions with the environment. Plants used for traditional medicine contain a wide range of substances that can be used to treat chronic as well as infectious diseases. A vast knowledge of how to use the plants against different illnesses may be expected to have accumulated in areas where the use of plants is still of great importance [2]. Five plant species growing in Varirata National Park, located 45 km southwest of the capital city Port Moresby, were evaluated for their antimicrobial activity (Table 1).

Some of these plants are used in folk medicine in the treatment of skin conditions, gastrointestinal infections and respiratory conditions [3-8, 12, 13]. Evidently, there are no previous reports that confirm

the antimicrobial properties of plants collected for this study. The phytochemical research based on ethnopharmacological information is generally considered an effective approach in the discovery of new anti-infective agents from higher plants (9)

MATERIALS AND METHODS

Plants were selected for this study based mainly on their medicinal use. Fresh plant parts of *Macaranga subpeltata, Mallotus philippensis, Antidesma polyanthum, Flindersia laevicarpa var. heterophylla and Evodia xanthoxyloides)* were collected from the Varirata National Park near Port Moresby. The voucher specimens in duplicate were deposited in the Biological Sciences Herbarium of University of Papua New Guinea. The plant materials were dried under shade and ground into fine powder using an electric blender.

PREPARATION OF EXTRACTS

Plant extracts were prepared by cold maceration method. 100 g of powdered dried leaves and barks of all the five plant species were soaked in 300 ml MeOH with intermittent shaking for 24 hours. The plant extracts were filtered through Whatman No. 1 filter paper, and concentrated using a rotary evaporator. Similarly, 650 g of bark extracts of *F. laevicarpa* var. *heterophylla* were variously prepared using hexane, dichloromethane, EtOAc and MeOH as solvents for maceration.

PREPARATION OF STOCK EXTRACTS AND INOCULUM

Stock concentrations (8mg/ml) of concentrated plant extracts were prepared in dimethylsulfoxide (DMSO) and filter sterilized. A four-hour culture of each of the test pathogen was diluted (1:10). This culture was further diluted in the ratio 1:10 until it reached 0.5 McFarland using the nephelometer. Preparation of inocula for the test pathogens was adapted from NCCLS protocol 2000 (11).

ANTIMICROBIAL SUSCEPTIBILITY TEST

The diluted extracts were subjected to susceptibility test using the broth dilution method.

A two-fold dilution into ten 1 ml Mueller-Hinton broth (MHB) tubes was carried out. Simultaneously, the test pathogens were tested for their susceptibility to their respective standard antibiotics to compare them with the plant extracts.

PHYTOCHEMICAL SCREENING, HPLC AND LCMS ANALYSIS OF BARK EXTRACTS OF F. LAEVICARPA VAR. HETEROPHYLLA*:*

The bark extracts of *F. laevicarpa* var. *heterophylla* were screened to detect the presence of alkaloids, anthraquinones, flavonoids, saponins, tannins, and terpenes using standard chemical tests.

The hexane extracts were further analyzed using the HPLC and LCMS. The HPLC was performed on a reversed phase column (Waters Symmetry C_{18}, 2.1 x 150 mm, 5 um) using a gradient elution method at a flow rate of 0.2 ml per min. The mobile phase contained water (A) and acetonitrile (B). Gradient elution was programmed linearly from 75% to 25% B and also from 0% to 100% B over 20 min.

The LCMS was operated under the following conditions: electro-spray in positive ion mode using a cross flow counter electrode, capillary voltage = 3.2 KV, cone voltage = 30 V, source temperature = 140^0C, collision energy = 35 eV, and collision gas cell pressure = 1.4 x 10^{-3} mBar. Two large peaks from the HPLC separation emerging between 14 and 16 minutes of the hexane extract were eluted and run through the LCMS (Figure 1).

Table 1: Uses and properties of plants collected for antimicrobial screening

Botanical Name/Family	Local Names(s)	Preparations and uses	Properties
Macaranga subpeltata (Euphorbiaceae)	Baka, Jikalou	Bark is heated over fire and applied on swellings, bruises and boils	Anti-inflammatory, Anti-infective
Mallotus philippensis (Euphorbiaceae)	Jikalou	Bark or leaf is heated over fire and applied externally on cuts and wounds	Anti-inflammatory, Anti-infective
Antidesma polyanthum (Euphorbiaceae)	Not known	Not known	Not known
Flindersia laevicarpa var. *hetero*phyla (Rutaceae)	Not known	Not known	Not known
Evodia xanthoxyloides (Rutaceae)	Not known	Decoction of bark is prepared in water and drunk to treat fever and respiratory infections	Febrifuge

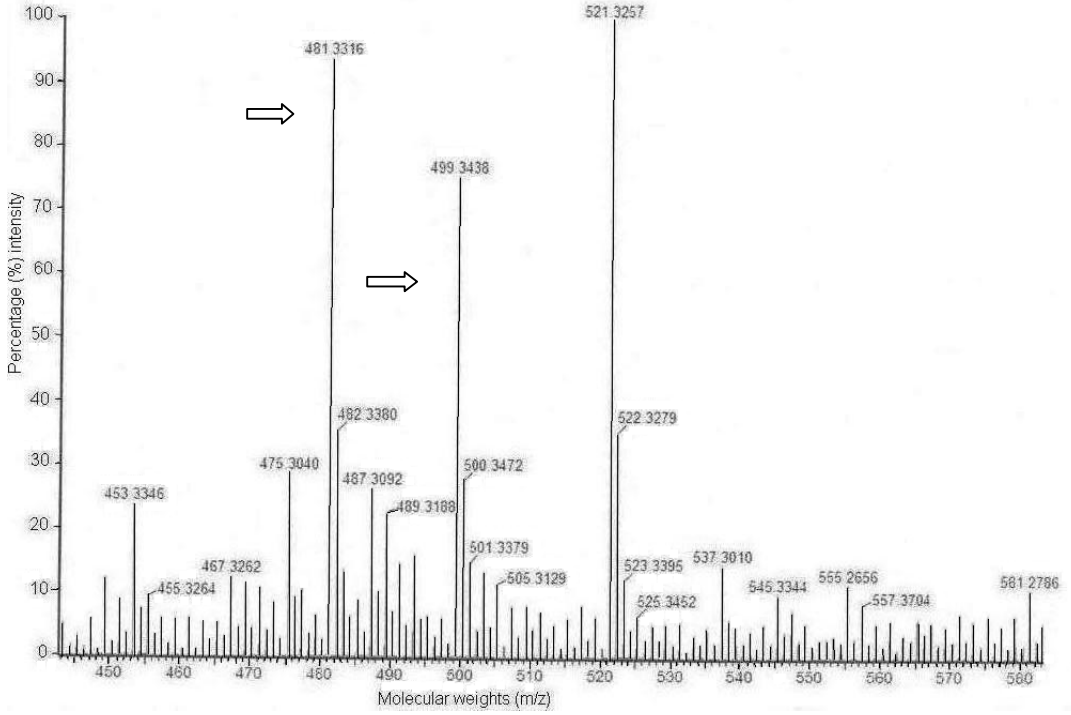

Figure 1: LCMS profile of M186-4-17 (hexane) stem bark extract of F. laevicarpa var. heterophylla (The arrows in the profile show the two molecular weights that were used to determine the identity of compounds borreverine and its hydroxylated analogue).

RESULTS AND DISCUSSION

Table 1 provides the botanical name, family, local name, plant parts used together with their traditional therapeutic uses and properties where known for the 5 ethno-medicinal plants collected from Varirata National Park. The bark extracts of *F. laevicarpa* var. *heterophylla* tested positive for saponins, terpenes, flavonoids and tannins. All plants showed antimicrobial activity in varying degrees. Generally, the bark extracts were more active than leaf extracts. The hexane extract of *F. laevicarpa* var. *heterophylla* bark exhibited the highest potency against all pathogens tested (>MIC 50 µg/mL). The results of the antimicrobial screening of the crude extracts of all species of plants are shown in Tables 2 & 3.

The NCCLS approved minimum inhibitory concentrations for amoxicillin and cloaxicillin against bacterial strains investigated in this study are given in Table 4 for comparison purposes. The tested plant extracts were most active against gram-positive microorganisms than gram-negative microorganisms. This is in agreement with previous reports by other workers [1].

Alkaloids borreverine and a hydroxylated analogue of borreverine were isolated from the bark of *F. laevicarpa* var. *heterophylla* by HPLC using a reverse-phase column and a gradient elution method; identities were confirmed using LC MS data. These two compounds were: a) 481.3316 (M+H), $C_{32}H_{40}N_4$ (borreverine) and b) 499.3438 (M+H),

$C_{32}H_{42}N_4O$ (hydroxylated analogue of borreverine) (Fig. 1). Antibacterial activity of borreverine has previously been reported (8). The two compounds identified in this study are new inclusions to the compounds that have been isolated from this plant.

Table 2: Summary of the inhibition (mean percent) of pathogens by different plant extracts

Pathogens tested with leaf and bark extracts	**Plant species**				
Leaf Extract	**MS**	**MP**	**AP**	**FL**	**EX**
E. coli	+	+ + +	+ + +	+	+
S. typhi	+ +	+ + +	+ +	+	+ +
S. aureus	+ + +	+ +	+	+	+ +
E. faecalis	+ +	+ +	+ + +	+ +	+ +
Bark extracts					
E. coli	+ +	+ +	+	+	+ + +
S. typhi	+ +	+ + +	+ +	+	+ +
S. aureus	+ + +	+ + +	+ +	+ +	+ +
E. faecalis	+ +	+ +	+ +	+ +	+ + +

MS = *Macaranga subpeltata*

MP = *Mallotus philippensis*

AP = *Antidesma polyanthum*

FL = *Flindersia laevicarpa* var. *heterophylla*

EX = *Evodia xanthoxyloides*

\+ = Low inhibition, ≤ 50%

\+ + = Moderate inhibition, > 50 - ≤ 80%

\+ + + = High inhibition, ≥ 80%

Table 3: Different concentrations of bark extracts of *F. laevicarpa* var. *heterophylla* tested against various pathogenic bacteria.

Pathogen	Concentrations (µg/ml) of bark extracts prepared in different solvents											
	Hex			DCM			EtOAC			MeOH		
	200	100	50	200	100	50	200	100	50	200	100	50
E. coli (ATCC 25922)			A			I			I			I
P. aeruginosa (ATCC 27853)		A	I	I*		I	I*		A		I*	A
S. pneumonia (ATCC 6303)		A	I	I		I	A		I		I	I
S. aerogenes (ATCC 3048)			A			A			A			A
S. aureus (ATCC 25923)		A	A	I		I	I		I		A	A
M. tuberculosis		A	A		Q	I		Q	I		I	I

Hex = hexane; DCM = dichloromethane; EtOAc = Ethyl acetate; MeOH = Methanol

A = Active (significantly different from control, i.e. high inhibition, ≥ 80%)

Q = Questionable activity (moderate inhibition, > 50 - < 80%)

I = Not significantly different from control (Low inhibition, ≤ 50%)

* = Highly variable

Table 4: NCCLS approved MIC (μg/ml) breakpoints for amoxicillin and cloxacillin for the bacterial species investigated in this study

Antibiotic	***Pathogen/ Bacterial species***	***Equivalent MIC (μg/ml) of Ranges Breakpoints***		
		Resistant	*Intermediate*	*Susceptible*
Amoxicillin	*E. coli*	*≥ 32*	*16*	*2-8*
Amoxicillin	*S. typhi*	*≥ 32*	*16*	*≤8*
Cloxacillin	*S. aureus*	*≥ 4*	*3*	*≤ 2*
Amoxicillin	*E. faecalis*	*>1*	*N/A*	*0.25-1*

N/A= Not applicable

CONCLUSIONS

The processing of the plants performed in this study was not comparable to the traditional approach when the herbalists used water for extracts whereas we have used organic solvents for extraction. In this sense it is not exact replication of the traditional knowledge. However, given that methanol extracts were effective, it is likely that water extracts will be effective as well and possibly more so.

The antibacterial activity of *M. subpeltata*, *M. philippensis*, *A. polyanthum*, *F. laevicarpa* var. *heterophylla* and *E. xanthoxyloides* were reported for the first time. No previous report on the antibacterial activity of these species could be found in the literature. Generally, the leaf and bark extracts of all the five plant species inhibited all test bacterial species (*E. coli*, *S. typhi*, *S. aureus* and *E. faecalis*) at varying intensities. The bark extracts of *F. laevicarpa* var. *heterophylla* were bioactive against *E. coli*, *P. aeruginosa*, *S. pneumonia*, *E. aerogenes*, *S. aureus* and *M. tuberculosis*; the hexane extract of the bark being the most bioactive.

The hexane extract of *F. laevicarpa* var. *heterophylla* exhibited the highest potency against *E. coli*, *E. aerogenes*, *S. aureus* and *M. tuberculosis* ($IC_{50\ \mu g/ml}$). Since tuberculosis is one of the major diseases in PNG and other developing countries, these extracts need to be further analysed for a possible anti-tuberculosis drug. Also, alkaloids borreverine and a hydroxylated analogue of borreverine were isolated from the bark of this plant for the first time. Antibacterial property of borreverine has already been reported in literature [8]. *F. laevicarpa* var. *heterophylla* could be a potential source for new antimicrobial agents.

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ACKNOWLEDGEMENTS:

The authors would like to thank University of Papua New Guinea and International Conservation and Biodiversity Group (ICBG) for financial support in various stages of this study. They are also grateful to Papua New Guinea Institute of Medical Research for providing stock cultures of bacterial species including laboratory space for antimicrobial testing. Chemical analysis was carried out in Professor Chris Ireland's laboratories at University of Utah with assistance from Professor Louis Barrows and Dr. Tim Bugni.

A TECHNIQUE OF INDIRECT RETORATION OF TEETH WITH COMPOSITE RESIN

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INTRODUCTION:

Indirect restoration is a modern restorative technique in which the restoration is prepared outside the oral cavity. The main difference between direct and indirect restoration is the cavity design and the extra-oral fabrication of the restoration. Indirect restorations can be either intra-coronal or extra-coronal.

Intra-coronal restoration is usually within the tooth cavity and is surrounded and supported by the remaining tooth tissue. Indirect restoration is also known as inlay and onlay if it replaces the cusp. Extra-coronal restoration on the other hand is restoration that surrounds the circumference of the remaining tooth structure and is also known as crown. The cavity design for a composite inlay restoration is quite different from preparing a cavity for a conventional direct composite restoration. The two main features of this cavity design are: All angles (except the pulpo-axial) are definite and sharp. All walls in an axial plane diverge occlusally.

This is different from the design of a direct composite restoration where the angles of the cavity are more rounded with convergent cavity walls, which create a slight undercut. The divergent walls in this cavity preparation make it easy to remove the impression from the tooth cavity without distortion and for easy insertion of the prepared inlay. However the diverging angle should not be too wide, as this will compromise the retention of the restoration. It is also important to remember that preservation of the remaining tooth structure is vital because all restorations depend on the strength and integrity of the remaining tooth structure for retention. Therefore it is important to preserve the buccal and lingual cusps when preparing a cavity for an inlay. “If the sides of the tooth structure is already weak, or indeed split, inlay is contraindicated and an extra-coronal restoration is indicated” [1].

The cavity design of a class II preparation will be discussed here as this class clarifies most of the general principles involved (Fig. 1).

- The structural defects and undermined enamel are removed
- The occlusal outline is extended to join with the proximal portion of the preparation.
- The gingival wall is placed such that the margin of the restoration is covered by the free gingiva. This wall must be straight bucco-lingually and meet the buccal and lingual walls at a definite angle. It should also be at right angle to the long axis of the tooth.
- The buccal and lingual walls should be extended to areas of the tooth surface, which are less susceptible to recurrent caries and slightly divergent from the gingival wall to the occlusal.

