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INFORMATION

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HEALTH WORKER TRAINING IN PNG: TIME TO RETHINK

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ABSTRACT:
After 20 years of in-service training in child health, involving many different WHO and UNICEF courses: the Integrated Management of Childhood Illness (IMCI), Infant and Young Child Feeding (IYCF), Severe acute malnutrition (SAM), Early Essential Newborn Care (EENC) and many others, it is time to consider what model of training is efficient and sustainable. Such a training model will need to address the complexities of child health in Papua New Guinea (PNG) in the era of the Sustainable Development Goals (SDG) and provide health workers with a program of continuing professional development (CPD). Efficient models of training will have a common framework and integrate the best of these individual courses, and involve modern information technology to improve efficiency, be easily updatable and enlarge access. Training should be flexible and modular so that it can be delivered as an in-service course, a program of CPD within a hospital, or as self-learning. It should involve the principles of adult learning, enabling health workers to build on their existing knowledge and skills, to learn how to use standard up-to-date texts and technical resources in everyday clinical practice, and to understand where and how to access quality, credible health information. In-service training and CPD should involve and support PNG's schools and colleges of nursing, HEOs and community health worker training, with the Paediatric Society, the School of Medicine and Health Sciences (SMHS) University of PNG, and the National Department of Health (NDoH) taking the lead. A course that integrates the best of the existing WHO and UNICEF courses could form the basis of a post-graduate child health nursing diploma, which could be established in more provinces to address the shortage of paediatric nurses.

Keywords: child health, training, Papua New Guinea, paediatrics, nurses, IMCI, Hospital Care for Children

HISTORY:

In the 1980s and 1990s Papua New Guinea (PNG) was one of the few developing countries to have evidence-based clinical guidelines, in the form of the PNG Standard Treatment Manual for Common Illnesses in Children [1]. This set of guidelines has been continuously published since the first edition in 1975. PNG also had other treatment guidelines targeted to different settings and health care staff, including Paediatrics for Doctors in PNG [2], and the green manual Child Health for Nurses. The

training approach was mostly a pre-service or undergraduate model, where these texts were used as the basis of the curriculum in schools and colleges of health worker training, and they were the standard references used in the field after graduation. In those years there were limited opportunities for continuing professional development, updates or ongoing training, such that many health workers would be 10 years or more without any retraining or updating.

Background and history of IMCI: globally and in PNG:

In the 1980s the World Health Organization (WHO) had separate "vertical" programs in child health: Acute Respiratory Infection, Diarrhoea, and Malaria for example. Much of the content of these programs was based on research in PNG, the Gambia in West Africa, and other low income tropical countries. In the late 1990s WHO developed the Integrated Management of Childhood Illness program (IMCI) [3]. This was designed to standardise and improve primary health care for children, recognising that while children may have one presenting symptom, those most at risk of dying have more than one disease or problem, for example diarrhoea and malaria, or pneumonia and malnutrition and anaemia. WHO promoted IMCI in developing countries around the world, with strong encouragement for PNG and other Pacific Island countries to adopt it. In PNG, adaptation of IMCI commenced in 1998 by the Paediatric Society and the National Department of Health (NDoH), in a series of meetings supported by WHO. A 10-step checklist was devised, based on the IMCI algorithms to cover common illnesses, and to be consistent with a previous project in PNG where a checklist was used to assess children presenting to primary care. The training approach of IMCI was to train trainers (often paediatricians), who would then run provincial-level courses, and health workers trained at a provincial level would then return to their districts and train district health staff. In 1999 training of trainers in the IMCI / 10-step checklist was funded by the AusAID Women's and Children's Health Project. This achieved good coverage in provincial centres, mostly because of the efforts of several paediatricians who became lead trainers. WHO then supported IMCI intensely in 2 districts, Henganofi and Madang, which became known as the two pilot districts. Here effort was put into including the other components of IMCI, particularly provision of commodities, drugs and equipment. WHO invested a great deal of funds in these 2 districts, far more than feasibly could be expected to be provided by the Health Department to any other districts in an IMCI expansion phase. Initial training was of 5 days duration, but this was later expanded to 10-11 days to be in line with the WHO model.

In 2003 a "young infant checklist" was finalized and incorporated into the 10 day training courses, to address the needs of neonates

which were mostly missed in the original IMCI algorithms. The combined child and young infant IMCI course was run in the two "IMCI pilot districts" supported by WHO, and in West Sepik. In 2002 and 2004 more training was done for "supervisors of IMCI" in Goroka, Madang and Henganofi, and subsequently further 10 day in-service trainings were conducted, this time supported by the Health Sector Improvement Program (HSIP).

By the end of the first decade of IMCI only a few provinces had done their planned district training, and follow-up after training was poor. IMCI training and follow-up supervision was often included in provincial annual activity plans (the plans that are supposed to direct the budget), but these activities often did not happen or only happened in a fragmented way. It is arguable that only Milne Bay Province embedded IMCI into the health culture of the province and conducted IMCI activities consistently, largely due to the commitment of Dr Gilchrist Oswyn.

From the beginning there were many threats to IMCI sustainability. First the duration of training, 10 or 11 days being a long time for health workers to be away from their places of work and families. Second, the resources required to run IMCI training are substantial: a typical course often cost over one hundred thousand Kina. In the AusAID and WHO funded eras, per diems became an expected part of in-service training, and this has partly driven the *overall* training model in PNG for the last decade and a half. In the first 15 years IMCI was frequently being revised to add or change steps, many revision workshops occurred, and the materials (trainers' manuals, participants' manuals, flip-charts) were costly to re-print and to transport to provinces and districts. A brief attempt at making electronic versions of the adapted IMCI materials through a Novartis and WHO funded program called ICATT (IMCI Computerised Adaptation and Training Tool) was never utilised. The WHO IMCI model required IMCI admission record forms for children to be completed at presentation, but these forms were never incorporated into routine Health Department documents. Printing costs were high and although the forms were designed they were never used. The 10-step checklist and the 8-step checklist for young infants were incorporated into the PNG Infant Record Book and the PNG Standard Treatment Manual, both attempts at embedding IMCI in the health culture, but generally health workers wrote in the free-hand sections of the Baby Buk, rather than using the checklists. The WHO model also relied on flipcharts with useful line-drawings of the clinical signs of each step (cough and difficult breathing, dehydration) and the advice to mothers (making oral rehydration solution, for example). These IMCI flipcharts required printing and distribution, and health workers sometimes were reluctant to use them in a clinic because they felt parents might doubt their knowledge or

competence. No consistent budget existed for printing IMCI material, so flipcharts were only sporadically and transiently printed, when a donor took on IMCI as a project to fund. However the materials could rarely be found in health centres. Finally high health worker attrition and new health workers entering the workforce meant that continuity and retention of skill and knowledge of IMCI was limited.

Realising the weaknesses of in-service training in implementation of IMCI, pre-service training of trainers was planned in 2004. Tutors from Lae Nursing School and community health worker schools were trained, and the schools were asked to develop their curricula incorporating IMCI training. Some did this, but there was no evaluation. The School of Medicine and Health Sciences (SMHS) University of PNG (UPNG) covered IMCI in clinical practice at the Children's Outpatient of Port Moresby General Hospital (PMGH), in the hope that medical students would have a working understanding of how nurses and Community Health Workers (CHWs) were being taught to practice child health.

During the first 15 years of IMCI there were attempts at incorporating the third component of IMCI, Family and Community Practices, using the same model of adaptation of WHO technical materials, selection of pilot districts, printing of materials, and training of trainers. There is no evidence of any impact at a community or district level on child health or family outcomes. In that time there were also several community household surveys funded by WHO. These were large budget surveys, and may have yielded useful information about current household practices, but the surveys were never properly analysed or published.

In the years since 2000 there were several funding proposals drawn up of "full implementation" of IMCI, including coordinators in each province and extensive roll-out of in-service training courses. These proposals had annual budgets of 10s of millions of Kina, at a time when the total budget for Family Health Services branch of the NDoH was a very small fraction of this. These have not gone beyond the stage of written plans.

The experience of IMCI in other countries:

In one way or another more than 100 countries introduced IMCI since the 1990s. The initial evaluations in the first 2 countries, Tanzania and Uganda showed promising results, with improvements in health worker practices after training, including assessment, classification and referral of sick children according to the IMCI algorithms [4]. Multiple studies followed of health worker performance after training, and a systematic review and meta-analysis concluded that IMCI-trained health workers were more likely to classify illness correctly, and that where the baseline performance was low, health workers after IMCI training showed greater improvements in prescribing medications, vaccinating children, counselling families on

nutrition and administering oral therapies. WHO designed a multi-country evaluation of IMCI, which included countries in each WHO region which were considered likely to succeed in the 3 IMCI components and achieve a mortality reduction [4].

In both Tanzania and Bangladesh, part of the multi-country evaluation, there was a decline in mortality in the IMCI areas compared to the control areas, but the differences were not statistically significant [4]. A recent meta-analysis of 4 studies assessing the effectiveness of IMCI concluded that the use of IMCI may lead to fewer deaths among children from birth to 5 years of age, but the finding was of low certainty. The meta-analysis also concluded that IMCI had little or no effect on the number of children suffering from stunting or wasting, or the number of children receiving vaccines [5]. Some authors speculated that the reasons for the lack of definite effect on mortality are related to the primary diseases that IMCI targeted not being the major causes of mortality in the countries in which it was implemented, and that IMCI guidelines are meant for the provision of local (primary) care of children with less severe diseases, but that referral to good quality hospital care is needed for those who are severely ill. If the facilities children are referred to be ill equipped, or staff not adequately skilled in managing complex or severe cases, then the primary care strategy will not be effective in reducing deaths. Therefore a focus on the quality of referral care is important, and WHO's Hospital Care for Children program was developed (described below).