CAVITY DESIGN

Outline form

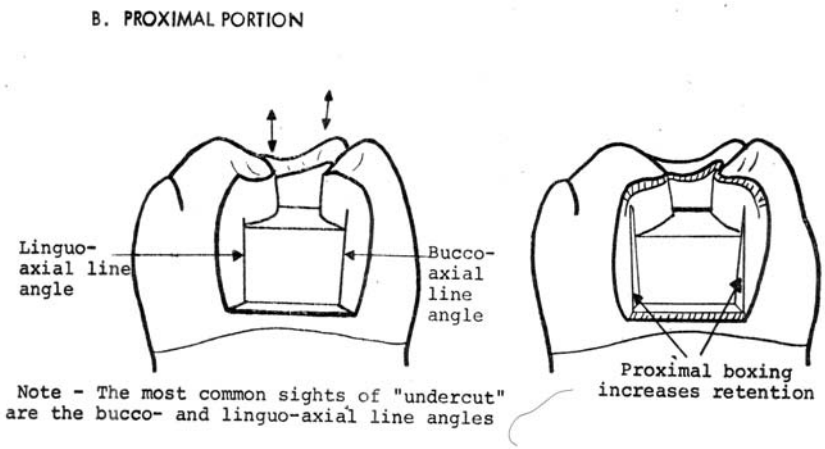
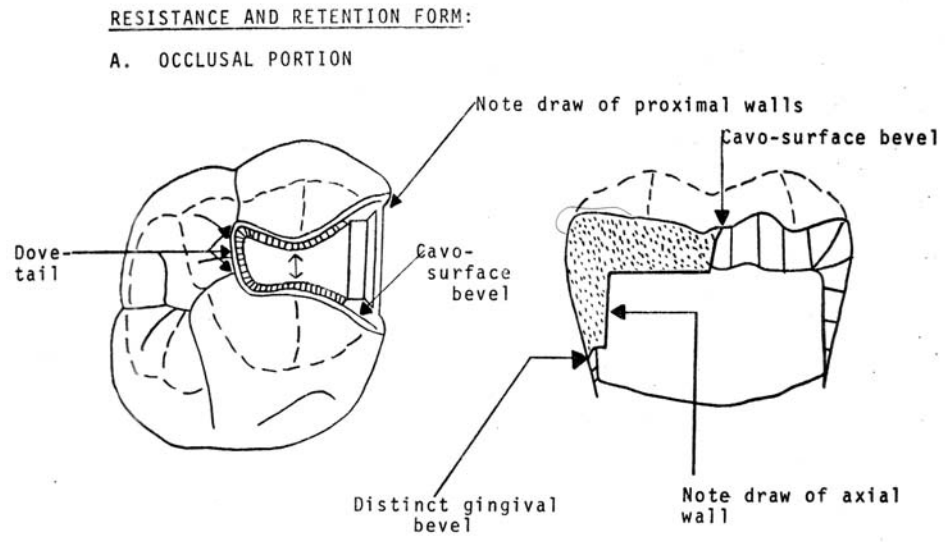


Fig. 1

(Manual of comprehensive operative dentistry, the University of Western Ontario) [3]

Resistance and Retention form



(Manual of comprehensive operative dentistry, the University of Western Ontario) [3]

- The pulpal floor should be flat and at right angle to the long axis of the tooth.
- The surrounding walls should slightly diverge from the pulpal floor.
- The distal portion should slightly widen bucco-lingually to establish a dovetail.
- The gingival wall should be flat and the buccal and lingual proximal walls should be straight and slightly divergent to be free of undercuts.
- The pulpoaxial line angle should be slightly bevelled or rounded.

It is important to have in mind that the luting cement used to cement the restoration into the cavity should not be relied upon as the primary source of retention. The cement will only prevent vertical displacement of the restoration cannot withstand the occlusal loads from different angles during mastication.

Mostly the resistance and retention form can be together with the outline form retention.

CAVITY LINING

Like in the direct restoration lining cement is also placed on the pulpal floor and axial wall of the cavity. This is done of cause to protect the pulp from thermal and chemical irritation. Cavity lining in this case should be placed before the impression is taken. The opposite cannot be done as the prepared inlay will not fit perfectly into the cavity because the lining will add extra height to the base of the inlay. Here the material of choice in a composite inlay restoration is glass ionomer cement (GIC) because of its properties in binding chemically with the tooth tissue and can be etched as this will change the dimension of the prepared cavity and to bond with the composite inlay. It is also biocompatible and does not elicit any chemical irritation to the pulp. After the lining is being placed any access cement should be trimmed down to level the lining and maintain the original design if the cavity. While lining the cavity, any undercuts and unsupported enamel on the cavity walls can also be filled. This should also be remembered so that tooth tissue on the pulpal floor and cavity walls can be preserved because the lining cement can level any irregularities. Always remember to carve the general outline of the cavity after the lining to achieve the desired cavity design before taking the impression.

TAKING IMPRESSION:

Preferably the rubber based impression material is used when taking impression for an indirect restoration. The rubber based impression material usually comes in a base and catalyst in two separate pastes. Alginate can be used to take the impression of the opposing arch to be used for articulation. Rubber based impression material is the material of choice because of the following properties:

- It has low viscosity and is capable of producing excellent reproduction of very fine surface details.
- Its elastic property makes it possible for repeated pouring.
- It has a high tear strength thus making it more resistant to tearing even when the impression is in thin section

The material is prepared by mixing the two components (base and catalyst) in correct proportions. The two pastes are squeezed onto a mixing pad along side each other in equal lengths. These two parts are mixed until the mix becomes an even colour. Then it is ready to be loaded into the syringe. The impression material is compressed into the syringe by compressing the mix against the mixing pad in a series of scooping motion until a

small amount of material extrudes from the plastic nozzle. The injecting plunge is inserted and the impression can be taken.

To take the impression, inject the material into the cavity to fill it up and also inject around the tooth. The remaining material on the pad is loaded into the impression tray and inserted into the mouth to take the impression. Keep the impression tray completely stable in the mouth for 4-5 minutes for it to set before removing it. The impression of the opposing arch is also taken. The impressions are then taken to the laboratory to pour out the model.

While the inlay is being processed in the laboratory, the cavity will have to be filled a temporary inlay. This is done to:

- To protect the pulp
- To prevent the ingrowth of gingival tissues
- To prevent alteration of occlusion and approximal contacts
- To prevent fracture of weakened cusps
- To restore appearance and comfort [4].

LABORATORY WORK

The impression is placed on the vibrator to make sure there are no air bubbles in the model. When the stone has set hard, the model is removed from the impression and mounted on the articulator. Composite inlay can then be prepared in the model.

When building the inlay on the model, composite is laid in increments and cured. This allows enough light penetration into the composite for polymerization to take place. As each layer of composite is laid down and cured, it is better to remove the restoration from the cavity so that it can be easily removed when completed. The restoration can be removed and cured from the base and from all side. This allows the restoration to be almost completely polymerized. If some spaces are left along the walls or base of the inlay in the event of building the inlay, it should not be filled again because these spaces will be filled up by the luting cement. The restoration can carved to match the tooth morphology on the model and the high spots can be trimmed down using the opposing arch on the articulator. The restoration is then ready for insertion in the tooth cavity.

LUTING CEMENTS AND INLAYS INSERTION

Luting cement

Luting cements are used to lute the space between the restoration and the tooth. This is done to prevent the ingress of bacteria and to bond the restoration to the tooth. The cement should not be thought of as the main means of retention because of the limitations of the physical properties in the cement available the difficulty of developing true long-term adhesion. The only part the cement plays in retention is to prevent the dislodgement of the restoration from the cavity through the original path of insertion. The restoration however relies mainly on the resistance and retention design on the cavity preparation to remain in place. Luting cements should have the following requirements:

- Biocompatibility, fine ultimate film thickness, high ultimate compressive strength, high ultimate tensile strength, radiopacity (is desirable), chemical or light activated dual cure

The material of choice in this case is low viscosity composite resin because apart from having the above properties, it is a flow able and can fill in the spaces that might be left on the cavity walls or the restoration during preparation. Further more it has the ability to bond chemically to the restoration and

micromechanically to the etched GIC lining and tooth tissue. It is also self-setting and there is no need to worry about light curing and polymerization shrinkage.

INSERTION OF INLAY

Insertion of the inlay is done when the patient comes back on the second visit. Firstly the temporary restoration is removed from the cavity. The inlay is the removed from the model and inserted into the cavity for trying. If the inlay does not fit onto the cavity it, check for remains of the temporary restoration or there might be some undetected blobs on the inlay caused by minor distortions to the impression. These things should be removed until the inlay seats perfectly into the cavity.

The cavity is then filled with luting cement and the inlay is inserted for the last time. Ask the patient to close firmly on a cotton wool roll to apply a steady pressure while the cement sets. Any excess amount of cement should not be removed until the cement has completely set using a flame shaped tungsten curbid bur on a slow speed hand piece. Trim the excess cement at the gingival margin of the proximal area with a polishing strip and polish the restoration.

CONCLUSION:

This technique limits the disadvantages of composite material and allows the clinician to make full use of its properties. This includes curing from all surfaces to achieve complete polymerization of composite thus limiting the possibility of polymerization shrinkage. This technique also eliminates the problem of maintaining a dry working area because the restoration is prepared outside the oral cavity. The restoration can also be carved to match the occlusal morphology with ease of instrumentation from all angles of the tooth and to get a good contact point. With all these advantages the indirect composite restoration minimises the probability of marginal leakage, which is the major cause of failure in direct composite restoration

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NUTRIENT AND ENERGY INTAKE OF PEOPLE LIVING WITH HIV/AIDS IN PORT MORESBY, PAPUA NEW GUINEA: A 24-HOUR RECALL STUDY

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ABSTRACT:

People living with HIV/AIDS have greater energy needs than uninfected persons. Extent of increase energy needs depends on progression and stage of HIV infection. Paucity of data on nutrient and energy intake of PLWHA in PNG necessitated the purpose of this study.

A prospective cross-sectional study carried out in the Heduru Clinic in Port Moresby General Hospital in PNG. Study population was selected by simple random sampling of PLWHA attending Heduru clinic from May to July 2006. 58 participants were recruited on a consecutive basis. Self-designed pre-tested 24-hour food-recall questionnaire was used to obtain data from consented participants. Standard and modified food-recall kits were used to obtain estimated quantities of all foods and drinks consumed the previous day (24-hours). Food-Works Professional edition 2005, version 4.00.1179: Xyris Software (Pacific Food Tables) was used to convert estimated food intakes into nutrient and energy values. Data analysis was carried out by Microsoft Excel data pack 2006.

Fifty (86%) PLWHA consented to participate. 21 (42%) were males and 29 (58%) females. Mean per capita intake of proteins, fat and carbohydrates were for males 62 $\pm$ 11g, 67 $\pm$ 6g and 258 $\pm$ 32g respectively, for females the values were 66 $\pm$ 12g, 61 $\pm$ 6g, 226 $\pm$ 28g respectively. Mean per capita intake of energy for males and females was 1892 $\pm$ 198 kcal (95% confidence interval 1576 – 2208 kcal) and 1725 $\pm$ 214 kcal (95% confidence interval 1385 - 2065 kcal) respectively. The mean energy intake of male and female PLWHA was 33.6% and 14% below the RDA for healthy non-HIV infected PNG males and females respectively. Significant differences were obtained when the energy intakes are compared to the WHO recommended energy intake for male and female PLWHA. Nutrition should be integrated into the essential package of care, treatment and support for PLWHA in PNG. It is essential to incorporate nutrition screening, assessment and counselling into the National Policy and Guidelines for care and treatment of PLWHA in PNG.

Key Words: HIV, AIDS, Energy, Diet, Protein

(Submitted September 2007, Accepted October 2007)

INTRODUCTION:

Antiretroviral therapy (ART) and adequate dietary intake are essential components in the management of people living with HIV/AIDS (PLWHA) [1,2,3]. Poor nutrition status and HIV/AIDS are interrelated and exacerbate one another creating a vicious cycle that progressively damage the immune system, enhances risk of developing opportunistic infections, increase fatigue, decrease physical activity and productivity of PLWHA [1,2,4].

HIV/AIDS specifically affects nutritional status by increasing energy requirements, reducing food intake and adversely affecting nutrient absorption and metabolism [1,4]. Responsiveness of PLWHA to nutritional interventions depends on viral load, stage of disease, concurrent treatment, body mass index and presence or absence of opportunistic infections [1,2,4,5]. PLWHA have greater energy needs than uninfected individuals. The extent of increased energy needs depends on progression and stage of HIV infection [1,2]. In asymptomatic PLWHA, the energy needs are 10% higher than the accepted levels for healthy non-HIV infected persons of the same age, sex and physical activity level [1,2]. The increase energy is needed to maintain body weight and physical activity, which are highly desirable for preserving quality of life [1,2,4]. In PLWHA that have symptoms or any opportunistic infection the energy needs are increased by 20 to 30% above the acceptable level for health non-HIV infected persons of the same age, sex and physical activity level [1,2]. The increase energy is needed to support weight recovery during and after HIV related illnesses [1,2]. The 20 to 30% increase in energy intake may not be easily achievable because of poor appetite, inadequate dietary intake or other reasons caused by acute infection/illness [1,2]. However, food intake should be encouraged and increased to the extent possible, particularly during the period of recovery [1].

According to WHO expert committee [1], the estimated increased energy requirements are to compensate for the increased level of Resting Energy Expenditure (REE) and to allow for normal Activity-related Energy Expenditure (AEE), both of which together represents the Total Energy Expenditure (TEE). Apart from dietary and energy intake, several social factors can negatively influence the nutritional status and efficacy of some medications of PLWHA. Some of these factors include marital status, residential status and relationship with the family, employment status, smoking and alcohol consumption.

THE ISSUE:

The National AIDS Council Secretariat (NACS), Provincial AIDS Committees (PAC), several International, Non-governmental (NGO), Private Institutions, Organizations and Agencies are intensively involved in the fight against HIV/AIDS in Papua New Guinea (PNG). However, information on periodic screening and assessment of nutritional status of PLWHA is scanty [6]. There are not published data on the dietary intake and nutritional status of PLWHA in PNG. This study was prompted by the apparent lack of published data needed to advocate for increased resource allocation and support for improved nutrition, and other nutritional needs of PLWHA in PNG.

AIM AND OBJECTIVES:

The aim of this study was to assess the nutrient and energy intake of PLWHA in Port Moresby. The objectives were to obtain baseline data on the average per capita intake of nutrients and energy by PLWHA in Port Moresby.

To provide baseline data for use as an advocacy tool to strengthening the need for decision-makers to include nutrition as an integral part of all on-going ART of PLWHA in PNG.

SUBJECTS AND METHODS:

This prospective cross-sectional study was carried out in the Heduru Clinic in Port Moresby General Hospital (PMGH), the major general, specialist and reference hospital in the National Capital District (NCD) and PNG. PMGH also serves as the Teaching Hospital for the School of Medicine and Health Sciences (SMHS), University of Papua New Guinea (UPNG). The study population was selected by simple random sampling of PLWHA attending Heduru clinic in PMGH from May to July 2006. Participants were recruited on a consecutive basis. No participant was recruited twice during the period of the study. Self-designed pre-tested 24-hour food-recall questionnaire was used to obtain data from consented participants. To avoid bias and distortion only one individual administered the questionnaires.

Standard and modified [7], food-recall kits were used to obtain estimated quantities of all foods and drinks consumed the previous day (24-hours). The Food-Works Professional edition 2005, version 4.00.1179: Xyris Software (Pacific Food Tables) was used to convert estimated food intakes into nutrient and energy values. Data analysis was carried out by Microsoft Excel data pack 2006.