In some countries lack of adherence to IMCI guidelines was an issue, and the time it took for health workers to carry out the IMCI approach in busy clinics was a disincentive. There were few countries which implemented the community component of IMCI, [4] so no effect seen on care seeking. Although many countries reported implementation of IMCI in more than 75% of health facilities, the population coverage was low. The 11-day training courses were costly, and after an initial burst of training activity during which a large number of health care workers were trained, budgetary and other constraints led to a decrease in the number of courses [4]. The turnover of staff meant that coverage was low, and because of the costs and logistics, training new health workers was often not feasible. In many countries there was a lack of investment of government funds, which resulted in IMCI being donor driven, and the lack of coordination between WHO and UNICEF was highlighted. The Health System component was not implemented; there was a lack of essential drugs in many countries, a lack of supervision and low community awareness [6]. Because of the limitation of the duration of training (11 days), many countries ran shorter courses of 5-7 days. Some, including Afghanistan, [7] and Rwanda [8] reported favourable results. A meta-analysis of these studies however concluded that the 11-

day training was more effective in improving the appropriate administration of oral antibiotics and ORS than shortened training, although the difference was small, and no harder outcomes were reported [9]. The experience of PNG with IMCI is therefore mirrored in other countries.

Other courses in PNG:

In the last 15 years WHO and UNICEF has also promoted many other courses. These include "Infant and Young Child Feeding"(IYCF), [10] "Early Essential Newborn Care" (EENC), [11] and "Severe Acute Malnutrition" (SAM) [12]. There have been additional in-service courses in neonatal resuscitation, anti-retroviral therapy (ART) prescribing, prevention of parent to child transmission of HIV (PPTCT), and child TB. A WHO in-service training course was even conducted in some provinces when vitamin A was introduced.

Another course developed in PNG was the "Hospital Care for Children" course. This is based on the WHO Pocketbook of Hospital Care for Children and the PNG Standard Treatment manual, [1, 13] and the course materials are available on-line:

www.pngpaediatricsociety.org/hospital-care-for-children-training-modules. It is a 4-5 day training course, modular so that it could be done as once a week lectures. Although it incorporates IMCI concepts, including syndromic diagnoses, it goes further to teach about how to care for severe illness, comorbidities, and provides updates on newer interventions. It teaches the different stages of management relevant to all seriously ill children: triage and emergency care, history and examination, laboratory investigations, diagnosis and differential diagnoses, monitoring and supportive care, discharge planning and follow-up. The course has incorporated new innovations: for example new TB diagnostics and treatment regimens, criteria for diagnosing HIV, oxygen therapy, neonatal resuscitation, essential newborn care and resuscitation, care of low birth weight babies, severe malnutrition management, recognition of rheumatic fever and managing chronic childhood illnesses. It focuses on what health workers need to know to improve the quality of care for children, and is appropriate for all children managed as inpatients and those who need continuing care for chronic illnesses in the community. The course was piloted in Kimbe in 2013, and conducted in all highlands provinces from 2013-2016. The course includes adult learning concepts, practical skills training, clinical updates of changes to Standard Treatment and new guidelines to build on what health workers already know. This course was developed in PNG and Solomon Islands, and has been adopted and translated into many languages and used in other Pacific Island nations, Asia (Lao, Indonesia, Vietnam), Eastern Europe (Kazakhstan, Uzbekistan), and various countries in Africa.

(www.hospitalcareforchildren.org)

Changes in the health sector and in child health:

Since the 1990s PNG has undergone extensive changes in the health and other sectors: devolution of responsibility for health services from National to Provincial and progressively to District level administrations, a major contraction of resources for health coordination and technical leadership at a national level, and a substantial increase in population. Furthermore paediatrics has become much more complex. Since the 1990s there are new conditions, and complications of old diseases: HIV, chloroquine resistant malaria, multi-drug resistant TB, antibiotic resistant newborn sepsis, a renewed focus on newborn health, adolescent health, disability, chronic diseases, child abuse and protection. New therapies have been introduced since 2000, including fixed dose combination TB treatment, artemisinin-based combination therapy for malaria, anti-retroviral drug therapy for HIV, and new diagnostics and technology including pulse oximetry, rapid diagnostic tests for malaria, vitamin A and Zinc, new conjugate vaccines, and oxygen concentrators. New comprehensive programs for HIV, including prevention of parent to child transmission of HIV, HIV early infant diagnosis and early ART have added to the information needed by child health workers in this century. Some of these new technologies have come at the expense of older initiatives; the loss of basic microbiological diagnostics including blood culture facilities at regional hospitals for example. These new initiatives have been added to address new problems or better address existing problems, and they have been mostly for the good. They add substantially to the complexity of what health workers caring for children need to learn and practice.

The current dilemma:

So after nearly 2 decades since IMCI and these many other courses were introduced it is timely to review health worker training from an overall perspective. IMCI in its current form has not achieved the coverage or impact that was hoped for in 2000, and is unsustainable with the current model of prolonged in-service courses being supported every 3-5 years by a different external donor. Each new training course addresses a gap, but carries opportunity costs. Standard Treatment, for example, may be weaker because of the emphasis on IMCI. Arguably the focus on in-service training courses has detracted from building stronger institutions of training, nursing colleges and CHW schools. Enormous resources have been spent on IMCI and other in-service training courses by external agencies and by the Health Department, whereas only a fraction of bilateral donor or UN partner resources have been invested into the fragile health education sector and health training colleges are grossly underfunded. Many CHW schools have annual budgets that are far less than what it costs to run a single IMCI in-

service training course. And it is not just money, but energy and effort that is syphoned. Whilst specialists have been involved in IMCI and other in-service courses, they have, in general, had a lesser input into teaching in their province's CHW or nursing schools.

The future: keep it simple and efficient:

Health workers, nurses, HEOs, CHWs and doctors all need continuing professional development (CPD). This is important for morale and competency. A good program of CPD also helps health workers network and share ideas. They need to stay up to date and informed of policy and guideline changes. And ongoing education needs to reach a national scale, so that health workers in remote areas are as informed as their sisters and brothers in capital cities. The number of nurses in PNG needs to increase to meet demand and match rates of attrition, and because of the increased complexity of child health, the number of Child Health Nursing courses need to increase to teach such specialty nursing. While we should not lose the best of the courses and programs run in the last 2 decades, we should make education more efficient, updatable, relevant to current policy and guidelines, and involve rather than detract from health training institutions.

In terms of post-graduate training it would be possible to incorporate the best components of the training courses (Hospital Care for Children, IMCI, IYCF, EENC, SAM, EPI, and more) into a single post-graduate child health nursing course. This could provide a balanced, practical curriculum. This has been done in Solomon Islands, and the first cohort of 17 paediatric nurses is soon to graduate from the Solomon Islands National University.

In terms of Child Health CPD perhaps we can begin by proposing some principles for discussion:

- A CPD education package would need to get support from all agencies so that there is consistency and coordination.
- It would have to be efficient, i.e. not taking health workers away from their work for overly-extended periods of time, not requiring a lot of printed teaching materials. Maximum duration of 4-5 days, but be able to spread as regular CPD over weeks, and be done as self-learning.
- There should be a common framework (e.g. the Hospital Care for Children) which would properly incorporate the best of other course teaching (IMCI, IYCF, BFHI, EENC) and up-to-date local information on guidelines and policy.
- It should also include the components of the Child Health Plan 2009-2020, for example adolescent health, disability and child protection, issues that the pre-service nursing courses do not have

time to cover. It should be linked with epidemiology and disease surveillance, so that changes in disease patterns are reflected in the training.

- It should be flexible: it would need to be updated as new guidelines and policies are developed. The Hospital Care for Children program, for example, has incorporated recent changes, including new vaccines and vaccine schedule changes, use of new malaria and TB diagnostics, increased emphasis on chronic illnesses in children, the change to Option B plus for maternal HIV, and child protection. It is not healthy if training programs are stuck in basic clinical algorithms a decade old, or if it takes a year of workshops and meetings to update them every time there is a change in policy. So the platform for this education material needs to be modern and flexible, that is not printed material.
- It should follow principles of adult learning, and be practical. I have seen that many experienced nurses attend IMCI courses, but they know all these basics which they learnt in nursing school. However what they benefit from is extending their knowledge, applying their knowledge, learning new guidelines and policies. They were often treated in IMCI as basic learners, but the nurses who work in health centres and provincial and rural hospitals have a lot of knowledge which can be built on. Teaching them the same things, packaged in the same algorithms is an opportunity lost.
- It should involve the use of information technology (IT), not rely on printed materials, such as special trainers or participants manuals, which just are used for training then not again. It should however involve the distribution and teaching on standard texts like Standard Treatment and Hospital Care for Children, so that health workers understand how to use such guidelines in everyday clinical practice. Receiving a standard text at a training course is a good way of dissemination, and endorses the text as a valuable tool, and encourages routine use. A training course cannot teach a health worker everything in a text (every disease, every treatment), but it can teach how to use it to manage a patient.

Training materials can be on CDs or USB data storage devices, and such materials can be used by participants for self-learning. Training materials should be modular and flexible, packaged so they can be used just as effectively to teach staff for an hour or 2 each week, or for self-learning, or used in a formal pre-service

nursing course, as it is for a 5 day in-service training course. Materials can be housed on the Internet, such as on the Paediatric Society of PNG web-site and kept up-to-date more efficiently. New technology is becoming easier to access and use; many nurses, students and doctors own smart-phones and get health information from online sources. There is WhatsApp, Skype and other methods of communication that can be used as a part of CPD. There is still a perception that IT is difficult, but it is getting much easier, and almost all PNG teaching institutions have IT facilities, even if rudimentary.

After 20 years it is time to rethink the many in-service courses that have been conducted in PNG, to make them more efficient and provide health workers with effective CPD. It is a positive step to learn from all that has been achieved and the things that have failed in the last 20 years, in PNG and elsewhere, and to move Child Health education forward for the current and future generations of health workers.

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VACCINE PREVENTABLE DISEASES: WHERE CLINICAL, LABORATORY, AND PUBLIC HEALTH SERVICES CONVERGE

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Disease surveillance is the monitoring of disease. It involves detection of illness by clinicians, confirmation of diagnosis by the laboratory, and disease prevention and control by public health authorities. The importance of this confluence of roles was sharply illustrated in the first cholera outbreak experienced in Papua New Guinea (PNG) between 2009 and 2011 for which PNG was not adequately prepared and in which some 15000 people were affected with 500 deaths. Clinicians were alerted to the possibility of cholera by patients with profuse watery diarrhoea. The diagnosis was initially confirmed in the PNG Institute of Medical Research (IMR) Laboratory in Madang. The public health response varied between different pockets of infection but probably prevented a nationwide and potentially devastating epidemic. Had the diagnosis not been suspected by the clinicians and the diagnosis not been confirmed, delay in the public health response would have almost certainly had disastrous consequences [1 – 4].