Ethical clearance and permission were obtained from the Ethical and Research Grant committee in SMHS UPNG, and from authorities in PMGH and Heduru Clinic.

RESULTS:

A total of 58 ethnic Papua New Guineans registered as PLWHA attending Heduru clinic in PMGH were recruited to the study. The purpose of the study was explained to each of them before requesting their consent. 54 (93%) consented to participate. Four of the consented participants were later excluded because the questionnaires were incomplete. Thus, 50 (86%) questionnaires obtained from 21 (42%) male and 29 (58%) female PLWHA were suitable for analysis.

Table 1 shows the age and gender distribution of the male and female participants. Mean age was 33yrs for males and 32.6yrs for females. 67% of the males and 76% of females were in the 25 – 39 yrs age range. In the age range 45 – 60 yrs, there were zero females compared to 19% of males.

Data on the marital status of male and female participants indicates that 42.8% of the males and 34.3% of the females were currently married. 28.6% of the male and 20.7% of the female were not married. More of the females (24.1%) compared to the males (9.5%) were divorced. 19% of the male participants were widow compared to 20.7% of widowers. Analysis of residential status shows that 90.5% of the males and 100% of the females were living together with the family. Only 9.5% of the male participants were living alone.

Data obtained on cooking / preparation of main meals indicates that 66.7% of the males and 55.2% of the females eat meals prepared by some else in the family. 9.5% males and 37.9% females prepared meals for themselves and the family. However, 23.8%

of the males compared to 7% of the females prepared their own main meals.

Data on employment status shows that 61.9% of the males and 72.2% of the females were currently unemployed. Data on social behaviour, such as, smoking and alcohol consumption were also obtained. The data on smoking indicates that 85.7% of the male and 93.1% of the female participants did not smoke, while 14.3% of the males and 6.9% of the females were regular smokers of tobacco and cigarettes.

On alcohol consumption, 95.2% of the males and all the females (100%) did not consume alcohol, while only 4.8% of the males consumed alcohol.

Data on use of Highly Active Antiretroviral Treatment (HAART) indicates that 52.4% of the males and 65.5% of the females received HAART. Further analysis of the data was done to identify the Antiretroviral (ARV) regimens used by the male and female participants on HAART. Four groups of ARV regimens were identified. The data indicates that 27% of the males and 32% of the females were using AZT/3TC/NVP. 18% and 26% of the males and females were using AZT/3TC/EFV. 36% of the males and 32% of the females were on d 4T/3TC/NVP. 18% of the males and 11% of the females were using d 4T/3TC/EFV.

Analysis of the percent distribution of the male and female participants according to the main meals and snacks consumed indicates that 86% and 83% of the males and the females respectively consumed breakfast. Less number of the males (57%) compared to the females (76%) consumed lunch, while 62% of the males and 58.6% of the females consumed snacks. Dinner was consumed by all the males and by 93% of the females.

Distribution of male and female participants that consumed snacks according to when the snacks were consumed shows that before breakfast none of the males consumed snack compared to 4% of females. Between breakfast and lunch 38% of the males and 38% of the females consumed snacks, while 52% of the males and 48% of the females consumed snacks between lunch and dinner. After dinner 24% of the males and 31% of the females consumed snacks, while only 14% of the males and 4% of the females consumed snacks after bedtime.

The mean per capita intake of macronutrients obtained from the main meals and snacks by both male and female participants are shown in Table 2. The standard deviation (SD) and 95% Confidence interval (95% CI) are also indicated in Table 2. The percent contribution of macronutrients to total calorie intake were calculated using the values obtained for the mean per capita intake of each macronutrient by the male and female participants. The data indicates that protein intake by the males and the females contributed 13% and 15% of their total calorie intake respectively. The fat intake by the males and females contributed the same quantity (32%) of their total calorie intake.

Intake of carbohydrates by the males and females contributed 55% and 53% of their total calorie intake respectively

Table 1: Percent distribution of PLWHA according to their Age and gender

Age (yrs)	Males (n)	Females (n)
20 – 24	9.5% (2)	13.8% (4)
25 – 29	24% (5)	34.5% (10)
30 – 34	28.6% (6)	20.7% (6)
35 – 39	14.3% (3)	20.7% (6)
40 – 44	4.8% (1)	10.3% (3)
45 – 49	4.8% (1)	0
50 – 55	4.8% (1)	0
56 – 60	9.5% (2)	0
> 60	0	0

Table 2: Mean per capita intake of macronutrients obtained from main meals and snacks

Macronutrients	Parameters	Males	Females
Protein (g)	Mean ± SD	61.7 ± 10.7	65.8 ± 12
	95% CL	45 – 79	46.8 – 85
Fat (g)	Mean ± SD	67.2 ± 5.8	61 ± 6.4
	95% CL	58 – 76.4	51 – 71
Carbohydrate (g)	Mean ± SD	258.2 ± 32.1	226 ± 28
	95% CL	207.1 – 309.3	182 – 270

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FIGURE 1: Mean per capita energy intake by male and female participants in 24-hours

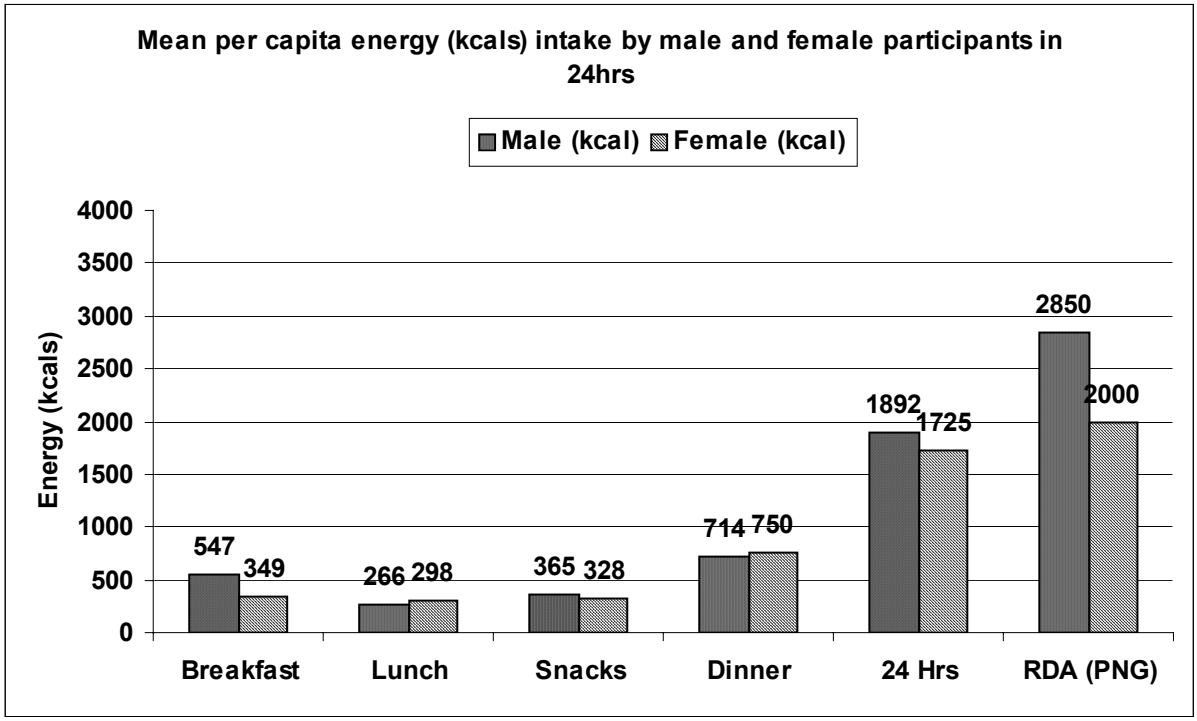

FIGURE 2: Mean per capita energy intake of male and female PLWHA compared to daily energy intake recommended by WHO (1) {RDA = Recommended Daily Allowance for PNG}

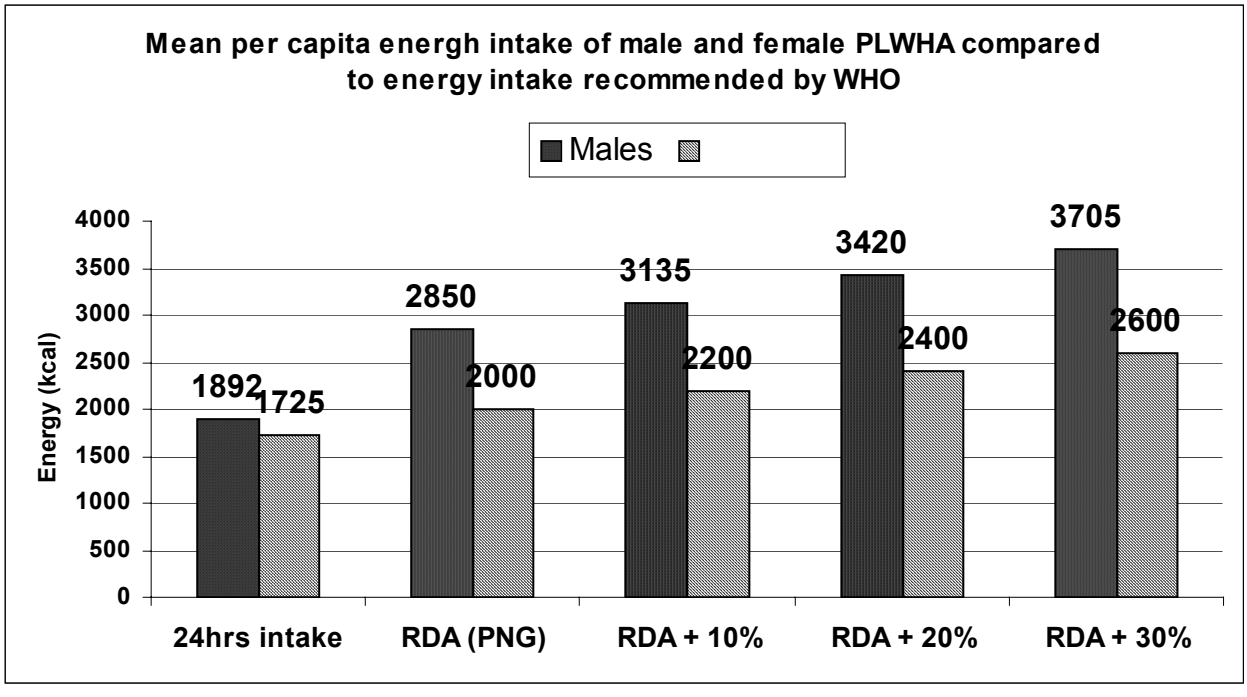

Figure 1 shows the mean per capita energy intake from main meals and snacks by the male and female participants. The total energy (kcal) intake in 24hours and the RDA for health non- HIV infected Papua New Guineans (7) is also indicated in Figure 2. The mean per capita intake of energy in 24hours by the males was 1892 $\pm$ 198 kcal (95% CI = 1575 – 2208 kcal). For the females the mean per capita intake of energy in 24hours was 1725 $\pm$ 214 kcal (95% CI = 1385 – 2065 kcal).

The mean per capita energy intake of male and female participants in 24hours compared to the energy intake recommended by WHO expert committee (1) for asymptomatic and symptomatic PLWHA is shown in Figure 2. The calculated percent difference between the current mean per capita energy intake by the male and female participants and the WHO recommended daily energy intake is presented in Table 3.

The mean per capita amount of Vitamins and Minerals expressed as % of RDA consumed by both male and female participants are presented in Table 4. Riboflavin and Vitamin A equivalent are significantly lower than the RDA for both males and females in PNG.

Calcium and Iron are significantly lower than the RDA for females in PNG. This should be of great concern to program planners because of reported prevalence of anaemia in PLWHA.

Table 3: Calculated percent difference between current mean per capita energy intake of male and female participants and WHO (1) recommended daily energy intake for PLWHA

Male (Current intake = 1892 kcal)	**Female (Current intake = 1723 kcal)**	**WHO recommendation for:**
33.6% < RDA (PNG)	14% < RDA (PNG)	
40% < RDA + 10%	22% < RDA + 10%	Asymptomatic PLWHA
45% < RDA + 20%	28% < RDA + 20%	Symptomatic PLWHA
49% < RDA + 30%	34% < RDA + 30%	Symptomatic PLWHA

RDA = Recommended Daily Allowance for PNG

Table 4: Mean per capita amount of vitamins and minerals expressed as % RDA consumed by male and female participants

Vitamins & Minerals	Males	Females
Thiamin (%)	93	92
Riboflavin (%)	61	63
Niacin (%)	103	119
Vitamin C (%)	138	145
Vitamin A equiv (%)	76	63
Na (%)	550	540
K (%)	125	98
Mg (%)	100	100
Ca (%)	43	34
Fe (%)	100	43
Zn (%)	100	100

DISCUSSION:

Comprehensive care and treatment are essential to the health and well being of PLWHA [1].

The data on age and gender distribution obtained in this study seems to indicate that elder male are more affected that elder female in Port Moresby. A more elaborate and detailed study is required to clarify this observation.

Data obtained in the current study indicates that there were no statistically ($p = 0.05$) significant differences in the marital status between the male and female PLWHA. Acceptance by the family is an important factor in the care of PLWHA [1]. Most of the male and female participants were living with their families, preparing main meals for the family and eating main meals prepared by family members. This might be an indication of the success of the on-going extensive awareness campaign on education and care for PLWHA in PNG. Data on employment status indicates that only 38.1% of male and 27.8% of female PLWHA were currently employed. Indicating that PLWHA in Port Moresby should be put in the high-risk group for food insecurity due to lack of financial resources.

Most of the male and female participants did not smoke or drink alcohol the previous day. However, when asked about their general attitude to smoking, 5% of the males and 17.2% of the females smoke occasionally, especially when they are under stress. On the issue of alcohol, 38% of the males and 24% of the females consume alcohol occasionally.

Smoking and alcohol consumption should be discouraged for PLWHA on HAART. Life style practices such as smoking and alcohol abuse may affect food and nutrient intake and can also decrease the efficiency of some medication [1].

ART is an essential component of care for PLWHA and nutritional assessment and counselling should be an integral part of all HIV/AIDS treatment programs [1,4]. The HAART is a combination of two types of drugs in the first class of ARV (Reverse Transcriptase Inhibitor).

The two types of drugs recommended by WHO are, Non-Nucleoside Reverse Transcriptase Inhibitor (NNRTI) and Nucleoside/ Nucleotide Reverse Transcriptase Inhibitor (NRTI). The following are the Four First-Line HAART recommended by WHO for use in resource limited settings [1].

Stavudine + Lamivudine + Nevirapine {d 4T/3TC/NVP}
Zidovudine + Lamivudine + Nevirapine {AZT/3TC/NVP}
Stavudine + Lamivudine + Efavirenz {d 4T/3TC/EFV}
Zidovudine + Lamivudine + Efavirenz {AZT/3TC/EFV}

Both males and females that were currently on ARV received one of the four standard WHO-recommended first-line HAART regimens for adults and adolescents in resource limited settings [1]. However 48% of the male and 34% of the female participants had not used any of the HAART regimens the previous day. To achieve full benefit of HAART, adequate nutrient and dietary energy intake is essential [1,2]. PLWHA on HAART with adequate nutrition are more likely to regain weight, adhere to their medications, thus helping them rejoin the work force and improve food security for themselves and their family [1,2,4]. Most of the participants consumed breakfast and dinner compared to lunch and snacks. This is typical of most families in developing countries. Meals are usually prepared for the whole family to eat together in the morning before going out and in the evening when everyone is back at home. Consumption of snacks depends on the availability of funds, which is usually not available.

According to WHO, the amount of macronutrients consumed by PLWHA should be the same as for non-HIV infected adults [1,2]. The recommended ranges of values are that proteins should contribute 12% to 15% of total energy intake; fat should contribute about 30% to 35% with the remaining coming from carbohydrates (i.e., 50 – 55%). The data in the current study shows that the percent contribution of macronutrients to total energy intake in 24-hours are similar to the WHO recommended range of values. The caloric RDA for health non-HIV infected Papua New Guineans is 2850 kcal for males and 2000 kcal for females [7]. The mean per capita energy (kcal) intake by male and female participants in 24 hours is below the RDA for healthy non-HIV infected Papua New Guineans. The mean intake of males was 33.6% below the RDA for healthy PNG males. The mean intake of females was 13.8% below the RDA for healthy PNG females. Significant differences are obtained when the intake of male and female participants are compared to the WHO recommended energy intake for male and female PLWHA. As can be seen in Table 3 the current energy intake of male and female participants is significantly lower the WHO recommended values.

Thus, although the male and female participants are consuming the WHO recommended proportion of macronutrients, the total amount consumed in 24hours is below the recommended total energy intake for asymptomatic and symptomatic PLWHA. The consequence of this can result in weight loss, low metabolic and physical status and possibly ineffectiveness of the HAART.

Although there is no clear recommendation for increase intake of micronutrients by PLWHA, the

amount consumed per day should not be less than the RDA for non-HIV infective individuals [1]. There is an urgent need to increase the intake of Iron by female PLWHA. In the short term this can be achieve by giving them Iron tablets, which is the current practise for women attending Anti-natal clinics in PMGH. In addition, multivitamin supplementation can be included as part of the on-going HAART management in Heduru Clinic, PMGH. In the long term, a comprehensive nutrition education program tailored towards using appropriate locally available foodstuffs to provide adequate amounts of energy and micronutrients to meet the required RDA should be advocated.

The growing epidemic of HIV/AIDS and food and nutrition insecurity is a potent combination that can negatively impact severely on the educational, socio-economic and political development of PNG. In order to avert this "perfect storm" more effective and strategic planning on the use of the limited resources available to combat the spread of HIV/AIDS and to improve food security is urgently needed.

RECOMMENDATIONS:

Implement WHO request for the integration of nutrition into the essential package of care, treatment and support for PLWHA [1]. Encourage PLWHA to eat more locally available nutrient dense foods regularly, frequently snacking on variety of foods throughout the day and to eat small, frequent meals especially if their appetite is poor [1]. Nutrition screening, assessment and counselling should be an integral part of all HIV/ AIDS treatment programs [1,2]. Incorporate nutrition screening, assessment and counselling into the National Policy and Guidelines for care and treatment of PLWHA in PNG. More elaborate and detailed study is required to fully assess the nutritional status, adequacy of diets and food habits of PLWHA in various parts of PNG.

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A COMMUNITY MEDICINES UTILIZATION SURVEY AMONG RESIDENTS OF WANIGELA KOKI VILLAGE - PORT MORESBY: HAZARDS AND WASTAGE

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(Submitted November 2007; Accepted November 2007)

INTRODUCTION

The goal of the Papua New Guinea (PNG) National Drug Policy is to improve the health of its people through timely availability and rational use of safe, effective, quality and affordable medicines, equipment and other medical supplies for prevention, diagnosis and treatment of diseases [1]. Despite government's endeavors to achieve this goal through the implementation of an essential drugs system [2], with heavily subsidized prescription medicines to its citizens [3], shortages of these medicines in hospitals and other health outlets serving communities continue to be a major problem [4]. The problem has been aggravated by inappropriate usage of medicines by clients in the households hence posing the likelihood of danger to patients particularly children, and contributing to wastage of financial resources [5]. The existing drug policy, which was established in 1998 regulates the use of medicines in the country. Increased benefits of the policy could be realized if rational prescribing and rational use of medicines and compliance by patients are achieved. There have been some limited reports on patient poor compliance with treatments in adults [6] as well as in children [7,8] in Papua New Guinea. Cases of self medication and utilization of expired medicines have also been reported [8].

Objectives: To study community based drug utilization patterns in the households of Wanigela - Koki community, Port Moresby, Papua New Guinea; to highlight the hazards and wastages of inappropriate usage of medicines, and to recommend interventions of minimizing hazards and wastage.

Setting: Wanigela - Koki community is a suburban area situated in the South East of Port Moresby, with houses partly built on land and on stilts on the shallow seashore. Socioeconomically, occupants are middle class who share a common language and culture, and heads of households are mostly men working as artisans.

METHODS

Before the study was done its objectives were explained to the village Counselor who in turn explained and communicated to residents, who agreed to cooperate.

A systematic survey of drugs kept in all of the 193 households of the suburb was then carried out employing a pre-tested questionnaire over a 12 – day

period in May 2006 by two well trained interviewers (resident pharmacists)

During administration of the questionnaire, heads of households or their spouses were interviewed, and asked to produce all drugs on their premises for evaluation.

Survey documentation included:

- Occupation of heads of households
- All medicines found including type of dosage form, therapeutic class, date acquired, date of expiry, quantities unused,
- Prescription status of medicines,
- And whether the medicines were currently used or stored for future re-use

Data Analysis: Collected data was analyzed using Microsoft Excel 2000, prevalence rates of responses were expressed as percentage of total number of preparations found. A Chi-square test of Prescribed vs. Non prescribed drugs was done. Significance level: p=0.05.

RESULTS AND DISCUSSION

One hundred and ninety three (193) households occupied by 2926 people; 899 children under 12 years, had 1 to 4 drug preparations. A total of 733 preparations were encountered. There were on average 17 people in a house (range: 5 – 50). There was No correlation between numbers of medicines found and the number of persons in the houses.

Table 2 shows the therapeutic classification of drug preparations found in the study. The top five (5) drug categories were: antibiotics 190 (25.9%), antipyretic analgesics 141 (19.2%), antimalarials 85 (11.6%), antitubecular (T.B) drugs 68 (9.3%), and cardiovascular drugs 35 (4.8%).

Table 3 represents the prescription and usage status of drugs found in the households. Of the 733 preparations found, 547 (75%) were prescribed while 186 (25%) drugs were non-prescribed; Over-The Counter (OTC) drugs. Six hundred and ninety three (693) i.e. 94.9% were oral medicines, while topical preparations totaled 40 (5.1%). Most of the drugs (418 or 57%) were in current use at the time of the study. Partially used medicines for future re-use accounted for 43% (n= 733).

There were concerns that large proportion of prescribed drugs 207 (28.2%) were not in current usage, and also that a substantial amount of the drugs encountered were not prescribed 186 (25%), table 3. To further investigate this we focused on antibiotics, antimalarials and anti -T.B drugs due to their major public health importance among the top 5 therapeutic classes. Table 4 outlines the prescription status of antibiotics found in the households.

Out of 190 antibiotic items found, a total of 93 (50.5%) preparations had been prescribed but not currently used. When asked for reasons for storage, the clients responded that the medicines had been partially used and stored for future re-use when similar symptoms would emerge. A small but significant proportion of the antibiotics 13 (6.8%) were acquired without prescription, and this amounts to inappropriate use of antibiotics. Both of the above findings i.e. partial usage and storage of antibiotics, and their acquisition without prescription add up to inappropriate use of vital lifesaving medicines. This could have far reaching consequences ranging from wastage of resources and development of resistance by organisms hence reducing effectiveness of the antibiotics. Overall, there is a strong likelihood of financial implications that would affect not only the immediate community studied, but also the

economics of the entire country [9,10]. Some antibiotics had expired, and were still being used or stored for future reuse. Expired drugs can be ineffective, toxic and represent wastage of resources.

Table 5 depicts the prescription status of antimalarial drugs found. Of the 85 antimalarial items encountered, 49 (57.6%) were prescribed, while 36 (42.4%) were non-prescribed. Out of the non-prescribed antimalarials (n=36), chloroquine and artemether/artesunate featured on top with 15 (41.7%) and 13 (36.1%) respectively which were followed by amodiaquine with 8 (22.2%).

The sources of the non-prescribed medicines included departmental food stores and some private sector pharmacies. The non prescribed antimalarials and those prescribed but partially used and stored for future re-use are likely to cause public health problems; the major one being exacerbation of /or development of resistance by malaria parasites [11,12,13], with subsequent health and economic burden, and accidental poisoning [14,15]. It was shocking to discover that the recently developed but controlled life saving artemether/artesunate antimalarials are already widely available without prescription.

Table 1. Number of residents and medicines found in the households

Number of households surveyed	193
Number of occupants	2926
Number of children below 12 yrs	899
Total Number of medicines found	733

Table 2. Therapeutic classification of drug preparations found in the households

DRUG CLASS	NO. OF PREPARATIONS	PREVALENCE (%)
Antibiotics	190	25.9
Antipyretic/Analgesics	141	19.2
Antimalarials	85	11.6
Antitubercular drugs	68	9.3
Cardiovascular drugs	35	4.8
Antihistamines	32	4.4
Vitamins & Micronutrients	23	3.1
Dermatologicals	21	2.9
Antifungals	18	2.5
Antidiabetic drugs	18	2.5
Antihelminthics	12	1.6
Corticosteroids	9	1.2
Others	81	11.0
TOTAL	733	100

Table 3. Prescription and usage status of drugs found in households (percentages in parenthesis)

	Prescribed drugs	Non –prescribed drugs	Total drugs
In current use	340 (46.4)	78 (10.6)	418 (57)
Not currently used (Partially used& stored)	207 (28.2)	108 (14.7)	315 (43)
Total	547 (75)	186 (25)	733

Differences are significant: $p < 0.05$

Table 4. Prescription status of antibiotics found in households (percentages in parenthesis; n=190)

	Prescribed antibiotics	Non prescribed antibiotics	Total
Currently used	84 (44.2)	3 (1.6)	87 (45.8)
Not currently used (Partially used& stored)	93 (50.5)	10 (5.3)	103 (54.2)
Total	177 (93.2)	13 (6.8)	190 (100)

Differences are significant: ($p < 0.05$)

Table 5. Prescription status of antimalarials found (percentages in parenthesis)

	Prescribed antimalarials	Non prescribed antimalarials	Total
Currently used	22 (25.9)	16 (18.8)	38 (44.7)
Not currently used (Partially used & stored)	27 (31.8)	20 (23.5)	47 (55.3)
Total	49 (57.6)	36 (42.4)	85 (100)

Differences are significant: $p < 0.05$

Table 6. Cost estimates of stored medicines

Dosage Form	Quantity	Cost (PNG K)
Solid medicines	12,899 units	15,705.84
Liquid medicines	14,987 ml	2,995.61
Total cost estimates		18,701.45

Antitubercular (T.B) drugs were among the top 5 therapeutic categories found in the households with a prevalence rate of 68 (9.3%) preparations, table 2. Tuberculosis is a disease of major public health interest, and it was reassuring to see that all T.B drugs encountered were in current usage according to prescribed regimens.

Medicines for lifestyle diseases such as those affecting the heart and the blood pressure had prevalence rate of 35(4.8%) preparations with all currently used. With the exception of only one self-bought item, all the rest 34 medicines were prescribed. This would reflect the seriousness with which clients view the impacts of cardiovascular drugs on their health.

Antipyretic-Analgesics were the second top of therapeutic class of drugs used. There were 141 (19.2 %) preparations of the 733 counted drugs; out of these, 76 were prescribed while 65 were not prescribed. The results compared well with similar studies carried out in PNG in the past [5]. The analgesics discussed here are not restricted to prescriptions. They could be obtained over-the-counter without prescription.

This study also examined the suitability of drug storage facilities in the households. Suitability was based on storage conditions capability to maintain integrity, stability and purity of preparation. Most preparations encountered were solids; tablets and capsules (61.4%), and their storage conditions were agreeably suitable. Our study considered liquid storage conditions at room temperature for longer than 3 weeks unsuitable. There were (34.2%) liquid preparations and only (3%) were stored in refrigerators. Most liquid preparations are flavored and sweetened by sugars etc and are usually susceptible to microbial growth under tropical weather conditions. Storage of drugs openly on room tables (1.9%) was unsuitable due to their easy accessibility by children.

The total quantity of partially used but stored drugs was rated approximately at PNG-K 18,702.00 (Us $ 5,798) at current market prices. The surveyed village may not be the most representative sample for Papua New Guinea, a country with a population of 5.2 million people of wide diversity. If however, that figure were to be extrapolated to cover 15 % of the Population, which is urban or suburban with great similarity to the surveyed community, it would approximate PNG-K 4,985,496 (US $ 1,545,507). These figures, even though difficult to accurately measure, are an attempt to project the wastage of resources on drugs at a given point in time.

As a part of feedback to the community that allowed the study to be carried out, simplified posters containing the outcomes of the study were posted in the community hall and manned by the investigators who provided verbal reinforcement of the results and advice to residents on the appropriate usage of medicines.

CONCLUSION:

Partial utilization of medicines, and re-use at a later date, of remaining portions which may have expired endangers the patient's life, and also points to waste of resources in increased health care costs. As

intervention, primary health care programs should emphasize on education of the public on the benefits of rational drug use, the hazards of self-medication and non-compliance to medication regimens.

ACKNOWLEDGEMENT:

We are grateful to United Nations Children's Fund (UNICEF) for funding support; to the Wanigela Community, Port Moresby for allowing the study, and to our research assistants; Mr George Toitopola and Jonesh Wangi final year pharmacy students for administering the questionnaires.

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Nutritional Status of Infants in the National Capital District of Papua New Guinea

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Paper submitted October 2007, Accepted November 2007

ABSTRACT:
Anthropometry is a conventional practical tool for assessing the nutritional status of infants and children. The aim of this study was to conduct anthropometric measurements of infants resident in NCD, and to use the data obtained for assessing their nutritional status using Z-score.

The sample size of 226 infants was based on a design effect of one, a relative precision of 10%, assumed prevalence rate of 20%, predicted non-response rate of 10% and confidence level of 95%. Simple random sampling was used to select infants attending the well-baby clinics in Port Moresby General Hospital. There were 121 (53.5%) male and 105 (46.5%) female infants, age group 0 to 24 months.

Weights and lengths were measured using standard recommended techniques. The age of each infant was obtained from the baby book. The weights and lengths of the infants were converted into Z-scores using the new WHO Anthro 2005 software, which also gives the summary statistics of the data.

Using the WHO 2005 standard, prevalence of stunting, wasting and underweight among the infants was 28.6%, 5.3% and 8.9% respectively. Stunting was higher among infants in the 6 to 11 months age group. The percent prevalence of stunting, wasting and underweight in the male infants was 33.1%, 4.6% and 7.4%, respectively, compared to 23.3%, 6.1% and 10.6%, respectively, in the female infants.
Coefficient of correlation between length and weight was high for both male (0.87) and female (0.78) infants. Males were significantly heavier ($p < 0.05$) and shorter, than the females. Stunting was higher in males, compared to the females.

Key Words: Anthro 2005, NCHS, Z-score, Stunting, Infants, NCD, PNG

INTRODUCTION:

Anthropometry is an acceptable method that is used to assess the growth and development of infants and young children. It is the conventional practical tool for evaluating the nutritional status of infants and young children, especially in developing countries [1,2]. The anthropometric parameters used for assessing the physical dimensions of the body, such as, weight, length/height, head circumference, chest circumference and mid-arm circumference are influenced by nutrition, particularly in infants and young children [1,2].

A variety of methods have been used for the interpretation of anthropometric data and for classification of the nutritional status of infants and young children under five years of age [1,2,3,4,5]. Weight-for-age, Height-for-age and Weight-for-height are some of the anthropometric indicators used for classification of nutritional status [1,2,3,4,5]. Each of these indicators used different sets of criteria and cut-off points for normal, mild, moderate and severe undernutrition among infants and children in various countries [1,3,4,5]. The cut-off points are usually a certain percent of the mean/median or a percentile of the reference population [1,2,3,6].