Good surveillance, involving the clinical and laboratory services has the potential to record disease burden, to document changes in disease patterns and to predict and confirm disease outbreaks. It is essential for adequate health planning.

This review focuses on surveillance for vaccine preventable diseases (VPDs) in PNG. In the current PNG Expanded Programme on Immunisation (EPI), vaccines should be provided free of charge to all children. The vaccines provide protection against Hepatitis B, Diphtheria, Tetanus, Whooping cough, *Haemophilus influenzae* type b (Hib), S*treptococcus pneumoniae* (pneumococcus), measles and rubella, polio and tuberculosis.

Surveillance involves the keeping and regular review of accurate records. The National Department of Health (NDoH) has a system in place - the National Health Information System (NHIS) to record disease statistics from hospitals and health centres throughout PNG. The system is however, notoriously fallible.

Diagnoses may be inaccurate, reports may not be sent at all, may be sent late or may be fabricated, and there is much room for human error. Mobile phone surveillance has been shown to be effective in the country [5] and the Health Department is currently testing out an e-based recording system using e-tablets, whereby information is entered directly onto the central data bank from the tablet.

Accurate information can also be obtained by focusing on specific areas of health. In order to obtain more precise information on childhood morbidity and mortality the Paediatric Society of Papua New Guinea set up its own Paediatric Hospital Reporting Program in 2010 and has produced annual reports each year providing valuable and easily accessible data and allowing patterns of disease in different provinces to be observed over time [6]. In the area of maternal health, the World Health Organisation (WHO) has a Maternal Death Surveillance Response programme aimed at improving reporting of all maternal deaths and focussing on appropriate responses to reduce maternal mortality [7].

To be of any value, surveillance relies on accurate diagnosis. In the absence of a laboratory test for the condition, such as neonatal tetanus, and where standard laboratory tests for confirmation of diagnosis are not available, surveillance should depend on syndromic reporting following strict criteria based definitions. But without laboratory confirmation data quality is limited. Meningitis is basically a clinical diagnosis. The paediatric reporting programme has provided accurate data on numbers and outcome for clinical meningitis [8] but it does not contain information on causation. In children the common causative bacteria are/ or were Hib, pneumococcus and meningococcus, but tuberculous meningitis is common, viral meningitis probably more common than is recorded, and other organisms such as Cryptococcus may be involved, whilst in neonates, gram negative organism such as E coli and *Klebsiella pneumoniae* are common. Unfortunately many of the provincial hospitals in the country do not have adequate laboratory facilities to determine accurate bacteriological diagnosis, and this is a matter of considerable concern not just in relation to monitoring the effect of vaccines, but of monitoring antimicrobial resistance.

The world is facing a crisis in the emergence of antibiotic resistance microorganisms [9]. In PNG the first report of penicillin resistance was reported in 1973 [10], resistance of Hib to Chloramphenicol, the mainstay of standard treatment was reported in the 1990s and increased rapidly to the extent that almost all Hib in the country is now resistant, and a change of standard management has been

required [11, 12]. A recent study reported the development of Chloramphenicol resistant pneumococcal strains [12]. There is well documented Methicillin resistant staphylococcus [13] and multiple antibiotic resistant Klebsiella strains [14]. The emergence of Multidrug resistant TB and Extensively drug resistant TB is no longer a spectre but a reality [15]. Appropriate antibiotic strategies can only be formulated when there is good data on causative organisms and their antibiotic sensitivities. Laboratories practicing at a high level of quality control are essential for bacteriological surveillance.

To return to the VPDs. Vaccination is an incredibly powerful public health strategy. The use of high quality vaccines in well-functioning health systems has resulted in extraordinary reductions in targeted disease and even in countries with poorly functioning health systems and low socioeconomic indicators, vaccination has produced remarkable effects. Smallpox was declared eradicated in1980. It is hoped that poliomyelitis will be eradicated within the next 3 years. Target dates have been set for the elimination of measles, congenital rubella syndrome and neonatal tetanus, and for a massive reduction in the number of people affected by Hepatitis B. It is estimated that between 1988 and 2016 polio vaccination prevented 16 million cases of paralytic polio [16] and that measles vaccine has prevented 20.3 million deaths between 2000 and 2015 [17]. There have been other remarkable achievements. The introduction of the conjugate Hib vaccine in high income countries in the 1990s led to the virtual eradication of invasive Hib disease, most notably meningitis [18, 19] and the introduction of the polyvalent pneumococcal conjugate vaccines has had similar, though less dramatic effects [20]. Surveillance is much more difficult in low and middle income countries, but where it has been in place, it has also shown dramatic reductions in the incidence of Hib meningitis following the introduction of Hib vaccine [21, 22]. There is good evidence that the vaccine is highly cost effective [23].

The effects of introducing vaccines on the incidence of meningitis can only be determined if laboratories are able to identify these organisms [24]. Although bacteriology facilities are lacking in many hospitals, we do have evidence that the introduction of Hib vaccine has reduced considerably from data from Madang, which reported a fall in the proportion of Cerebrospinal fluids (CSFs) positive for HIB from 47% to 9% after the introduction of the vaccine [25] and from an as yet unpublished study of data from PMGH and Mt Hagen which has shown a significant reduction in the proportion of Hib isolated from CSF and estimated an 83% drop in population incidence in the years following the introduction of the

vaccine. Notable in this study was the use of latex agglutination tests for bacterial antigen detection in the years after introduction of the vaccine so that surveillance was considerably improved.

Syndromic diagnosis and laboratory confirmation are fundamental to the eradication and elimination programmes of the WHO. Acute Flaccid Paralysis (AFP) and Acute Fever and Rash (AFR) are the best known. AFP is most often the result of Guillain Barre syndrome (acute post infectious polyneuropathy) but is also caused by transverse myelitis, spinal shock following injury, or other pathology of the lower motor nerves, neuromuscular junction or muscles as well as polio. Cases of AFP are immediately notified to the health authorities. Stool samples are collected for testing for polio virus in WHO specified regional laboratories, and if polio is confirmed rapid and focussed response by Public Health authorities to vaccinate the community from which the AFP case is reported is instituted. The incidence of AFP in the absence of polio is similar in all countries of the world and an adequately functioning surveillance system will detect at least one case per 100 000 children less than 15 years of age each year. Failure to do so is indicative of poor surveillance. Adequacy of stool collection and reporting are also markers of surveillance efficiency. The system therefore is vital to the detection of individuals with polio and the control of polio outbreaks. Together with vaccination, AFP surveillance has been crucial to the massive reduction of cases of polio and will be fundamental to the achievement and maintenance of its eradication [26].

AFR surveillance is fundamental not only to the global medium term measles elimination programme, but vital for the early detection and rapid response to control measles out breaks in individual countries. Acute Fever and Rash is a syndrome which can be caused not only by measles, but also by rubella, several other viruses including parvovirus B19, and by an allergic reaction. All children presenting with AFR should have a dried blood spot or serum tested for Measles antibodies. In PNG this test is done at the Central Public Health laboratory (CPHL). The detection of IgM antibodies indicates an acute infection and should result in immediate notification of the national and provincial health authorities. In countries such as Australia with high vaccination coverage the AFR surveillance system and public health response has successfully limited the spread of measles from imported cases for many years [27]. In PNG and other countries with low routine vaccination coverage the potential for large outbreaks is ever present. PNG experienced almost a decade without measles as a result of supplementary immunisation activities but at the end of 2013 cases of AFR

confirmed to be due to measles were detected in West Sepik.

Measles is one of the most contagious diseases known. Public Health authorities responded with a mass vaccination campaign and doubtless prevented many cases and many deaths from measles but the epidemic spread through the country and then onto the Solomon Islands and Vanuatu. During 2014 2589 laboratory confirmed and epidemiologically linked cases and 73183 clinically suspected cases from all 22 provinces of PNG were reported. More than 365 measles deaths were reported from an entirely preventable disease [28, 29]. Gene-typing of the measles virus indicated that there were two importations, one related to the Hong Kong strain and the other to a Philippine strain introduced into a large and highly susceptible population of young children who had not been immunised.

The costs of surveillance need not be large. An integrated disease surveillance and response system targeting 19 priority diseases in Eritrea, Burkino Faso and Mali cost less than 50 US cents per capita; between 0.3% and 5% of the total government health spending per capita [30]. The costs of a measles epidemic, whooping cough epidemic and the costs of the high mortality and morbidity from Hib and pneumococcal disease heavily outweigh surveillance costs.

Given that surveillance is a low cost public health intervention which, when working effectively prevents disease outbreaks and saves lives and substantial costs, it follows that investment in education of all health workers about its importance, and training in the procedures necessary for detection, reporting and response, should be a priority. All provinces have Provincial Disease Control Officers (PDOs) responsible for disease surveillance, and the NDoH has run training courses for field epidemiologists. In practice these officers are given additional responsibilities, and support for their primary function is often lacking. Clinicians should work in close collaboration with the PDOs to give support and recognition to the importance of their role.

In general, surveillance systems are passive in the sense that they depend on reporting from peripheral sites to a central unit from which a response is coordinated. There are, however, situations in which active surveillance, in which activity is directed to finding cases in high risk communities, is necessary. Such surveillance activity is more costly, but in the case of diseases such as TB active case finding focussed on high risk “hot spots” is necessary for disease control. A recent study from PNG shows that such focussed active surveillance is possible with limited resources even in remote areas [31].

The dramatic reduction in morbidity and mortality from Vaccine Preventable Diseases has only been possible because of clinicians, laboratories and public health authorities working together. There is still much to be done in PNG. The country is a risk of a further measles outbreak unless vaccination levels are substantially increased. It will be clinical health workers alert to AFR and the laboratory staff which will give early warning allowing preventative measures to be taken against another disastrous epidemic. Vaccination coverage for all the EPI antigens must be improved and the highly significant reductions in incidence of Hib not only in high income countries but also in low and middle income countries including PNG should be widely acknowledged and should provide encouragement to all those involved in disease prevention. It is important for all health workers, particularly those working in the forgotten front lines of rural PNG to know that their work in vaccinating children makes a major difference. Laboratory capabilities in Provincial hospitals need support to enable good bacteriologic surveillance for monitoring of VPDs and antimicrobial sensitivity.

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A BROKEN CALABASH: SOME CAUSES OF MATERNAL DEATHS IN SIERRA LEONE

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This is an essay on the proposed causes of maternal death in Sierra Leone in 2010 based on findings in five districts for an exploratory film documentary developed and produced for the United Nations Population Fund (UNFPA) agency in Sierra Leone entitled: "A Broken Calabash: Maternal Deaths in Sierra Leone: the causes and interventions".