The use of different reference values and cut-off points has been a major hindrance in comparing anthropometric data across various studies and countries [1,2]. The indicators of undernutrition that need to be clearly classified for use in the developing countries are wasting, stunting, and underweight. Wasting (Low weight-for-length) is used to compare body weight relative to length/height and does not require age. It is a good indicator of acute undernutrition; although it reflects both acute and chronic underweight, it cannot be used to distinguish between both of them [1,2,3,4]. Stunting (Low length-for-age) describes linear growth relative to age; it indicates chronic undernutrition, which may be due to either prolonged food deprivation or illness [1,2]. Weight-for-age is used for assessing underweight as an indicator of undernutrition because of its availability and its ability to capture stunting, which is generally associated with long-term undernutrition, and wasting, which is the manifestation of recent and acute undernutrition [6,7]. Underweight (Low weight-for-age) indicates body weight relative to age and is influenced by recent changes in health or nutritional status. It also reflects both acute and chronic undernutrition, but it cannot be used to differentiate both of them [1,2].

According to WHO expert committee, the overall nutritional status of infants and young children can be assessed by comparing their growth or attained weight or recumbent length (height) for their age with that of the appropriate gender in a reference population of healthy infants and children [7,8]. This comparison is calculated in terms of standard deviation (SD) scores, or Z-scores, in which the placement of a measure, like the weight of the child within a distribution of the reference weights of healthy children, is characterised by its distance from the median in SD units [7,8]. WHO recommends this classification system for its ability to describe nutritional status including, at the extreme ends, of the distribution, and to allow for derivation of summary statistics of the data [8]. Besides being sex-specific and able to measure all the three indicators, the main advantage of Z-scores is that it allows comparison across indicators and countries. In addition, Z-Scores can be subjected to summary

statistics, such as the Mean, SD and 95% Confidence Interval (95% CI), which help to assess the quality of the data collected [8].

In order to ensure standardization in the use of the Z-scores worldwide, the WHO developed and released the WHO Anthro 2005 software, which is freely available on the Internet [8]. The WHO Anthro 2005 software, referred to as "WHO 2005 standards," is intended for use to assess child nutritional status, to follow a child's development and growth over time, and to conduct and analyse nutritional surveys [8]. It is also recommended for facilitating the application of the WHO Child Growth Standards in monitoring growth and motor development in individuals and populations. The software also contains the International NCHS/CDC/WHO reference population, which is referred to as "NCHS reference" [8].

The Z-Scores are now widely used in most developing countries, especially in community-based studies [3,4,6,7]. In Papua New Guinea (PNG), the Z-scores were used in the classification of the nutritional status of children 6 – 59 months during the PNG National Nutrition Survey, conducted in 2005 [9]. There is, however, paucity of published data that use the Z-scores to assess the nutritional status of infants in the National Capital District (NCD) of PNG.

The aims of this study were to conduct anthropometric measurements of infants, resident in NCD, and to use the data obtained for assessing the nutritional status of these infants, using Z-scores. The main objective of the project was to compare the Z-scores obtained, using the NCHS reference and the WHO 2005 standards.

SUBJECT AND METHODS:

This cross-sectional study was conducted at the well baby clinic and paediatric ward in Port Moresby General Hospital (PMGH), which is the major general, specialist and reference hospital in NCD and PNG. PMGH also serves as the Teaching Hospital for the School of Medicine and Health Sciences (SMHS). PMGH is the preferred primary sampling unit, because it is the only public specialist hospital that caters for the whole population of Port Moresby. It is therefore likely to be fairly representative of the NCD population. There may be some systematic exclusion of the rich (about 1000 births occur per year in Private medical centres) and of a fringe group on the other end of the social scale, who do not utilize any health interventions, even when these services are free of charge.

All the subjects in the study were infants, age 0 – 24 months, whose parents were residents in the NCD. The sample size of 226 infants used in this study was based on a design effect of one, a relative precision of 10%, assumed prevalence rate of 20%, predicted non-response rate of 10% and confidence level of 95%. Simple random sampling was used to select infants attending the well-baby clinics and those admitted for minor illness at the paediatric ward.

The infants were weighed and their length measured according to the WHO guidelines on Anthropometry [8]. The weight of each infant was obtained to the nearest 0.1 kg by using a special digital weighing machine. For children less than 24 months of age, the recumbent length was measured to the nearest 1.0mm using a specially designed Shaw board. In each case, the date of birth was obtained from the baby book.

The weights and lengths of the infants were converted into Z-scores using the new WHO Anthro 2005 software, which also gives the summary

statistics of the data [8]. The Z-scores for the different nutritional indicators: Weight-for-Age (WAZ), Length-for-Age (LAZ) and Weight-for-Length (WLZ) were calculated in comparison to the NCHS reference population and the WHO 2005 standards, by using the appropriate component of the new WHO Anthro 2005 software. This new software considers Z-score values <-6 as outliers for LAZ and WAZ, but for WLZ outliers are Z-score values <-5. The Data Pack MS Excel 2003, and SPSS-PC software (version 10) were used for additional data analysis. When required, means were compared and *P* value < 0.05 was considered as statistically significant.

Ethical clearance and approval for this study were obtained from the Ethical and Research Grant Committee of the SMHS, UPNG. Permission was obtained from both the Chief Executive Officer and Director of Medical Services of PMGH. Informed consent was obtained from the parents of each of the infants.

RESULTS:

Informed consent was obtained from each of the parents of the 226 infants, randomly selected for the study. The 100% consent rate is typical of research projects that do not involve collection of blood or urine samples from individuals.

In using the WHO Anthro 2005 software, only the valid weight or length measurements and age data are used to calculate the appropriate Z-scores. The Z-score data obtained for each infant were interpreted, using the WHO recommended criteria and cut-off points [8].

Underweight was defined as Weight-for-Age (WAZ) Z-score <-2, stunting was defined as Length-for-Age (LAZ) Z-score <-2, and wasting was defined as Weight-for-Length (WLZ) Z-score <-2.

Fig. 1 shows the per cent prevalence of underweight, stunting and wasting among all the infants, when compared to the NCHS reference population and the WHO 2005 standards. When compared to the NCHS reference population, the prevalence of stunting (LAZ < -2 SD) among the infants was 21.7%. Prevalence of stunting among the infants was 28.6%, when compared to the WHO 2005 standards. The summary statistics for WAZ, LAZ and WLZ for all the infants are presented in Table 1.

The mean LAZ for all the infants was lower, than the international reference mean of zero for the WHO 2005 standards and the NCHS reference. Using the WHO 2005 standard, the mean WAZ for all the infants was lower than the international reference mean of zero. However, the mean WAZ for all the infants was higher than the international reference mean for the NCHS reference. The WLZ means were higher than the international reference means for the WHO 2005 standards and the NCHS reference.

Compared to the WHO 2005 standards, 12.5% of the infants were moderately stunted and 16.1 were severely stunted. Moderate and severe stunting was prevalent in 10.2% and 11.5% of the infants, when compared to the NCHS reference.

Figures 2 and 3 show the distributions of the Z-score for LAZ of all the infants in comparison with the WHO 2005 standards and the NCHS reference, respectively. The distributions of the Z-score for LAZ for all the infants were shifted to the left of the WHO standards and the NCHS reference.

Fig. 1: % Prevalence of underweight, stunting and wasting among infants in NCD, using the NCHS reference and WHO standard

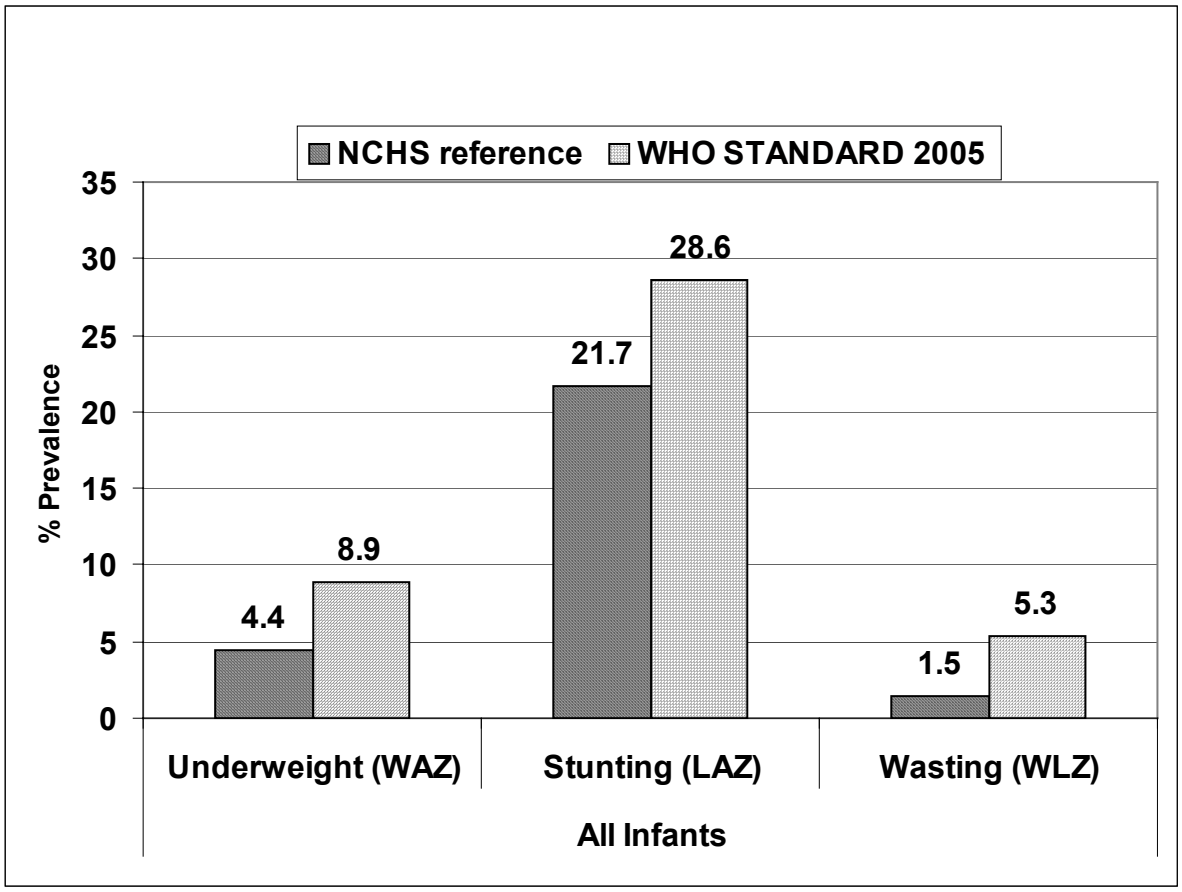


Table 1: Summary statistics for LAZ, WAZ and WLZ among infants, using the WHO 2005 Standards and NCHS reference population.

				% Prevalence			
Indices		**N**	**Mean ± SD**	**Total**	**95% CI**	**Moderate**	**Severe**
LAZ	WHO	224	-1.15 ± 1.88	28.6	22.4, 34.7	12.5	16.1
	NCHS	226	-0.96 ± 1.62	21.7	16.1, 27.3	10.2	11.5
WAZ	WHO	225	-0.14 ± 1.25	8.9	4.9, 12.8	6.2	2.7
	NCHS	226	0.19 ± 1.25	4.4	1.5, 7.3	3.1	1.3
WLZ	WHO	208	0.88 ± 1.67	5.3	2.0, 8.6	3.9	1.4
	NCHS	196	1.0 ± 1.41	1.5	0, 3.5	1.0	0.5

Fig. 2: Comparison of the distribution of Z-score for LAZ of all the infants to WHO 2005 standards.

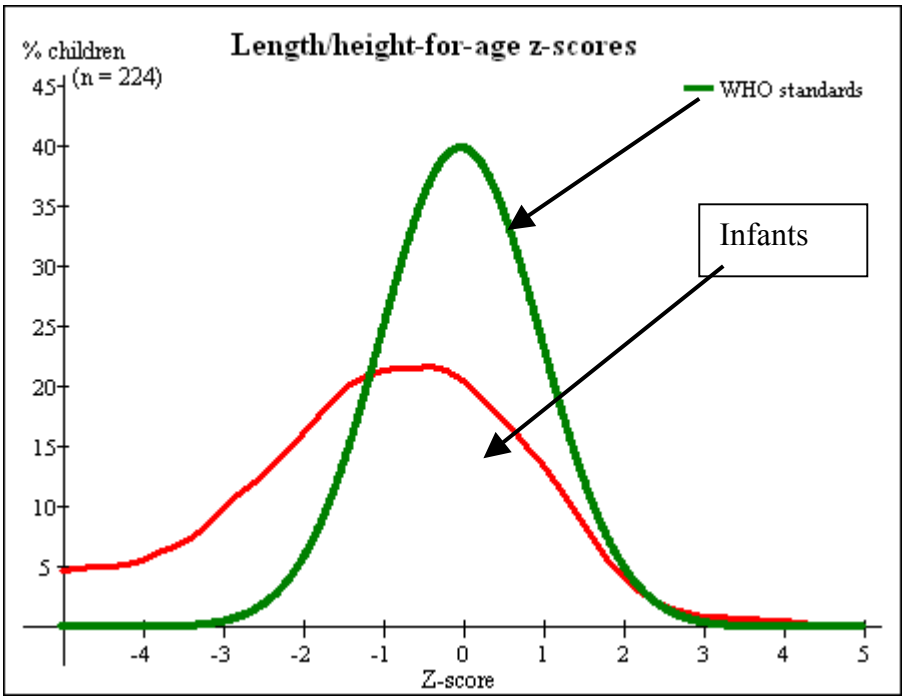
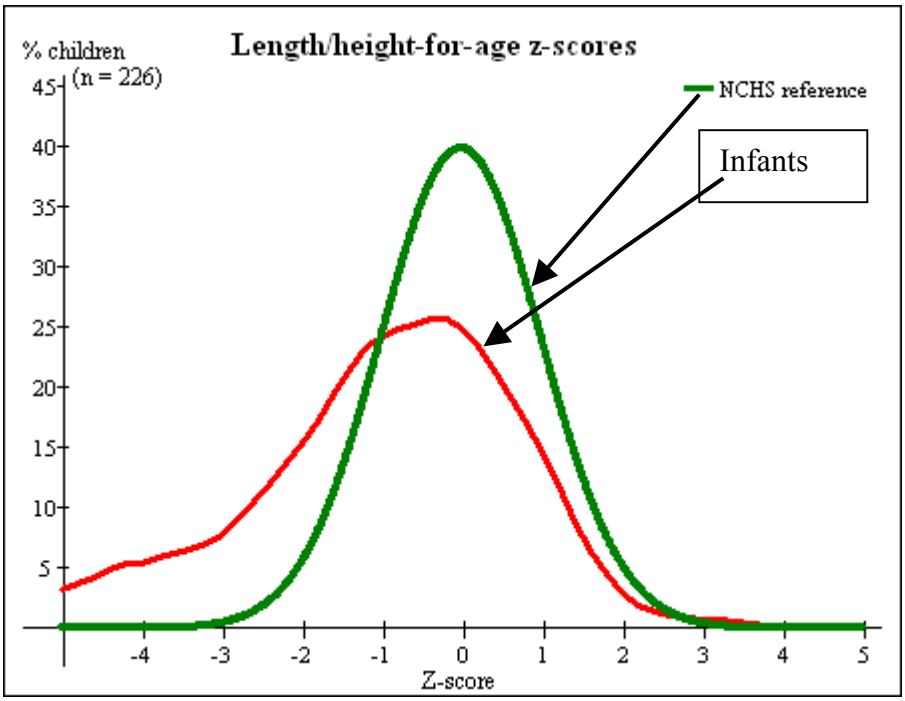


Fig. 3: Comparison of the distribution of Z-score for LAZ of all the infants to the NCHS reference



When the data were analysed according to age groups, prevalence of stunting was higher among infants in the 6 to 11 months age group. Using the WHO 2005 standards, 31.8% of the infants in the 6 to 11 months age group were stunted (Mean = -1.3 ± 2.21, 95% CI = 10.1, 53.6). Of these, 4.5% were moderately stunted and 27.3 were severely stunted. In the 0 to 5 months age group, 26.9% of the infants were stunted.

When the NCHS reference was used, 31.8% of the infants in the 6 to 11 months age group were stunted (Mean = -1.22 ± 1.9, 95% CI = 10.1, 53.6). Of these, 18.2% were moderately stunted and 13.6% were severely stunted.

Further analyses of the data according to gender indicate that, of the 226 consented infants, 122 (54%) were male and 104 (46%) were female. The percent prevalence of underweight, stunting and wasting among the male and female infants compared to the NCHS reference population and the WHO 2005 standards is presented in Fig. 4. Both references indicate that stunting was higher among the male infants, compared to the female infants. Using the WHO 2005 standards, 33.1% of the male infants were stunted, compared to 23.3% of the female infants. It also shows that 10.6% of the female infants were underweight, compared to 7.4% of the male infants.

Fig. 4: % Prevalence of underweight, stunting and wasting among male and female infants in NCD, using the NCHS reference and WHO 2005 standards

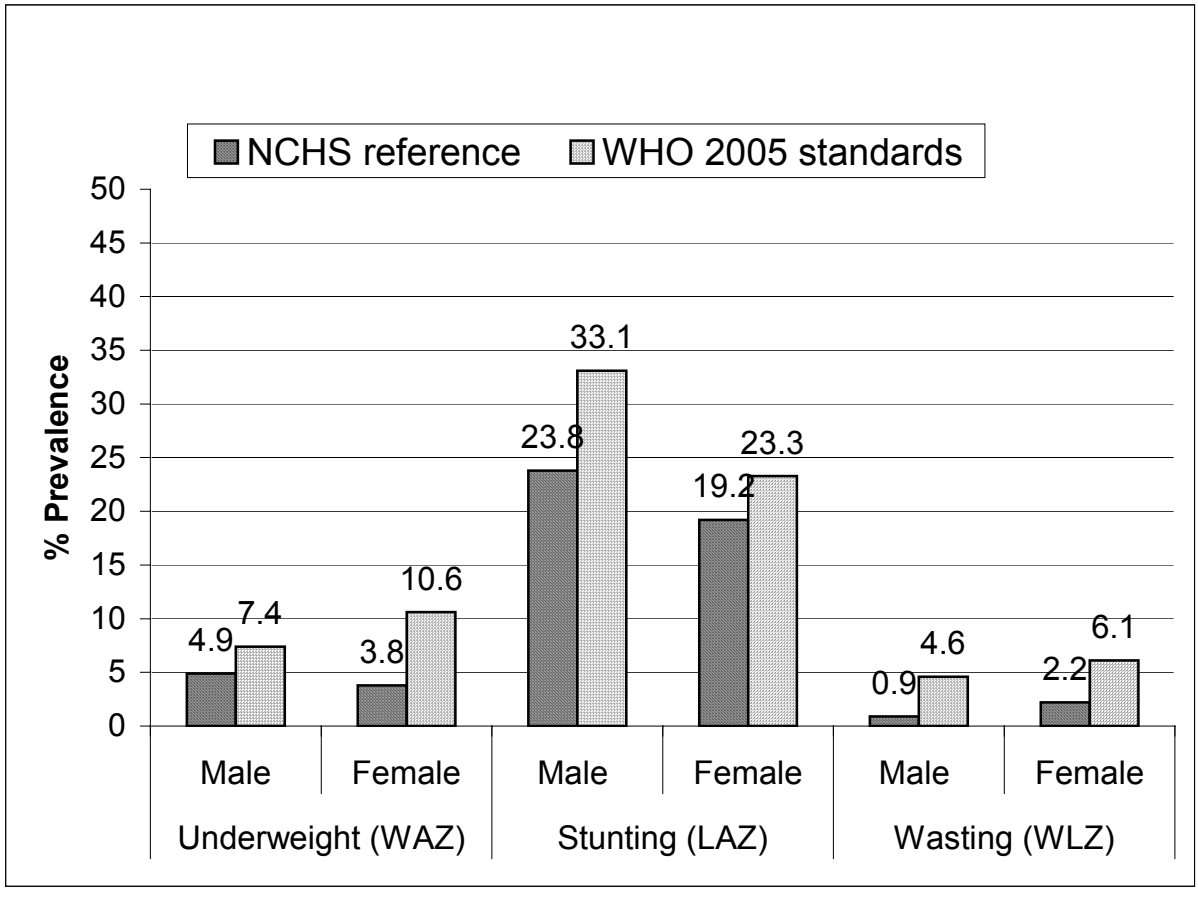


Table 2: Summary statistics for LAZ, WAZ and WLZ among male infants, using the WHO 2005 Standards and NCHS reference population.

				% Prevalence			
Indices		**N**	**Mean ± SD**	**Total**	**95% CI**	**Moderate**	**Severe**
LAZ	WHO	121	-1.32 ± 1-94	33.1	24.3, 41.9	15.7	17.4
	NCHS	122	-1.05 ± 1.62	23.8	15.8, 31.7	9.9	13.9
WAZ	WHO	121	-0.07 ± 1.22	7.4	2.3, 12.5	4.9	2.5
	NCHS	122	0.19 ± 1.16	4.9	0.7, 9.2	3.3	1.6
WLZ	WHO	109	1.12 ± 1.65	4.6	0.2, 9.0	3.7	0.9
	NCHS	106	1.19 ± 1.42	0.9	0, 3.3	0.9	0

Table 3: Summary statistics for LAZ, WAZ and WLZ among female infants, using the WHO 2005 Standards and NCHS reference population.

				% Prevalence			
Indices		**N**	**Mean ± SD**	**Total**	**95% CI**	**Moderate**	**Severe**
LAZ	WHO	103	-0.96 ± 1.81	23.3	14.7, 32.0	8.7	14.6
	NCHS	104	-0.86 ± 1.63	19.2	11.2, 27.3	10.5	8.7
WAZ	WHO	104	-0.22 ± 1.29	10.6	4.2, 17.0	7.7	2.9
	NCHS	104	0.18 ± 1.35	3.8	0, 8.0	2.8	1.0
WLZ	WHO	99	0.62 ± 1.65	6.1	0.9, 11.3	4.1	2.0
	NCHS	90	0.77 ± 1.37	2.2	0, 5.8	1.1	1.1

The summary statistics for the LAZ, WAZ and WLZ for the male and female infants are presented in Table 2 and Table 3, respectively. The mean LAZ values for the male and female infants were both lower than zero, which is the approved mean value for the WHO 2005 standard and the NCHS reference population. The WLZ means for both male and female infants were higher than the international reference mean of zero for the WHO 2005 standards and the NCHS reference population. Using the WHO 2005 standards, the prevalence of severe stunting was higher in the male (17.4%), compared to the female (14.6%) infants. About twice more male (15.7%) than female (8.7%) infants were moderately stunted. However, using the NCHS reference, the prevalence of moderate stunting was almost similar in the male (9.9%) and female (10.5%) infants.

The distributions of the Z-scores for LAZ, obtained for the male and female infants, compared to the Z-scores distribution for the WHO 2005 standards and the NCHS reference, are shown in Fig 5 and Fig 6. The distribution of the Z-scores for LAZ for the male infants is shifted more to the left of the reference curves, than that of the female curves. The direction of the shift of the Z-score distribution is indicated by the mean of the Z-score. A positive mean Z-score indicates a shift to the right of the reference curve. A negative mean Z-score indicates a shift to the left of the reference curve. The male infants were more stunted but slightly heavier than the female infants.

Coefficient of correlation between length and weight was high for both male (0.87) and female (0.78) infants. Males were significantly heavier ($p < 0.05$) than the females. Stunting was higher in males, compared to the females.

DISCUSSION:

Several researchers support the association of undernutrition with growth retardation, impaired mental development and increased susceptibility to infectious diseases among infants [6,7,10]. Thus, there is need to constantly monitor the nutritional status of infants, so that corrective measures can be taken to prevent or minimise the negative effects that may be caused by undernutrition. Underweight, stunting and wasting reflect distinct biological processes; their use for monitoring is necessary for determining appropriate nutritional interventions needed to reduce childhood mortality, especially in the developing countries [1,2,3,4].

In the present study, the prevalence of underweight (low WAZ), stunting (low LAZ) and wasting (low WAL) was calculated at the cut-off level of Z-score <- 2, and the prevalence of severe underweight, stunting and wasting – at the cut-off level of Z-score <-3 of the WHO 2005 standards and the NCHS reference mean values [8]. As already stated, these classifications were used to interpret the anthropometric data for under-five children obtained in the PNG National Nutrition Survey (PNG NNS), conducted in 2005 [9].

The NCD is part of the Southern region in PNG. The preliminary results of the PNG NNS indicate that, using either the WHO standards or NCHS reference, the percent prevalence of stunting, wasting and underweight among children 6 to 59 months of age in the Southern region of PNG was below the cut-off points (40%, 5% and 20%, respectively [9]) that indicate public health significance

Fig. 5: Comparison of the distribution of Z-scores for LAZ for male and female infants to the WHO 2005 standards.

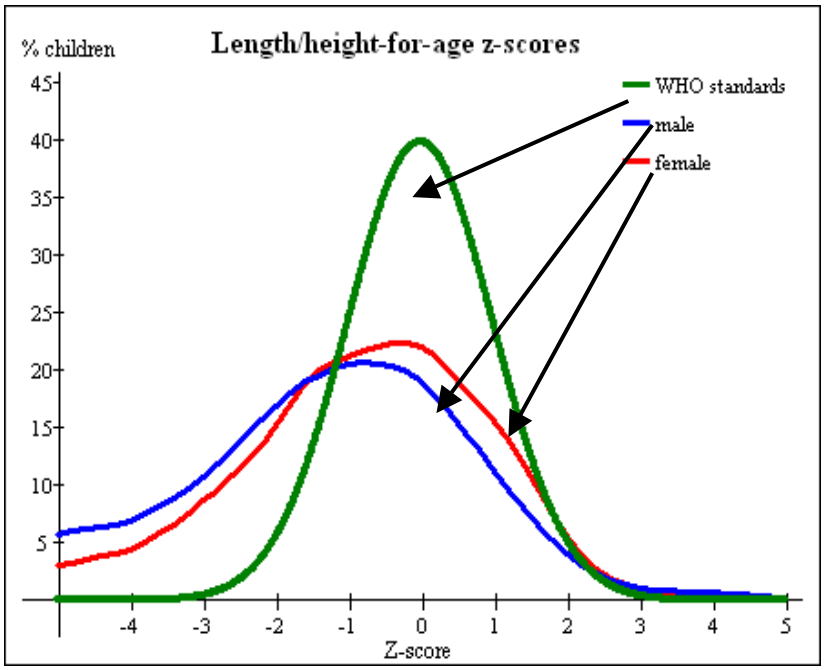
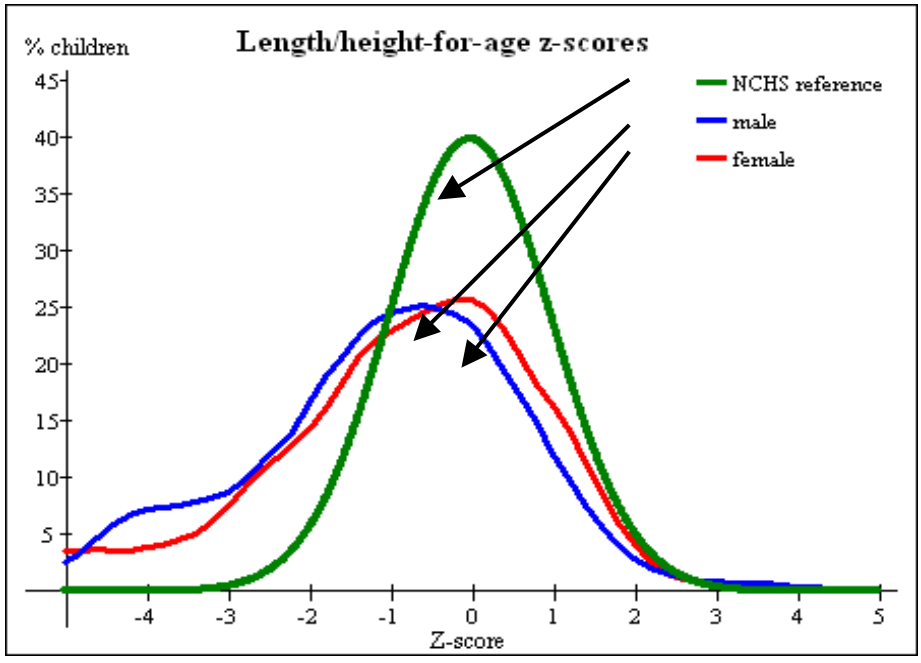


Fig. 6: Comparison of the distribution of Z-scores for LAZ for male and female infants to the NCHS reference



The results in the present study indicate that, using the NCHS reference, the percent prevalence of stunting, wasting and underweight among infants 0 to 24 months in NCD was below the cut-off points that indicate public health significance. However, although the percent prevalence of stunting and underweight was below the cut-off points of public health significance, when using the WHO standards, the percent prevalence of wasting was 6.1% among the female infants. The distribution of the Z-score for WAZ for all the infants was shifted to the left of the WHO standards, whereas the WLZ was shifted to the right. The Z-score values for the WAZ and WLZ for all the infants were both shifted to the right of the NCHS reference.

Using the NCHS reference, the values obtained for the percent prevalence of stunting, wasting and underweight among all the infants (Fig. 1) and among the male and female infants (Fig. 4), are lower, than the values obtained when using the WHO 2005 standards. Several studied have indicated that the NCHS reference tends to underestimate the percent prevalence of the indicators of malnutrition among infants and young children, which was one of several reasons that justified the development of the new WHO 2005 standards [5,8,10,11]. The WHO Anthro 2005, published on the basis of the WHO Multiple Centre Growth Reference Study (MGRS), is the new replacement of Anthro 1.02 (last updated in 1999), which was based on the NCHS/WHO reference population (NCHS reference) [8].

The WHO 2005 standards are unique, because they document children's growth from six different countries (Brazil, Ghana, India, Norway, Oman and USA) under optimal conditions, rather than merely describing growth in a reference population at a particular time or place [8]. The WHO 2005 standards are recommended for use in all countries, thus further discussion of this project will focus on the results, related to the WHO 2005 standards.

Although the percent prevalence of stunting among all the infants (28.6%) and among the male (33.1%) and female (23.3%) infants was not of public health significance, yet these figures indicate that the rate of stunting in NCD should be classified as moderate, not low, prevalence rate [6,10]. This should be of concern to program planners, because of the complex sub-clinical problems that have been related to stunting [10,12]. The stunting syndrome has been related to cumulative deficient growth and features that may include developmental delay, impaired immune function, reduced cognitive development, metabolic disturbances leading to accumulation of body fat, loss of lean mass and risk of developing hypertension [10,12,13]. This underscores the urgent need for advocacy for improving the current nutritional status of infants and young children in NCD.