The global maternal death ratio fell by 44 per cent between 1990 and 2015. The total number of maternal deaths around the world dropped from about 532,000 in 1990 to an estimated 303,000 in 2015. This equates to an estimated global maternal death ratio of 216 maternal deaths per 100,000 live births, down from 385 in 1990 [1]

In 2010, when the film documentation project was undertaken to explore and study the causes of maternal mortality in Sierra Leone, the country population, according to the last population and housing census taken in 2004, was 5.0 million. During this period, statistics revealed the rise of maternal deaths in Sierra Leone to 857 deaths out of every 100,000 living. It motivated the government to revise its population policy.

In 2009, the Government of Sierra Leone launched its revised National Population Policy. The revised policy addressed many of the fundamental issues of population, health, sexual and reproductive rights, education, gender equality, equity and empowerment of women and their interrelated development challenges; [2]. to progress towards a complete demographic transition of a considerably reduced level of low birth and death rates, and the resultant low population growth rates through the spread of voluntary family planning and small family norms, so as to facilitate the attainment of national economic and social targets.

The policy goal was to increase birth rates, decrease death rates that were affecting population growth. The high mortality rate of women when giving life, in a population of five million inhabitants (2004 census), reflecting a decline in growth when compared to results of previous censuses indicate an annual population growth rate of 1.8 percent during the 1985–2004 period, which was a decline from the 2.3 percent annual rate reported for the 1974–1985 period [3].

According to the Demographic and Health Survey (DHS) of 2008, traditional surveys and compilation of maternal mortality estimates was determined by answers from a questionnaire presented to siblings for information on the health and status of their sisters [4]. The method of ascertaining the statistics was based on the United Nations model. Sierra Leone adopted to convert the statistics to maternal mortality ratio (MMR), expressed per 100,000 live births, by dividing the rate by the general fertility rate associated with the same time period. This brings out the obstetrical risks of pregnancy and childbearing. Using this method, the MMR was estimated to be 857 maternal deaths per 100,000 live births for the period 0-6 years preceding the survey. The estimated age-specific proportions of deaths due to maternal causes for the period 2001-2008 display a plausible pattern, being higher for age group 30-34, when more than four in ten deaths (41%) were related to maternal causes. Unlike the other measures of mortality presented earlier, these proportions are not affected by under reporting because it can be assumed that under reporting does not affect maternal deaths any more than deaths due to other causes. Therefore, it can be estimated that about more than one in four deaths (27%) among women of childbearing age (15-49) was due to maternal causes [4, 5] (Table 1).

Table 1: Maternal mortality

Maternal mortality rates for the period 2001 to 2008, based on the survivorship of sisters of survey respondents, Sierra Leone 2008 [4, 5]

Age groups (yrs)	Maternal deaths	Years of exposure	Mortality rates (%)	Proportion dying of maternal causes
15 – 19	21	12,094	1.7	29.3
20 – 24	19	13,239	1.4	26.6
25 – 29	19	12,633	1.5	28.2
30 – 34	24	10,135	2.3	41.2
35 – 39	9	7,382	1.2	20.5
40 – 44	4	4,230	0.9	11.3
45 – 49	1	2,368	0.5	10.0
15 – 49	97	62,082	1.5	27.1
General Fertility Rate (GFR)*			173	
Maternal Mortality Ratio (MMR)**			857	

*Age adjusted

**Per 100,000 births; calculated as maternal mortality rate divided by the general fertility rate.

The direct estimates of maternal mortality obtained from reports of sister survivorship are presented in Table 1. The number of maternal deaths among women age 15-49 is estimated at 97 for the period 0-6 years preceding the survey. Age-specific proportions dying of maternal causes display, with the exception of the age group 15-19 a consistent pattern, increasing with age, up to age 30-34, then decreasing in the older age groups. Given the relatively low number of events, the method used was to estimate a single rate corresponding to the reproductive years. The estimate for all mortality due to maternal causes, expressed per 1,000 women-years of exposure to maternal risk, is 1.5 for the period 2001-2008 [4, 5].

The Office of the First Lady, undertook the advocacy campaign to reduce the mortality rate in Sierra Leone. The Office was supported by the UNFPA. The Agency's Communication office under the consultancy of Isa Blyden initiated the production of a film documentary to explore and document the causes of maternal deaths in Sierra Leone and what interventions had been made.

Five districts were selected: Bo (South), Koinadugu (Northwestern), Bombali, Tonkolili (North), Western Urban and Rural Area (Western Peninsula including the Capital Freetown).

The Maternal Health Facilities:

The Ministry of Health and Sanitation is the major health care provider in Sierra Leone. The Ministry operates all government health facilities in the country. The public delivery system starts from the peripheral health units, which include the Community Health Centres (CHC) at chiefdom headquarter towns and Community Health Posts (CHP) and Maternal and Child Health Posts (MCHP) in other villages within chiefdoms. The next level comprises hospitals at the district headquarter towns. The third level of care is provided in hospitals at the regional headquarter towns. There are two national hospitals – the Connaught Hospital and the Princess Christian Maternal Health Hospital.

Our objectives were to collect information, conduct interviews of maternal death incidents from local health authorities in these districts or village communities, indicated causes of maternal mortality, the age of the women, infant mortality resulting from such deaths and the prevalence. We visited the hospitals in district headquarter towns, Community Health Posts and Maternal Child Health Posts in villages within chiefdoms and hospitals in regional headquarter towns, in north and southern districts.

The population of the districts according to the 2004 census data was as follows:

Population for North, South Districts and Western Urban area: Tonkolili: 347,197; Bombali: 606,544; Koinadugu: 409,372; Bo: 575,478; Western Rural: 444,270 and Western Urban: 1,055,964.

District Maternal Health Units and Hospitals visited and documented:
Magburaka Government Hospital, Tonkolili District; Government Hospital in Makeni Town; Kabala Government Hospital; Bo Government Hospital; Princess Christian Maternal Hospital, Freetown; Goderich Maternity Clinic at Funkia; Tokkei Community Health Center; Maternal child health posts in Magbasse, Tonkolili and in Bombali.

The health facilities we visited varied in size and resources.
Magburaka Hospital in Tonkolili District had poor infrastructure. The Pediatric wing for example, though well staffed with a pediatrician, chief and assistant nurses, did not have enough beds; sanitation was poor and we were informed that infant mortality was often prevalent. The Maternity ward had seven beds, an operating theater and post-operating room. It was served by one obstetrician and two nurses. No midwife was present. Electricity was provided by a small generator. The number of beds was inadequate.

In Magbasse Village, the maternal child health post was a devastated structure that lacked water, utilities and equipment for delivery. It was manned by a station nurse. It had one station nurse, in a devastated structure to which women were required to attend for delivery. It lacked beds, equipment and was unsanitary.

Bombali District - In Makeni Town, we visited Makeni Hospital. It was better equipped, sanitation was better. When asked whether they had had incidences of maternal mortality, we were informed there had been none. The Swedish-run maternity hospital was operated by a rotating European staff. It had a total of 35 beds and received women for delivery from remote rural areas and nearby Makeni Town. The head of the section informed me that cases of maternal death had been reported. During the time of this filming, there had been five maternal deaths caused in part by malaria.
The Maternal Child Health Post in Gbendembu Village outside of Makeni Town, that we filmed, consisted of a head nurse and a traditional (Sowei) midwife. It was an experimental intervention introduced by the UNFPA Agency that had proved successful. The goal was to encourage the attendance of the women in this rural fishing village to attend the clinic. Because of the traditional midwife, more deliveries were done and complicated cases were taken by an ambulance (supported by UNFPA) to Makeni

Hospital. The successful traditional midwives were selected for training in nursing and midwifery in the formal health sector.

Koinadugu District Kabala Government Hospital:

The Government Hospital in Kabala Town is twenty miles away from Fadugu and surrounding villages where there is a prevalence of multiple birth pregnancies. Women with complications during traditional delivery will walk to the hospital or are transported at the expense of the chief of Fadugu. When we arrived at the maternity ward, we encountered a situation in which a 35 years old woman had delivered triplets. She was emaciated from loss of blood and could not afford the fee of 60,000 Leones (USD 15) to get blood from the blood bank. Her relatives that had accompanied her over fifteen miles from her village did not believe in giving blood. We paid for the blood and it was administered (she received the blood transfusion). However, we were later told that the patient and one of the triplets died. The two babies were adopted by the District Medical Officer. The UNFPA took over the support and education of the twins.

Kasumpeh is a hilly village about sixteen miles from Kabala Town and the government hospital. It is very rural and isolated. A maternal child post constructed by National Commission for Social Action (NACSA) during the civilian restoration period stands intact and empty. No doctor or midwife has ever reported for duty. The villagers are dependent on traditional healing and medicine. One traditional midwife serves ten surrounding villages in addition. Being unskilled in the rare case of a hemorrhaging patient is her only challenge. She reported that she did not have a high maternal death rate. The women interviewed explained they had not means of transportation to take them to the maternity clinic located at the foot of the hill, and carrying women in labour on the backs of their husbands often resulted in loss of blood and even death. Many of them could not afford the fee of 10,000 Leones (USD 3) to pay the hospital.

Bo Government Hospital, Bo District:

The hospital was old but well kept. It has had some intervention from UNFPA Agency. The maternity ward received a considerable adolescent population of women from the surrounding villages and communities. Some came in with serious sepsis or malnutrition. There was one Gynecologist /Obstetrician serving the entire District. The obstetrician stated that the challenge facing district health institutions was being under the direction of a centralized health administration that operated from the Capital. It impeded the flow of emergency response, delayed medical supplies and deliveries. He reported that he did not

encounter many incidents of maternal deaths at the hospital. Those that occurred he explained were from women who had come in from remote rural areas presenting with fatal illnesses such as, Lassa Fever or Malaria.

A maternity clinic at Yamaha run by the Belgians (MSF-B) would not entertain a request for interview and filming. The clinic was noted for receiving considerable number of women who died in childbirth.

A community health post we visited in the Bo environs was clean and sanitary. It was run by two nurses. The head nurse explained that there was no ambulatory service; women in labour were taken by motorcycle to the hospital. The post received a population of adolescent (16-19) who dropped out of school opting for pregnancy as a means of gaining status in their community. No maternal deaths were reported.

The Western District, Freetown Peninsula:

The Princess Christian Maternity Hospital and Ola During Children's Hospital in 2009-2010 was newly renovated by the Japanese International Cooperation Agency (JICA). It served the female population in the capital and its immediate environs. The hospital complex also has a nursing school that trains midwifery and nursing. There had been no recorded maternal deaths in the period we were documenting.

In the Western Rural Area beginning with Lumley Maternity Clinic and the Goderich Maternity clinic at Funkia, service and human resource though available, shortages of basic items and restrictions impeded effective delivery of services. The Maternity Center at Lumley was much better facilitated than that of the Goderich Maternity Center which had dilapidated construction, poorly equipped interior and only three beds to serve the area we filmed. There was only one delivery room. It was staffed with a senior midwife and three nurses. The Tokkei Mother Child Post clinic was usually busy during vaccination periods.

SUMMARY OF FINDINGS:

Common findings in all the district health service centers we visited and filmed were: A collapsed health infrastructure inadequate number of maternity clinics serving the rural population; a rigid centralized health administration; poor water supply; inadequate public and maternal health education; difficult outreach to remote rural areas; Disconnect between the centralized and district health administration;

Inadequate number of beds; No recording mechanism of maternal deaths was available; Irregular inspection by the Ministry of Health of its district health service centers; Women in the rural areas who opted for traditional midwifery and maternal care were safer and ran less risk of maternal death; Women in the rural areas

who attended government health centers were at risk of maternal death;

The causes of maternal deaths appeared to result from poor health infrastructure and services. Non-existent ambulatory care and service for women in labor; Distances of village communities or remote rural areas from the main maternity hospital made it difficult, particularly in the rough, hilly and mountainous terrain of Koinadugu District for outreach services; Blood banks in the hospitals lack sufficient blood; Acute shortage of Obstetricians and Midwives serving in the districts.

CONCLUSION:

In April 2010, the President launched the Free Health Care Act for Pregnant Women, Lactating Mothers and children under five. Women in this category now have access to free health care for themselves and children under five. It has increased the number of women in rural communities who go to maternity clinics or hospitals for delivery. However problems of corruption and theft have arisen during distribution of medical supplies to the district hospitals and peripheral health units. An ambulatory service now exists in Kabala Town, and other environs. Since the completion of this project and production of the film, some improvements have been made by the Health Ministry services in district rural areas. However maternal death figures have continued to rise. Thus there is an urgent need to advocate for the allocation of resources to significantly improve the maternal and child health status in the country.

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A COMMUNITY BASED CROSS SECTIONAL RAPID SURVEY IN FIVE DISTRICTS IN BIHAR INDIA TO ASSESS ROUTINE IMMUNIZATION STATUS AND REASONS FOR DROP-OUTS

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ABSTRACT:
The aim of the study was to assess the status of routine immunization status and reasons for drop-outs in five districts in Bihar India. A community based cross sectional rapid survey in five districts in Bihar was undertaken from 11th January to 5th February 2013. Of the 38 districts in Bihar, 5 districts prioritized by the state government for intensive routine immunization support were selected purposively for the rapid assessment. Samples of primary health centres, Health sub centres, villages were chosen for the study using geographic and performance criteria. Twenty households having babies 0 to 36 months old from each village were randomly selected. A total of 7,500 households were taken from the 5 study districts. Apart from household survey, cold chain points where vaccines are stored and vaccination session sites were also assessed for service delivery and community participation. The assessment findings revealed high access resulted in good coverage of the initial vaccination such as BCG and DPT1, while low utilization due to drop out of children from DPT1 to DPT3 (15%) and BCG –measles dropout (27%). The coverage was inequitable, with 12% difference in full immunization among children below poverty line and scheduled caste and tribe children. The reasons for low vaccination coverage were both related to demand and supply side. Lack of awareness on immunization, lack of correct information about the place and time of immunization, illness of the child at the time of immunization session, irregular session timing and fear of adverse effects were found to be the major causes for almost 60% of households. The health staff ascribed it mainly to erratic supply of vaccines and logistics, poor planning, insignificant role of media or past experience of Adverse Effect Following Immunization (AEFI) as major causes. Based on the assessment of cold chain and vaccination session facility and key informant interviews, it was recommended that special emphasis should be given to due list preparation and tracking of beneficiaries using local volunteers, self-help groups and mobilizers especially in hard to reach areas. In addition, to ensure regular vaccine and logistic availability, Microplanning to include disadvantaged communities like Scheduled Caste (SC)/Scheduled Tribe (ST) & Below Poverty Line (BPL) households and intensive monitoring using both internal and external supervisors for regular monitoring of the routine immunization activities

Keywords: Vaccination left out, drop outs, inequity, immunization

INTRODUCTION:

India's attainment of the Millennium Development Goal (MDG) 4 in 2015 reducing the Under Five Mortality Rate (U5-MR) of children critically depends on large and the performance of poor states like Bihar, Uttar Pradesh, Madhya Pradesh and Rajasthan. These States have large share un-immunized children that have negative impact in the country as a whole. The state of Bihar has total population of 100.83 million (Census 2011) and has a U5-MR of 64 per 1000 live births which is higher than national rate of 59/1000 live births [1]. Many initiatives were undertaken to improve the child survival in the state including newborn care, integrated management of childhood illnesses, under nutrition and Routine Immunization (RI). The full immunization coverage in the state increased from 10.7% in 1992 to 64.5% in 2010, still a third of children are not getting the protection from the life saving vaccines [2 – 5]. A study with focus on drop-outs from RI was undertaken to focus on drop-outs in the on-going RI programme in the State.

METHODOLOGY:

The procedure used was to conduct a cross-sectional community survey to find out the coverage and reasons behind the drop out of children, then monitoring of RI sessions to identify the service delivery bottlenecks and also to conduct key informant interviews to triangulate the findings of coverage, service delivery and reasons behind drop-outs from the RI programme.

Study area and population:

There are a total of 38 districts in Bihar (total population 103,804,637million as per Census 2011) out of which 5 districts prioritized by the state government for intensive routine immunization support were selected purposively for the rapid assessment. From each district, 5 primary health centres (PHCs) were identified (best performing-2 and poor performing-3), from each PHC, 5 Health sub centres (HSCs) (2 HSCs near from the block head quarter and 3 from remote location) were chosen for the rapid assessment. Similarly, 3 villages from each HSC were identified randomly for household survey and a total of 20 households having babies 0 to 36 months old from each village were randomly selected. A total 1500 Households (HHs) were covered from each district (1D x 5 PHCs x 5 HSCs x 3 Villages x 20 HHs). Thus a total of 7500 HHs were covered from the 5 districts. The village centre was identified first and the bottle/pen was turned to identify the direction of the first house, diagonally walk taken till the edge of the village in the same direction. Later the currency note taken to find the last digit in the note to identify the row of first house. Once the first house was identified the next house selection was done on the basis nearest next door till

reaching the sample size. A total of 7500 children aged 0-35 month were taken based on sample size of 367 for a district with 100,000 cohort size, assuming Full Immunization coverage (FIC) of 60 percent and acceptance of 5% standard error

Apart from the household survey, cold chain points where vaccines are stored in Ice Lined Refrigerator (ILR) points of each selected blocks was assessed and all session sites commencing during the time of visit amongst the 5 identified HSCs per block were also assessed for service delivery and community participation. Average population per district in Bihar is 2.73 million, whereas all districts selected for the survey were in the range of 3.03 to 4.37 million (11% to 60% more than the average population). Gaya (29.6%) and Vaishali (20.7%) districts have more than state average (15.7%) of SC (Scheduled Cast) population. Similarly ST (Scheduled Tribe) population is higher in Purnea (4.4%) and Bhagalpur (2.3%) than state average (0.9%) and is negligible in the other 3 districts. Except Gaya and Purnea, sex ratio is very low in the other three districts as compared with the state average. Female literacy is lower in Purnea (43.19%) and Darbhanga (46.88%) than state average of 53.3% (Table 1).

Data collection and analysis:

The study was undertaken from 11th January to 5th February 2013. Data entry was done at district level whereas analysis was done at UNICEF Field Office. During the preparatory phase finalization of study protocol along with the survey instruments using monitoring formats used by Government of India i.e. Household, Session site and ILR point monitoring formats were used.

UNICEF Routine Immunization coordinators were involved during the process of data collection. There were 3 teams formed for each district comprising of 2 coordinators in each team and for each team 25 villages allotted for data collection. Before going to the field, meeting cum orientation of district team members along with district officials (Civil Surgeon, District Program Manager and District Immunization Officer) were arranged and the processes and methodology were discussed.

In the selected households, children below 3 years of age and their mothers were included as study subjects after getting their informed consent being explained regarding purpose and nature of the study. In case the selected household declined, the immediate neighbor, nearest to doorstep of the present house was given the chance to be included. The help of Accredited Social Health Activist (ASHA) and Anganwadi workers (AWW) was taken to build a good rapport for the interview. The various study variables used for data collection were Age, Sex, Religion, Caste, Immunization status, Literacy status of parent, Occupation status of parent, Place of delivery.

The data was analyzed using Epi Info™ 7 (7.1.2) software. The following process and

output indicators were considered with an attempt to interpret an approximate picture of the situation on RI situation in the five districts and generalize the same situation all across the state: Coverage; Status of Full Immunization; Antigen wise coverage; Community Awareness and Mobilization; Due list preparation; Involvement of ASHA and AWW; Availability of vaccines and logistics.

RESULTS:

The profile of the respondents (Table 2) revealed that majority of the study populations were from Hindu (84.2%) community followed by Muslim (15.8%). Caste wise Other Backward Caste (OBC) accounts for the highest (40.8%) followed by SC (34.0%), General (21.7%) and ST (2.2%). The children in the 0 to 11 months, 12 to 23 month and 24 to 35 month age groups accounts for 34.9%, 33.3% and 31.8% respectively. Gender wise most of the children up to 3yrs of age were male (52.8%) and majority of the households assessed belongs to Below Poverty Line (BPL) category (60.9%).