CONCLUSION:

The nutritional status of infants in NCD needs urgent attention. There should be greater focus on nutritional education to reduce malnutrition among infants. Emphasis should be placed on educating the community, individuals and families. Nutrition education messages should be simple and easy to understand by the community. Important information, such as when to start solid foods, how often to feed solid food, what to buy in the store for infants, as well as family planning, must be taught over and over again at the community level. Data obtained in future anthropometric studies of under-five children in PNG should be analysed using the WHO 2005 standards.

ACKNOWLEDGEMENT:

Our gratitude and acknowledgement to the following: All the mothers and their lovely babies; Nurses at the 'Well Baby' Clinic, Ward Manager, Sr. Miriam Kispa, Sr. E. Mantu, Sr. J. M. Uhe and Sr. R. Mantu and other nurses; Sisters-in-Charge and their nurses at Gerehu, 6-Mile and Hohola Clinic; The technical staff in BMS: Samson Grant, Jenny and Tony Kopapa; Theresa, the BMS secretary, Michael Mohe; Prof. M. Sapuri; CEO of PMGH, Dr. A. Tay, DMS PMGH, Dr. S. Mete; Katie Tripp (CDC, Atlanta USA); Karen Codling (UNICEF, Bangkok); Wila Saweri (NDOH).

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PAPERS PRESENTED AT THE JOINT DIVISIONAL SEMINAR SERIES: 2007
DIVISIONS OF BASID MEDICAL SCIENCES, HEALTH SCIENCES & DENTISTRY

RETROSPECTIVE ASSESSMENT OF THYROID FUNCTION TESTS RESULTS OBTAINED IN PORT MORESBY GENERAL HOSPITAL IN 2004 AND 2005

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INTRODUCTION:

The Thyroid hormones are Thyroxine (T4, also called 3,5,3',5'–Tetra-Iodothyronine) and Tri-Iodothyronine (T3 also called 3,5,3'–Tri-Iodothyronine). T4 is a Pro-hormone and is produced exclusively in the thyroid gland[1]. Some amount of T3 is also produced in the thyroid gland, however most of the T3 in plasma is produced in the Liver, Kidney and Muscle from the de-iodination of T4 by the De-Iodinase enzyme that contains Seleno-Cysteine[1,2]. Tri-Iodothyronine is the biologically active form, because it is the hormone that binds to receptors and trigger end-organ effects. Reverse T3 (rT3, 3,3',5'-Tri-Iodothyronine) is the biologically inactive form of thyroid hormones. The De-Iodinase enzyme that does not require Selenium catalyzes the conversion of T4 to Reverse T3 [1,2].

Thus, selenium deficiency affects thyroid function because it reduces the formation of T3, while increasing the formation of reverse T3 [1,2].

Feedback regulation of Thyroid hormones occurs via the Hypothalamic-Pituitary-Thyroid axis (HPT axis). Hypothalamus secretes Thyrotropin-Releasing Hormone (TRH), which then stimulates the anterior pituitary to synthesize and release Thyroid-Stimulating Hormone (TSH). The TSH stimulates the thyroid glands to produce and release the thyroid hormones[1,2]. Both T4 and T3 are transported in plasma bound to Thyroxine-Binding Globulin (TBG) and other plasma proteins, such as thyroxine-binding pre-albumin and albumin[1,2]. Circulating unbound thyroid hormones (FT4 and FT3) act via Long Loop Feedback mechanism to regulate production of TSH and TRH[1,2]. Dopamine, Somatostatin, Glucocorticoids, Interleukins and Cytokines can inhibit the release of TSH in Non-Thyroidal Illness[1].

Thyroid Function Tests (TFTs) are used to establish if there is Thyroid dysfunction. Current recommended parameters used for the TFTs are Plasma TSH and Free Thyroid hormones (FT4 & FT3). However, the choice of TFTs used usually depends on local arrangements and laboratory protocols[1,3]. Thus, Thyroid function tests can be ordered as TSH alone by entering "TSH", as FT4 alone by entering "FT4" or as FT3 alone by entering "FT3" or as a combination (TSH, FT4 and or FT3) by requesting "TFT"[1,3,4,5].

The combined results can occur in either of six patterns[5,6]. The six possible patterns are as follows: Low TSH, Raised FT4 or FT3: Primary hyperthyroidism (Graves' disease, multinodular

goitre, toxic nodule, and thers); Low TSH, Normal FT4 or FT3: Subclinical hyperthyroidism, thyroxine ingestion; Low TSH, Low FT4 or FT3: Non-thyroidal illness (euthyroid sick syndrome), recent treatment for hyperthyroidism (TSH remains suppressed); Normal TSH, Low FT4 or FT3: Non-thyroidal illness, recent treatment for hyperthyroidism, possible secondary hypothyroidism; Raised TSH, Low FT4 and FT3: Primary hypothyroidism, chronic autoimmune thyroiditis, post thyroidectomy; Raised TSH, Normal FT4 or FT3: Subclinical hypothyroidism; Normal TSH, Raised FT4 or FT3: Euthyroid hyperthyroxinemia; Raised TSH, Raised FT4 or FT3: TSH-mediated hyperthyroidism[5,6].

TFTs results can be classified as either Concordant if both TSH and FT4 indicated the same findings (as Euthyroid, Hypothyroid or Hyperthyroid) or Discordant if TSH and FT4 did not indicate the same findings[3,5,6].

AIM AND OBJECTIVE:

The aim of this project was to retrospectively assess Thyroid Function Tests carried out in Port Moresby General Hospital (PMGH) in 2004 and 2005. The objective was to classify the TFTs for the purpose of providing base line information that can be used to assess the possible types of thyroid dysfunctions that are prevalence in PNG.

METHODS:

This study was carried out in PMGH, which is the major general, specialist and reference hospital in the National Capital District (NCD) and PNG. PMGH also serves as the Teaching Hospital for the School of Medicine and Health Sciences (SMHS), University of Papua New Guinea (UPNG). The Central Pathology Hospital Laboratory (CPHL) is located in PMGH. Clinical Biochemistry laboratory is one of several units in the CPHL.

All TFTs carried out in the CPHL in PMGH during the period from January 2004 to December 2005 were obtained from records available in the Clinical Biochemistry laboratory. The data collected were registration number of the patient, gender, age, tests ordered (TSH, FT4 or both), date of the test and results of the tests. The registration number was used to identify patients with more than one test per year; only the first result was used for such patients. TFTs results were classified as either Concordant or Discordant[3,5,6]. Discordant results were further seperated into various groups as recommended[5,6]. Ethical clearance for the study was obtained from the SMHS ethics and research grant committee and the authorities at PMGH.

RESULTS AND DISCUSSION:

The ranges for TSH and FT4 used were obtained from the CPHL in PMGH.

TSH: Normal range: 0.32 – 5.0 μIU/mL; Low < 0.32 μIU/mL; High > 5.0 μIU/mL

FT4: Normal range: 9.14 – 23.08 pmol/L; Low < 9.14 pmol/L; High > 23.08 pmol/L

In 2004 a total of 479 TFT tests were ordered. Analysis for TSH and FT4 were completed in 426 (89%) and 443 (93%) of the samples respectively. TSH and FT4 were not done in 53 (11%) and 36 (7%) of the total samples respectively. Further analysis shows that of the 426 TSH tests completed 101 (24%) were for male and 325 (76%) for female patients. For the 443 FT4 completed tests 109 (25%) were male and 334 (75%) were female patients. Total TFTs ordered in 2005 was 641. TSH analysis was completed in 503 (79%) samples and FT4 in 595 (93%) samples. Of the 503 completed TSH tests 125 (25%) were male and 378 (75%) were female

patients. For the completed FT4 tests 149 (25%) were male and 446 (75%) were female patients.

In 2005 TSH was not done in 138 (21%) of the samples and FT4 was not done in 46 (7%) of the samples. Insufficient blood samples collected from patients and improper storage of blood on transit from provincial hospitals to PMGH were the major reasons given for not doing the analyses in 2004 and 2005. It is important to ensure that adequate amount of blood samples are collected from patients sent for TFTs.
In 2004 the types of TFTs requested were as follows, one (0.2%) TSH only test, 18 (4%) FT4 only tests and 425 (about 95%) combined TSH/FT4 tests. In 2005, requests were for 13 (2.5%) TSH only tests, 105 (17.6%) FT4 only tests and 490 (80%) combined TSH/FT4 tests.

Table 1 show the age and gender distribution of patiens for which TFTs was requested in 2004 and 2005. In 2004 there were 118 (25%) males and 361 (75%) females age range 15 to 65years. This indicates about 3 times more females than males were sent for TFTs in 2004. For male patients, more TFTs requests were made in the 45 to 49 years age group, closely followed by the 35 to 39 years age group. Request for female patients were higher in the 45 to 49 years and 20 to 24 years age groups. The trend was similar in the TFTs requested in 2005. There were 160 (25%) male and 481 (75%) female patients. In the males the highest requests were made for patients in the 35 to 39 years age group. In the female highest request was in the 30 to 34 years age groups closely followed by 20 to 24 and 35 to 39 years age groups. Several authors [1,3,5,6] have reported higher incidence of thyroid dysfunction in females compared to males.

Table 2 shows distribution of male and female patients according to levels of TSH and FT4 obtained in 2004 and 2005. These data were further analysed and presented in Table 3 and Table 4 as summary of TFTs results obtained for male and female patients in 2004 and 2005 respectively. In 2004 (Table 3), most of the male (54%) and female (44%) patients had normal TSH and FT4 levels. A similar trend was obtained in 2005 with most of the male (25%) and female (25%) patients having normal TSH and FT4 levels. The classification of TFTs results for 2004 and 2005 as concordant or discordant is presented in Table 5.

In 2004, 85 (78%) of male patients had concordant results compared to 16 (15%) with discordant results. 237 (71%) of the female patients were concordant and 87 (26%) were discordant. Of the 85 concordant males, 59 (69%) were euthyroid, 9 (11%) hypothyroid and 17 (20%) hyperthyroid. 146 (62%) of the 237 concordant females were euthyroid, 22 (9%) were hypothyroid and 69 (29%) were hyperthyroid.

In 2005, results indicate 61 (41%) concordant and 61 (41%) discordant male patients. Of the 61 concordant males, 37 (61%) were euthyroid, 10 (16%) were hypothyroid and 14 (23%) were hyperthyroid. For the females, 175 (39.2%) were concordant and 191 (43%) discordant. 112 (64%) of the 175 concordant females were euthyroid, 21 (12%) hypothyroid and 42 (24%) hyperthyroid.

Further analysis of the discordant results for 2004 and 2005 are presented in Table 7.
In 2004, the discordant results show that subclinical hyperthyroidism (low TSH with normal FT4) was highest in male (50%) and female (44%) patients. Non-thyroidal illness (normal TSH with low FT4) was next in both male and female patients.

In 2005, the discordant results indicate prevalence of two types of non-thyroidal illnesses (normal TSH with low FT4, low TSH with low FT4) among the male and female patients. 31 (51%) of male and 91 (48%) of female patients had the first type and 21 (34%) males and 69 (36%) female had the second type of non-thyroid illness.

Table 1: Age and gender distribution of patients for which TFTs were requested in 2004 and 2005

	2004		2005	
Age in yrs	**Male N = 118 (%)**	**Female N = 361 (%)**	**Male N = 160 (%)**	**Female N = 481 (%)**
15 – 19	1 (1%)	5 (1%)	2 (1%)	3 (1%)
20 – 24	10 (8%)	64 (18%)	18 (11%)	74 (15%)
25 – 29	13 (11%)	49 (14%)	15 (9%)	54 (11%)
30 – 34	9 (8%)	37 (10%)	17 (11%)	80 (17%)
35 – 39	21 (18%)	31 (9%)	37 (23%)	74 (15%)
40 – 44	11 (9%)	40 (11%)	18 (11%)	56 (12%))
45 – 49	23 (20%)	65 (18%)	17 (11%)	47 (10%)
50 – 55	9 (8%)	27 (8%)	16 (10%)	39 (8%)
56 – 60	14 (12%)	27 (8%)	16 (10%)	42 (9%)
> 60	7 (6%)	16 (4%)	4 (3%)	12 (3%)

Table 2: Distribution of male and female patients according to levels of TSH and FT4 in 2004 and 2005

	2004				2005			
Levels	**TSH**		**FT4**		**TSH**		**FT4**	
	Male	Female	Male	Female	Male	Female	Male	Female
Low	24 (24%)	114 (35%)	13 (12%)	46 (14%)	39 (31%)	131 (35%)	67 (45%)	190 (43%)
Normal	65 (64%)	177 (55%)	77 (71%)	210 (63%)	71 (57%)	211 (56%)	54 (36%)	187 (42%)
Raised	12 (12%)	34 (11%)	19 (17%)	78 (24%)	15 (12%)	36 (10%)	28 (19%)	69 (16%)

Table 3: Summary of TFTs results for male and female patients in 2004

	Low TSH		**Normal TSH**		**Raised TSH**		**Not classified**	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Low FT4	0	3 (1%)	4 (4%)	21 (6%)	9 (8%)	22 (7%)	0	0
Normal FT4	8 (7%)	38 (11%)	59 (54%)	146 (44%)	3 (3%)	18 (5%)	7 (6%)	8 (2%)
Raised FT4	17 (16%)	69 (21%)	1 (1%)	7 (2%)	0	0	1 (1%)	2 (1%)

Note: Total FT4: Male patients = 109; Female patients = 334

Table 4: Summary of TFTs results for male and female patients in 2005

	Low TSH		Normal TSH		Raised TSH		Not classified	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Low FT4	21 (14%)	69 (16%)	31 (21%)	91 (20%)	10 (7%)	21 (5%)	5 (3%)	9 (2%)
Normal FT4	2 (1%)	19 (4%)	37 (25%)	112 (25%)	5 (3%)	9 (2%)	10 (7%)	47 (11%)
Raised FT4	14 (9%)	42 (9%)	2 (1%)	3 (1%)	0	0	12 (8%)	24 (5%)

Note: Total FT4: Male patients = 149; Female patients = 446

Table 5: Classification of TFTs results for male and female patients in 2004 and 2005

	2004		2005	
	Male	**Female**	**Male**	**Female**
Concordant	85 (78%)	237 (71%)	61 (41%)	175 (39%)
Discordant	16 (15%)	87 (26%)	61 (41%)	191 (43%)
Not classified	8 (7%)	10 (3%)	27 (18%)	80 (18%)

Table: 6: Distribution of Discordant results for male and female patients in 2004 and 2005

Discordant results	**Probable course** [4,5,6]	**2004**		**2005**	
		Male	**Female**	**Male**	**Female**
Low FT4 & Low TSH	Non-thyroidal Illness	0	3 (3%)	21 (34%)	69 (36%)
Low FT4 % Normal TSH	Non-thyroidal Illness	4 (25%)	21 (24%)	31 (51%)	91 (48%)
Normal FT4 & Low TSH	Subclinical Hyperthyroidism	8 (50%)	38 (44%)	2 (3%)	19 (10%)
Normal FT4 & High TSH	Subclinical Hypothyroidism	3 (19%)	18 (21%)	5 (8%)	9 (5%)
High FT4 & Normal TSH	Euthyroid Hyperthyroxinemia	1 (7%)	7 (8%)	2 (3%)	3 (2%)

LIMITATIONS IN THE STUDY:

There are several limitations to this study.

One of the major limitations is the retrospective design that prevents analysis of the reasons for which the thyroid function tests were ordered

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ANTI-TB ACTIVITY OF EVODIA ELLERYANA- A MEDICINAL PLANT FROM MANUS PROVINCE

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(Presented by: Emma Powan)

INTRODUCTION:

Tuberculosis caused 2 million deaths world-wide in 2003.[1] Drug resistance, non-compliance, increasing HIV/TB co-infection, drug interaction and cost are problems associated with these deaths[2]. Tuberculosis in Papua New Guinea is a serious health concern with about 3,000 deaths reported yearly. The DOTS program covers only 47% of the population in PNG[3]. The effort to discover and explore alternative treatments for TB is essential. Natural products and medicinal plants continue to be an important source of new drugs[4]. PNG's biodiversity and medicinal plants provide a good basis for investigating potential anti-TB agents.