Inequity in coverage:

Overall BCG coverage was highest in the general caste category, which was 100% followed by OBC (98%) and SC/ST (96%). Similarly, Antigen wise individual vaccine coverage was also more in the general category followed by OBC then SC/ST. Overall fully immunization coverage was highest among the general category, which was 69% followed by OBC category (63%) and lowest seen in the SC/ST category (58%) population. Fully immunization coverage and antigen wise individual vaccine coverage was assessed amongst the study subjects of 12 months to 23 months old children. Gap in fully immunization coverage between General and SC/ST category was as high as 11%. Religion wise, individual vaccine coverage was more in the Hindu community than the Muslim community and the overall fully immunization coverage was 64% for Hindu and 63% for Muslim community. Individual vaccine coverage between APL and BPL was found more in the APL category than the BPL category. Overall fully immunization status for APL family was 70% and BPL family was 58% (Table 4)

Dropout rates: The difference in immunization coverage between the first and the last dose of the same vaccine (e.g., between DTP-1 and DTP-3) was above 10 percent except in Purnea where it was found to be 7%. The drop out between BCG and Measles (the first and last dose of the schedule under one year) was above 20% with highest of 34% in Dharbhanga district (Table 5).

Table 1: Profiles of the districts under study

		Bihar	Gaya	Bhagalpur	Vaishali	Darbhanga	Purnia
1	Total population (Census 2011) (in millions)	103.8	4.37	3.03	3.49	3.92	3.27
2	% to total population of the state	100.0	4.22	2.92	3.37	5,78	3.15
3	Rural population (%)	89.5	86.3	81.3	93.1	91.9	91.3
4	Schedule Caste population (%)	15.7	29.6	10.5	20.7	15.5	12.3
5	Schedule Tribe population (%)	0.9	0.1	2.3	0.1	0	4.4
6	Minority (%)	16.6	11.6	17.5	17.4	22.7	10.1
7	Sex ratio (no. of females per 1000 males)	916	932	879	892	910	930
8	Female literacy rate (%)	53.33	55.9	56.49	59.1	46.88	43.19

Table 2: Characteristics of the studied sample (n = 7500)

	Number (%)
Religion – HINDU	6314 (84.2%)
Religion – MUSLIM	1184 (15.8%)
Religion – OTHER	2 (0.03%)
Total	7500
Scheduled Caste (SC)	2550 (34.0%)
Scheduled Tribe (ST)	164 (2.2%)
Other Backward Caste (OBC)	3057 (40.8%)
General Caste (GEN)	1729 (23.0%)
Total	7500
Age of the child- 0 to 11 month	2617 (34.9%)
Age of the child- 12 to 23 month	2498 (33.3%)
Age of the child- 24 to 35 month	2385 (31.8%)
Total	7500
Sex of the selected Child – Male	3957 (52.8%)
Sex of the selected Child – Female	3543 (47.2%)
Total	7500
Socio economic status – Above Poverty Line (APL)	2930 (39.1%)
Socio economic status – Below Poverty Line (BPL)	4570 (60.9%)

Table 3: Antigen wise coverage and Full Immunization Coverage (FIC) of the five districts among children 12 months to 24 months (all values are in percentages)

	BCG	OPV 0	DPT 1	DPT 2	DPT 3	OPV 1	OPV 2	OPV 3	HEPB 1	HEPB 2	HEPB 3	Measles	FIC
Gaya	97	53	95	89	80	89	81	75	72	62	56	71	59.3
Vaishali	97	58	96	92	86	81	76	68	60	54	48	76	52
Dharbanga	97	52	93	86	78	83	74	69	36	40	30	63	62
Bhagalpur	98	64	96	93	89	89	86	56	68	52	45	76	63.5
Purnia	98	70	96	93	84	91	86	79	71	65	59	73	68

*FIC: BCG OPV1 2 3 DPT1 2 3 Measles

Table 4: Equity in coverage

	Percentage of children immunized among children of different Socio-Economic Status (SES), Caste and Religion							
	SES		Caste			Religion		
	APL	BPL	OBC	SC&ST	GEN	Hindu	Muslim	
BCG	99	96	99	96	100	98	97	
DPT3	86	81	86	81	87	85	82	
OPV3	76	66	76	66	77	73	69	
Measles	77	68	77	68	77	74	70	
FIC	70	58	70	58	69	64	63	

Table 5: Percentage of Dropout rates

Dropout rate	Vaishali	Bhagalpur	Purnea	Gaya	Dharbhanga
DPT1-DPT3	10	7	12	15	15
BCG-MEASLES	21	22	25	26	34

Antigen wise coverage:

Figure 1 shows the immunization coverage of all the individual vaccines and fully immunization coverage of Bihar amongst 12 to 23 month old children indicated by various standard surveys and the present rapid assessment survey. As far as antigen wise coverage is concerned, BCG was found to have the highest coverage (97.4%) as against the lowest coverage of OPV3, which was 70.8%. Between the findings of AHS-2011 and the present study, the difference in individual vaccine coverage is statistically insignificant ($p>0.5$ for each individual vaccine). Coverage

of BCG and DPT3 was found to be higher than the findings of the present study whereas coverage of OPV3 and Measles was less in the present study. Fully immunization coverage is 63.6% in the present study which is 0.9% less than that of the AHS-2011 report (64.5%) for Bihar (Figure 1).

Antigen wise coverage of five districts among the children aged between 12 to 36 months is shown in table 2. BCG coverage is above 90% in all the five districts, DPT3 coverage above 80% except the Dharbhanga district which is 78%. Measles coverage is 60% to 70%; OPV Zero dose coverage is 50% to 60% except in Purnia where it is 70%. HepB 3 coverage less than 60%.The full immunization coverage (BCG, DPT1 2 3 and measles) is 59.3%, 52%, 62%, 63.5% and 68% in Districts Gaya, Vaishali, Dharbanga, Bhagalpur and Purnia districts respectively (Table 3)

Reasons for partial or no immunization:

There were 3341 children out of 7500 children surveyed who were unimmunized or partially immunized, their parents were asked questions to find the reasons for not getting the children vaccinated. The reasons categorized either due to supply side issues or in demand side. The results are presented in Figure 2. The major reasons as described by the parents for non-immunization were unaware about immunization (24%), did not know when to get vaccination (19%) and child was sick (11%), unavailability of vaccine was also figured out in 10% of responses. Inconvenient timing and location of session and fear of side effects were found to be common causes for both partial and un-immunizations.

BCG mark present in left deltoid area:

BCG scar mark over the left deltoid area was present during examination in an average of 89.2% children across all five districts against 97.4% of total BCG coverage. The reason for absence of scar mark in 7.2% babies aged less than 12 weeks was because the scar mark was not yet developed in them. However in the rest of the cases (1%) among babies above 12 weeks of age with no scar mark the reason was either due to faulty technique or inadequate immunological response. The highest BCG rate was found among children of Bhagalpur district (93%) followed by Purnea (90%), Gaya (89%) and Vaishali (85%) and Darbhanga (85%).

Retention of RI / Mother and Child Protection (MCP) card:

Retention of RI card by the parents during the time of field visit was better in Bhagalpur and Vaishali (87% each) and Purnea (83%), but poor in Darbhanga (71%) and lowest in Gaya 59%. The major reasons of non-retention of RI cards in Gaya were either the cards were not provided by the Auxillary Nurse-cum-Midwife (ANM) (19%), or the card was lost (16%) and in 4% of cases, the card was under lock and key and the head of the household was not present during the time of visit. Similarly, major reason

for non-availability of RI card in all districts (except Gaya), was due to loss of card followed by card being not provided by ANM.

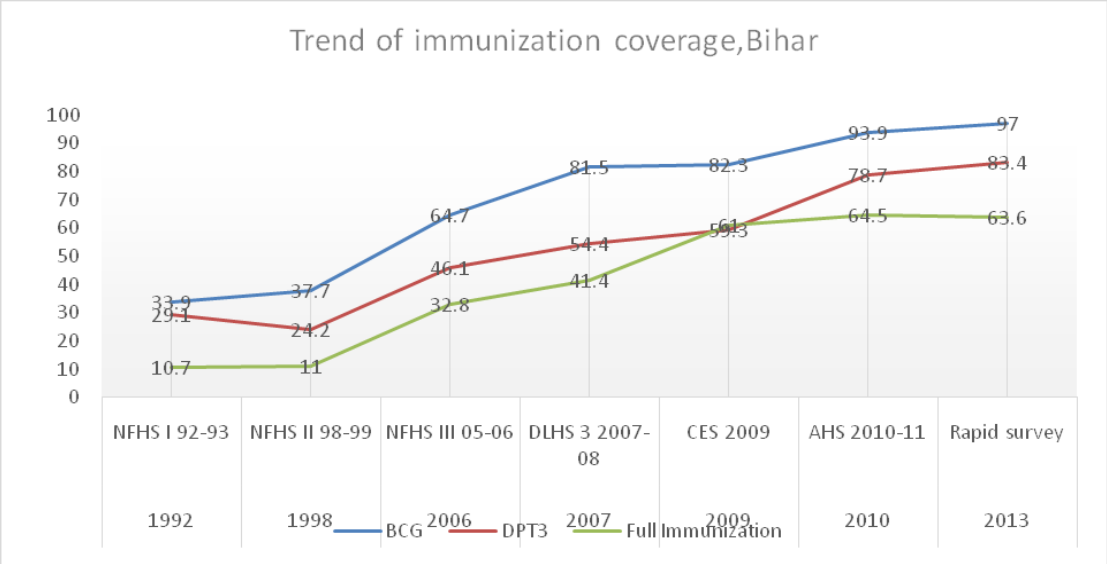
Vaccine availability at the session site:

Availability of BCG, t-OPV, and Hepatitis B vaccines were inadequate in all the districts during the time of visit to session sites. Subsequently the ILR points and District Vaccine Stores were crosschecked for the stock position of vaccines but adequate storage of vaccines for the next four weeks was not observed in any of the five districts reviewed under the rapid survey. Hepatitis B was out of stock for the last one month in Gaya district.

Due lists availability:

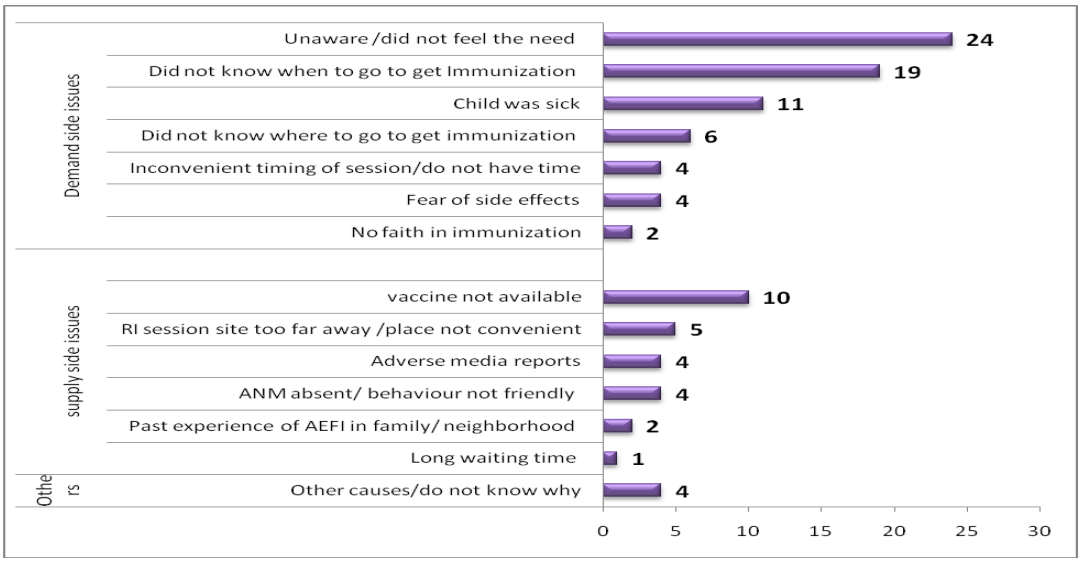
Out of all the session sites visited, the due list was found in only 27% of the districts in form of a freshly written list prepared by the ANM in consultation with ASHA /AWW. In 56% of the sessions, markings in the Mother and Child Health (MCH) register were done for mobilization of beneficiaries. But the area of concern was that in 17% of the session sites the due list was totally absent.

Figure 1: Immunization coverage trend Bihar state



Refs: 1992 National Family Health Survey (NFHS) 1992-1993; 1998 NFHS: 1998-1999; 2006 NFHS: 2005-2006; 2007: District Level Household Survey (DLHS) 2007-2008; 2009 Coverage Evaluation Survey (CES) 2009; 2010- Annual Health Survey (AHS) 2010-2011

Figure 2: Reasons for partial or no immunization (N 3341) in percentage



DISCUSSION:

High initial utilization: BCG coverage of 97% and DPT1 coverage of 93% with evidence of BCG scar were present in 89.2% of the total children surveyed. Similarly AHS 2012-13 report for Bihar also depicts BCG coverage of 94.7% [9]. Early utilization of vaccination has shown good improvement in the vaccination programme in the state [6].

High Drop outs: DPT1-DPT3 dropout of 15% and BCG –measles dropout of more than 27% are the consistent findings in all the five districts; this is one of the main reasons for partial immunization and incomplete protection of children in these districts. Though the dropout proportion has been showing improvement as compared to the CES-2009 report for Bihar in which the dropout rate mentioned was quite high (DPT1-DPT3 dropout was 23.9% and BCG –measles dropout more than 29.3%) [2], yet the programmatic direction should now focus on reducing drop outs.

Inequity in coverage: Children in families BPL and families of as scheduled castes and tribes are more prone to missing the vaccination (Fully Immunized Children difference of 12%). Hence programmatic direction again needs to be focused on these demographic profiled families [7, 8].

Reasons for the partial and no vaccination: The reasons for left out and drop out, as ascertained by the parents, can be ascribing to various issues related to both demand and supply side. Lack of awareness on immunization, lack of correct information about the place and time of immunization, illness of the child at the time of immunization session, irregular session timing and fear of adverse

effects were found to be the major causes for almost 60% of the people. On the contrary, the health staff ascribed it mainly to erratic supply of vaccines and logistics, poor planning, insignificant role of media or past experience of AEFI as major causes for poor immunization coverage. The major causes for partial and non-immunization due to the demand and supply side issues identified in our study remained more or less the same or similar when compared to the findings of CES-2009 and AHS 2012-13 [2, 9].

Continuous supply and availability of vaccines at the session sites: The issues on vaccine forecasting at each level and maintaining minimum stock level, buffer stock and reorder level need to be practiced at the state and district and PHC levels. Poor stock management practices are contributing to drop outs and missing the age appropriate dosages of vaccines for the children.

However, adequate supply of vaccines was not up to mark in any of the districts studied, which was validated through the observations during the visit to session sites. BCG, t-OPV, Hepatitis B vaccines were found inadequate in most of the session sites in all districts and more importantly in the district of Gaya where none of the vaccines was adequately available for 2 months and there was no stock of Hepatitis B.

Coordination among ASHA, AWW and ANM were key front line workers in creating awareness on immunization whereas Panchayat Raj Institutes (PRI), Self Help Group (SHG) and others have least role in bringing awareness among the mothers. Proportion of community awareness on immunization was found to be encouraging. Approximately 91% of the people interviewed were found to be aware of immunization in all these five districts with highest proportions in the district of Vaishali and the least in Gaya.

Use of duelist was found to be a grey area in almost all districts. Out of 52 session sites visited during the data collection, an average of only 20% ANMs and 22% mobilizers were found to have used duelists. In none of the session site in the district of Bhagalpur district was the duelist utilized either by the ANM or by the mobilizer. Similarly, no ANM in Darbhanga was found using duelist. Another important observation was that 65.6% of immunization sessions were held at the VHND sessions. In Purnea district 90% of the session sites were synchronized with VHND, whereas Gaya was found having the least (36%) session sites being synchronized with VHND.

RECOMMENDATIONS:

The assessment was carried out in five districts of Bihar, identified as program priority by the state government. Based on the findings of household survey, cold chain and session site facility assessment and key informant interviews, it is recommended that:

1. Special emphasis is needed for reducing Dropout rate through social mobilization by involving the Self Help Groups apart from the regular mobilizer, due list preparation

and utilization, tracking of beneficiaries, coverage of hard to reach areas and developing immediate plan for the missed sessions.

2. Ensuring uninterrupted and adequate vaccine and logistic availability at the ILR points and session sites with orientation to the vaccinators on effective vaccine management.
3. Emphasis has to be given on equitable immunization coverage. To bridge the gap, the disadvantaged communities like (SC/ST & BPL households) need special focus initially by accommodating them in the micro-plan and providing special outreach and hard-to-reach services.
4. Increasing the awareness in the community about the importance of immunization by extensively involving the VHSC, teachers, SHGs, religious leaders and also the media.
5. Building capacity of the vaccinators on preparation of micro-plan (with focus on hard to reach, missed session and disadvantage groups), tracking of beneficiaries by preparing due list, Effective Vaccine Management, Injection safety, proper biomedical disposal of waste, record keeping and identification of adverse events following immunization.
6. Involvement of both internal and external supervisors and managers for regular monitoring and supervision of the routine immunization activities

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ASSESSMENT OF AFLATOXIN M1 IN BREAST MILK OF LACTATING MOTHERS IN PAPUA NEW GUINEA

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ABSTRACT:
Aflatoxin M1 (AFM1) is a secondary metabolite in the breast milk of lactating mothers who consume foodstuffs infected by the fungi *Aspergillus flavus* and *Aspergillus Parasiticus*. The concentration of AFM1 in breast milk of lactating mothers is of major public health concern, because it can negatively affect the health of their babies. The major objective of this study was to assess the AFM1 concentration in the breast milk of lactating mothers in Papua New Guinea (PNG). This was a prospective cross-sectional study carried out between 2011 and 2015 in three of the four Regions in PNG: the National Capital District (NCD) in the Southern Region; Eastern Highlands (EHP) and Western Highlands (WHP) provinces in the Highlands Region; and East New Britain (ENB) and Manus provinces in the Islands Region. The Susu-Mama, Well-Baby and Paediatric clinics in the General Hospitals in each of the selected provinces in the three regions were the primary sites for this study. A solid phase competitive Enzyme-Linked Immunosorbent Assay (ELISA 96 Microwell plates) was used for the quantification of AFM1 in breast milk from consented lactating mothers. A total of 874 lactating mothers and their babies participated in this study. The mean age of the mothers was 28.0 ±5.5 years. The age range of all the babies was 2 to 6 weeks. 76.1% (665/874) of all breast milk samples analyzed had detectable levels of AFM1. The concentration of AFM1 was above 10.00ppt in 89 (10.2%) of the 874 breast milk samples (which, according to the Australia / New Zealand / Austria safe cut-off limits for AFM1, makes them unsafe for consumption by the babies). The mean AFM1 concentration in the breast milk samples from lactating mothers in EHP (7.99ppt) was higher than that in the samples from the other 4 provinces in the present study. AFM1 concentration was above 10.00ppt in 14 (4.6%) of the 300 breast milk samples from NCD, in 62 (31.0%) of the 200 samples from EHP, in 10 (4.5%) of the 220 samples from ENB and in 3 (3.0%) of the 100 samples from WHP. In order to reduce the AFM1 concentrations in breast milk of lactating mothers, basic nutrition education, aggressive advocacy, social mobilization, awareness campaigns, including communication with all relevant target groups and the relevant policy makers are urgently required.

Keywords: Breast milk, Aflatoxin, Aflatoxin M1, Lactating mothers, Papua New Guinea

INTRODUCTION:

Mycotoxins are toxic metabolites produced by fungi. One of their major functions is protection of the environment of the fungi [1]. Aflatoxin (AF) is one of the most widely occurring mycotoxins produced by the fungi, *Aspergillus* species that grow in a variety of food crops in temperate climates during storage. AF is a secondary metabolite of the frequently occurring *A. flavus*, *A. parasiticus* and *A. Nominis* [1 – 3]. Other AF-producing Aspergillus species that are encountered less frequently are *Aspergillus bombycis*, *Aspergillus ochraceoroseus* and *Aspergillu spseudotamari* [4 – 6]. There are over 30 Aflatoxins already identified [7, 8]. The specific Aflatoxins that are of public health concern and are, therefore, monitored in the food chain, are Aflatoxin B1 (AFB1), B2 (AFB2), G1 (AFG1), G2 (AFG2) and M1 (AFM1) [7, 8]. Aflatoxin B1 (AFB1) is the most toxic, compared to all the others [3, 4]. AFB1 is metabolized to Aflatoxin M1 (AFM 1) in the liver, and is then excreted in the breast milk of any lactating mammals (including humans) that consumed foods contaminated by AFB1 [5, 8, 9]. Thus, AFM1 is a biomarker of recent dietary exposure of lactating mothers to AFB1 contaminated foodstuffs. AFB1 and AFM1 are classified as class 1 human carcinogens by the International Agency for Research on Cancer (IARC) [3, 10, 11]. They are hepatotoxic, carcinogenic, mutagenic, teratogenic and immunosuppressive. AFM1 causes birth defects, malnutrition and growth retardation in neonates [3, 5, 7, 10, 11].