OBJECTIVE:

This study was designed to provide scientific evidence on the inhibitory effect of medicinal plant- *Evodia elleryana* on the growth of *Mycobacterium tuberculosis in vitro. E. elleryana* bark is used traditionally to treat cough in Manus Province, PNG.

METHODS:

Inhibition of TB was quantified using a colorimetric MTT dye (3-4, 5-dimthylthiazole-2-yl--2, 5 diphenyltetrazolium bromide) assay. Toxicity of the plant extracts was evaluated using a colorimetric MTT assay against growth of Human T-cell leukemia. Extracts of *E. elleryana* bark were tested at concentrations 50 µg/ml and 5 µg/ml. All results were quantified on the Microsoft Excel template.

RESULTS

E. elleryana bark extract in ethyl acetate (94B-E) had 95% TB inhibition at 50 µg/ml. The result was comparable to Rifampicin at 5 µg/ml, which had 94 % inhibition. Isoniazid at 5 µg/ml had less activity compared to 94B-E, showing only 88% inhibition. Cytotoxicity of 94B-E to human T-cell was 31%. IC_{50} of its active fraction (94BEL2H-46) obtained from several fractionation techniques (LH-20 and HPLC) was 40 µg/ml.

Fractionation and Mass spectrometer techniques showed evidence for quinolone alkaloids previously identified from *E. rutacarpa*- a similar species to *E. elleryana.* Compounds evocarpine, 1-methyl-2-(4Z, 7Z)-4, 7-tridecadienyl-4 (1H)-quinolinone, 1-methyl-2-pentadecyl-4(1H)-quinolinone and 1-methyl-2-nonyl-4(1H)-quinolinone showed identical masses to the active extracts (94B-E and 94BEL2H-46) in the MS (+) data.[5,6,7] Positive Draggendoff's test on these active extracts proves the presence of alkaloids.

Literature searches showed that these identified quinolones were reported from other studies to be active against various strains of mycobacterium[8].

Consistent with these findings is the number of related synthetic quinolones such as gatifloxacin, moxifloxacin and ofloxacin on clinical trials against TB[9]. All these evidence shows a high possibility for quinolone alkaloids in *E. elleryana* bark extract as the responsible agents for the anti-TB activity observed.

CONCLUSION:

This study has scientifically correlated *E. elleryana* bark-used traditionally to treat cough as considerably safe to human T-cells and effective against *Mycobacterium tuberculosis in vitro.* It also identified Quinolone Alkaloids from *Evodia elleryana* as probable compounds responsible for the Anti-TB activity. Quinolone alkaloids may serve as potential lead or marker compounds for further drug development. Further pharmacological study and chemical analysis are recommended.

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THE EFFICACY OF THE STERILIZING TECHNIQUE AT THE UPNG DENTAL CLINIC

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(Presented by: C. Kili)

INTRODUCTION

Infection control is a very important part of dental and indeed general health care and in PNG where a rapidly increasing incidence of people with blood borne infectious diseases like HIV/AIDS, its importance cannot be overstated. Imperative to this is the sterilization of dental instruments, which will be reused. Now sterilization is "the process by which all types of microorganisms (including spores) are destroyed. And this is achieved by the use of heat, radiation, chemicals, or filtrations".[1]

AIMS AND OBJECTIVES

There is a large and growing amount of literature on the hazards of cross infection from contaminated and inadequately sterilized instruments in dental practice.[2] It is for this very reason that this study was carried out to investigate the effectiveness of the sterilization procedure used by the university of PNG dental clinic, and from the information gathered assess the need for improvements of the process.

METHOD:

Randomly selected routinely used, packed sterilized instruments such as mouth mirrors, probes, extraction forceps, and hand pieces were sent off to the pathology lab where they were analyzed to see if some microbial life persisted after the sterilization procedure.

Sterilization procedure acquired by dental clinic:

The sterilization procedure used by the dental clinic includes firstly scrubbing the soiled instruments under running water to remove surface debris. This is followed by soaking the washed instruments in a multipurpose detergent (Comprox, 1:50) for 20-30 minutes. The instruments are then rinsed, dried and packed in paper or plastic sterilizing envelopes, and sealed with indicator tapes before being placed in an autoclave to be steam sterilized for 1 hour at 250^{O}C. After being left to cool they are finally packed away in stainless steel lockers.

Laboratory Analysis:

The detection method included "swabbing each instrument with a sterile swab and putting the swab in a nutrient broth to support the growth of the organism. This was followed by the inoculation of each swab on the nonselective blood agar plate and selective MacConkey agar plate. The inoculum is applied by swabbing a dime-sized area on the media plate and the original inoculum is then cross truck with an ordinary inoculating loop for isolation of the organism. Inoculated media are then incubated at a temperature of 35 to 37^{O}C for 48 hours and finally observed for bacterial growth. Colonies were examined using gram staining and biochemical tests to identify the organism".[3]

RESULTS & DISCUSSION

Out of the 41 samples microbial growth was isolated from only 2 items, the stainless steel bowl and tumbler. The colonial appearances on the Blood agar were medium; opaque, convex; non-hemolytic and yellow in color, the biochemical tests in addition confirmed the organism to be Micrococcus particularly M. luteus species.[3]

Micrococcaceae are environmental organisms that are found in soil (however, they cannot survive long in soil), water, air, and also as part of the normal flora of the mammalian skin. In addition, they colonize the human mouth, mucosa, oropharynx and upper respiratory tract. The mode of transmission of Micrococci is uncertain and is rarely implicated as a cause of infections. When infection does occur, they most likely involve the endogenous strains. The pathologic ability is unknown, probably of extremely low virulence. Micrococcus luteus is non pathogenic to animals and man though it may be seen as an opportunistic pathogen, particularly associated with immunocompromised hosts.[4]

According to the laboratory report the contamination could have been due to exposure in the sterilizing envelope before swabbing or technical contamination during culturing.

As M. luteus does not survive long enough, contamination could have occurred from the time of the collection of the instruments for analysis (as gloves were not used), up to the time that they were swabbed for analysis in the lab.

During this study it was observed that the 2 instruments with microbial growth were inadequately wrapped and sealed during the pre sterilizing procedure compared to the other samples. Moreover the outer surface of the bowl and tumbler were wrapped and the excess wrapping was pushed into the inner surface rather than taped over, thus exposing a portion of the instrument to the external environment. It was also noted that these were the only 2 instruments that were wrapped in this manner. It is because of this that the microorganism found is assumed to be a contaminant of the samples.

With the information gained form the study it recommended that all dental instruments are adequately wrapped and sealed, proper infection control must be practiced even when transferring sterilized instruments from the storage lockers to the surgery rooms. And thirdly storage lockers should be dusted and washed more often.

CONCLUSION

Sterilization of dental instruments plays an important role in avoidance of cross infection among patients and dental professionals. With the issues of infectious diseases like HBV, TB and HIV it is important to monitor the effectiveness of sterilization in dental clinics and develop ways to improve sterilization techniques.

There are of course ways to improve the study but as already mentioned this is the first of its kind for the dental clinic and we can only look forward form here.

RECOMMENDATIONS

The following recommendations are made in light of the current knowledge obtained from this simple study;

- All dental instruments must be adequately wrapped

- The storage lockers should be dusted and washed out more often
- Regularly conduct study to monitor the efficacy of the sterilization technique

ACKNOWLEDGEMENT: Angela N. Kilepak, Laboratory Technician, Medical Lab Science Division, SMHS, UPNG,

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PROPOSAL FOR ICD-CODED PRESCRIPTIONS

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(Presented by: Phillip Kigodi)

INTRODUCTION:

Rational use of drugs (medicines) (RUD) is a recurrent problem for all developing and developed countries. The specific issues of concern in any country at any time vary widely. On one hand, in a developed country the issues may involve the quick adoption of new medicines that better targets the clinical situation at hand or the deletion of less effective medicines. On the other hand, in the developing countries the RUD issues may be the same old stuff of inappropriate use medicines such as polypharmacy, using antibiotics for common flu or the use of more expensive second line antibiotics for commercial gain etc. In order to adequately address the problems resulting from inappropriate use of medicines it is necessary to use both educational and legislative approaches. To assess with certainty inappropriate use of medicines one must know what the indication of any medicine is. Current set up and practices put investigators of RUD in a position of second guessing this as the indication of prescribed medicines are not allowed in the prescription due to ethical issues. The International Classification of Diseases (ICD) coding system discussed below has the potential of removing this obstacle. The problem of inappropriate use of medicines has been studied over several years at several NCD health facilities with the help of Bachelor of Pharmacy final year students. A synthesis view of the findings and main obstacles to achieving improved RUD is discussed in this presentation.

It was noted that the country implemented ICD (Revision 9) system for its disease classification and reporting m for statistical purposes for many years and it migrated[1] to Revision 10 of the ICD since 2003. The practice of ICD-coded disease classification does not have a direct impact on the current patient at a health facility.

AIM AND OBJECTIVES

The aim of the investigation was to find means to implement ICD-coded prescriptions practice as diversification of the national use of ICD-code in reporting morbidity and mortality data in the country.

The objectives of the study is to enable pharmacists to render improved advice to prescribers using tangible data obtained from ICD-coded prescriptions to improve the RUD through evidence-based clinical decision and verification of the validity of prescriptions derived from accepted norms (national or international)

WHAT IS ICD-CODING?

International Statistical classification (ICD) of diseases in current use was developed over a period of 200 years as a branch of classification of causes of deaths. Initially the body responsible for ICD was The International Statistical Institute but subsequently it became the responsibility of WHO[2]. The first list adopted in 1900 was made up of a detailed classification of causes of death consisting of 179 groups and an abridged list of 35 groups.

A classification of diseases for use in statistics of sickness was adopted in1900. In 1909 extra categories for non-fatal diseases were formed by subdivision of certain rubrics of the cause-of-death classification into two or three disease groups, each of these being designated by a letter. The Second Decennial Revision, published by the United States Department of Commerce and Labor in 1910, was entitled International Classification of Causes of Sickness and Death. It also provided a common base for comparison of morbidity and mortality statistics[3] During the years that the Seventh (1955) and Eighth Revisions (1966) of the ICD were in force, the use of the ICD for indexing hospital medical records increased rapidly and some countries prepared national adaptations which provided the additional detail needed for this application of the ICD.

In ninth revision the main changes made to ICD included the adaptation of the classification to make it more relevant for the evaluation of medical care, by classifying conditions to the chapters concerned with the part of the body affected rather than to those dealing with the underlying generalized disease. The final proposals was presented to and accepted by the Conference retained the basic structure of the ICD, although with much additional detail at the level of the four-digit subcategories, and some optional five-digit subdivisions. For the benefit of users not requiring such detail, care was taken to ensure that the categories at the three-digit level were appropriate.

For the benefit of users wishing to produce statistics and indices oriented towards medical care, the Ninth Revision included an optional alternative method of classifying diagnostic statements, including information about both an underlying general disease and a manifestation in a particular organ or site. This system became known as the dagger and asterisk system and is retained in the Tenth Revision. A number of other technical innovations were included in the Ninth Revision, aimed at increasing its flexibility for use in a variety of situations.

The Twenty-ninth World Health Assembly, noting the recommendations of the International Conference for the Ninth Revision of the International Classification of Diseases, approved the publication, for trial purposes, of supplementary classifications of Impairments and Handicaps and of Procedures in Medicine as supplements to, but not as integral parts of, the International Classification of Diseases. The Conference also made recommendations on a number of related technical subjects: coding rules for mortality were amended slightly and rules for the selection of a single cause for tabulation of morbidity were introduced for the first time; definitions and recommendations for statistics in the field of perinatal mortality were amended and extended and a certificate of causes of perinatal death was recommended; countries were encouraged to do further work on multiple-condition coding and analysis, but no formal methods were recommended; and a new basic tabulation list was produced.

JUSTIFICATION

The justification for requiring prescriptions to be ICD coding emanates directly from the philosophy of RUD. Examination of prescriptions at any time reveals a number of errors some of which are of a magnitude requiring the attention of the clinicians. Here are some examples: Standard survey by Iona Taakau[4] and Jenny Joku[5] in 1977at the paediatric outpatient and sexually transmitted infections clinics revealed some inconsistencies (Figure 1)whose intervention proved difficult. More recently a standard survey by Dixon Dimiri[6] of comparative prescribing patterns at OPD of four private facilities and one

public healthcare outlet in 2004, showed current practices wanting as shown in Table 1.

A detailed look of two private facilities these practices by Phoebe Baragut[7] in 2005 revealed the following Patients age shown 1-16/60 (distribution children to adults), sex not shown 9/60, weight given 7-55/60, Diagnosis given 53/59/60 ICD-coded prescriptions should improve RUD through timely intervention to ensure only compliant prescriptions are dispensed. The main players resisted this attempt. Johnny Simeng[8] in 2006 evaluated the perception of doctors, and pharmacists on the value of ICD-coded prescriptions using a number of indicators. The results are summarized in Table 2.

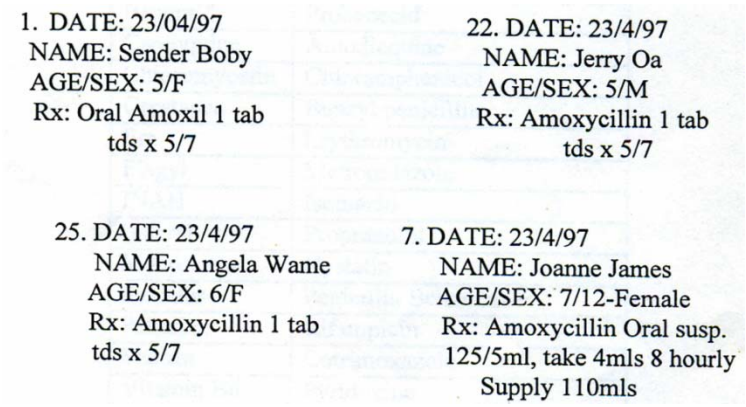

Figure 1: Examples of Common prescription errors

Table 1: Indicators for drug use compliance patterns

Category	Results (%)	International trend (%)
Average items per prescription was	3-3.5	1.3-2.2,
Antibiotics use	70-83.3	27-63
Injections use	51-74	=<45%
Generic prescribing	19.8-45	>=90%
EDL prescription ranges were	60-85	>=85

Table 2: Assessment of the perception for ICD-coded prescription

Perception	% In favour of ICD-coded prescriptions
Should they be used	> 62
Happy to adopt and adapt	>= 50
Link to diagnosis useful	> 65
Useful to counseling patients	> 90

COMPLIANCE WITH STG AND THE LAW:

The errors in the prescription were detected on the basis of principle and educated guess whose validity depends on the indication of the medicine. The more limited its indications are the better the educated 'guess'. ICD-coding would directly narrow down the precision with which it can be handled and remove vague advice and hence reduce wastage and expenses. It would also allow for more robust and better quality advice.

Compliance with STG is an ethical undertaking while compliance with the law would be legally binding. But the **law is deficient** in that it **completely omits mentioning the prescription at all**. For some reason the clinical officers do not feel it their duty to do the best for their patients through improved RUD and cost minimization.

CONCLUSION

Repeated long term survey of prescribing patterns show that inappropriate use of medicines is common. Prescribers did not accept attempted intervention by voluntary adoption of ICD-coded prescriptions. Legal enforcement of the same failed because of serious lapses in the law.

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