Some common foodstuffs contaminated with AFB1 are peanuts, maize, cottonseeds, grains, rice, cassava, cereals, sago, coconuts, ginger, dried fruits, wheat and chillies [10 – 13]. These are foodstuffs frequently consumed by humans. Some of these foodstuffs are the staple foods in most countries worldwide. AFB1 contamination of food crops may occur before harvest and during storage [13, 14]. Postharvest Aflatoxin contamination may occur when the crops are not properly treated during the drying and storage processes. Some of the important factors that should be considered during storage include the moisture content of the crops and the relative humidity of the surroundings [13 – 17]. The favorable conditions for growth of the Aspergillus fungi are storage temperatures between 27°C and 35°C and moisture content exceeding 7.0% (10.0% with ventilation) [13 – 17]. Timely harvesting of crops, rapid and adequate drying prior to storage are important in preventing fungal growth and, consequently, Aflatoxin contamination [14 -16]. AFB1 contamination is particularly severe in resource limited countries in Asia, Africa and the South Pacific, where

there is little consumer awareness of food safety issues related to Aflatoxins [5, 13].

The levels of Aflatoxins considered safe for human consumption, vary from country to country. In most developed countries, the generally acceptable levels range from 0 to 30.0ppb [17 – 19]. The Codex Alimentarius Commission (CAC) has established a limit of 15.0ppb for total Aflatoxins in all foods worldwide [17 - 19]. However, some countries and organizations have set their own cut-off limits. These levels are to be monitored by consumer protection agencies that regulate the importation of foodstuffs [17 – 19]. The upper limit of AFM1 in breast milk is set at less than 0.05ppb (50.0ppt) by the CAC and the European Community [17 – 19].

In some resource limited countries like Papua New Guinea (PNG), although the legislation is in place to regulate the AFB1 levels in foodstuffs, the laws are not strictly implemented. According to reports from the CAC, most people living in resource limited countries are typically exposed to Aflatoxins in their diets, largely because their locally produced food crops are not effectively monitored to ensure proper implementation of guidelines for harvesting, drying and storage [18, 19].

In 1972, of the 20 food samples collected from Kundiawa, Kaiapit, Koki, Lae, East New Britain (ENB) and Markham Valley in PNG, 16 (80.0%) were contaminated with AFB1 [20]. In surveys, conducted in 1996 and 2002 by the National Agricultural Research Institute (NARI), 34.4% of the foodstuffs collected from markets in Western Highlands, Sepik, Morobe, East New Britain (ENB) Provinces and the National Capital Districts (NCD) were contaminated with AFB1 in levels between 5.0 to 20.0 ppb [21]. In a recent study, AFB1 contamination of foodstuffs was reported in some major cities in PNG [22].

Despite the cumulative evidence of the prevalence of AFB1 contaminated foodstuffs in the various provinces, there is no published data on the AFM1 levels in the breast milk of lactating mothers in PNG.

Breastfeeding is a common practice in most of the provinces in PNG; thus, there is a high risk of exposure of neonates to AFM1 in the breast milk of lactating mothers, if they have consumed AFB1 contaminated foodstuffs. However, breastfeeding of the neonate for the first six months of life, with continued breast feeding for up to two years of age, is very important and must be encouraged. Breast feeding promotes mother-child relationship and guarantees the effective growth and development of the infant by providing adequate nutrients and the required antibodies for control of infections [23]. There is, therefore, the need to regularly assess the AFM1 concentration in the breast milk of lactating mothers, in order to obtain data that can be

used for formulation of policies and programs for the systematic monitoring of Aflatoxin levels in foodstuffs in PNG.

The major objective of this study was to assess the AFM1 concentrations in breast milk of lactating mothers in PNG, using breast milk of lactating mothers resident in three of the four regions in PNG.

METHODOLOGY:

Study sites:

This was a prospective study, carried out between 2011 and 2015 in three of the four Regions in PNG: the National Capital District in the Southern Region; Eastern Highlands and Western Highlands provinces in the Highlands Region; and East New Britain and Manus provinces in the Islands Region. The Susu-Mama, Well-Baby and Paediatric clinics in the General Hospitals in each of the selected provinces in the regions were the primary sites for this study.

Study Design and Sampling:

This was a prospective hospital out-patient based cross-sectional study, because of the difficulty obtaining ethical clearance and permission to collect biological samples from healthy individuals in PNG for research. All lactating mothers that attended the Susu-Mama clinics for guidance on breastfeeding of their babies, and those that attended the Children's Outpatient clinics including the Well-baby clinics for routine check-up and vaccination during the study period were eligible for enrolment. Simple random sampling, using a table of random numbers, was used to select the lactating mothers that participated in this study.

Exclusion criteria:

Lactating mothers with malaria, high fever, any other significant illness and those with infants admitted in the paediatric wards were excluded from the study.

Collection of breast milk samples and questionnaires:

Each of the selected lactating mothers was briefed on the purpose of the study, before asking her or the accompanying relative to read and to sign an informed consent form. The mothers were at different stages of lactation. The consented lactating mother was then requested to donate about 5.0ml of breast milk during regular feeding of her baby; by hand expression the milk was put directly into a labeled sterile container. The breast milk samples were kept inside a cool-box at 4 to 8ºC, before they were moved to the laboratory in the Hospital and kept frozen in a freezer at –15ºC. All the breast milk samples from the provincial hospitals were kept frozen and transported by air to the Micronutrient Research Laboratory (MRL), in the Division of Basic Medical Sciences (BMS) in School of

Medicine and Health Sciences (SMHS) University of Papua New Guinea (UPNG). The samples were kept frozen at – 70ºC until required for analysis.

A self-designed pretested questionnaire was used to collect specific information about the lactating mothers and their babies. The information collected included, residential location, age, time of last meal eaten, type of meal eaten, type of nuts consumed regularly and knowledge of Aflatoxin. For the babies the gender, date of birth, birth weight and length were obtained mainly from the baby book.

Sample preparation and analysis:

Each of the breast milk was gradually thawed from – 70ºC to – 20ºC and then to 4ºC. They were centrifuging at 2000g for 10 minutes in a refrigerated centrifuge to induce separation of the upper fatty layer in each of the samples. The fatty layer was later removed by aspiration with sterile pasture pipette and the lower plasma used for the assay of AFM1 [24].

A commercial Enzyme-Linked Immunosorbent Assay (ELISA) from HELICA Bio-systems Inc was used for the quantification of AFM1 in the breast milk. The HELICA Aflatoxin M1 Assay is a solid phase competitive enzyme immunoassay (ELIZA 96 Microwell plates). An antibody with high affinity for Aflatoxin M1 is coated onto polystyrene microwells. When standards or samples containing AFM1 are added to the appropriate microwells, the AFM1, which is the antigen, binds to the coated antibody [24].

The complete analytical procedure, using the breast milk samples, commercial standards and quality control samples, were carried out as indicated in the instructional protocol of the manufacturer [24]. All tests were done in duplicate; a Microplate washer and multi-channel semi-automated pipettes were used as appropriate. After the addition of the stop-solution, a Microplate reader (RT-2000C fully integrated with a read-out panel) with an absorbance filter set at 450 nm and a differential filter set at 630 nm was used to measure the optical density of the microwells. The limit of detection was 2.00ppt, mean recovery was 95.5 ±2.5% and Coefficient of Variation (CV) was 3.0%. All reagents used were of analytical grade.

Data analysis and interpretation:

The statistical package for social sciences (SPSS) version 20 for Windows and Excel MS data pack software were used for statistical analysis of the data. The Kolmogorov-Smirnov test was used to assess distribution of the data; Mann-Whitney U test, Wilcoxon rank sum tests and Chi-square test (Fisher's exact test), were used as appropriate.

Currently in PNG there are no recommended cut-off limits to indicate the safe concentration of AFM1 in breast milk. In Australia, New Zealand and Austria the recommended safe

cut-off limit for AFM1 in breast milk is AFM1 < 10.00 pg/ml (10.00ppt or 10.00ng/L). The Codex Alimentarius Commission (CAC), European Union (EU) and the United States of America (USA) recommended the safe cut-off limits are AFM1 <25.00ppt for breast milk and AFM1 < 50.00ppt for AFM1 in milk powder and other milk products [3, 4, 13, 19, 25]. In the present study both recommended cut-off limits were used for interpretation of the results.

Ethical clearance:

Ethical clearance and approval for this study was obtained from the Ethics and Research Grant Committee in the SMHS UPNG, and the Medical Research Advisory Committee (MRAC), National Department of Health (NDOH) PNG. Permission was obtained from the Chief Executive Officer and Director of Medical Services of PMGH and the appropriate authorities in the various Provincial General hospitals. The significance of the study was explained to each of the selected lactating mothers. Oral and signed informed consents were obtained from each lactating mother before receiving the breast milk sample.

RESULTS:

A total of 1000 lactating mothers were recruited for this study. Consent was obtained from 900 lactating mothers, which gave a non-consent rate of 10.0%. Of the 900 breast milk collected, 26 were discarded because of spillage (10 samples), non-availability of the questionnaires (6 samples) and very small amount of breast milk collected (10 samples). Six of the 26 samples discarded were from Manus province and 20 from the NCD.

The data obtained for the 874 lactating mothers is presented as the PNG data. The mean age of all the 874 lactating mothers was 26.0 ± 5.5 years (mean ± standard deviation), the age range was 15.0 to 40.0 years (Table 1). The distribution of all the mothers according to their age groups is presented in Table 2. A total of 304 (34.0%) lactating mothers were in the 20 to 24 years age group, followed by 264 (30.2%) in the 25 – 29 years age group.

All the 874 babies were full term; their age range was 2 to 6 weeks and they were still breast feeding at the time of the visit to collect the breast milk. The mean birth weight of the babies was 3.1 ± 0.62 kg, the range was 1.3 to 4.7 kg and the median was 3.10 kg. The birth weights of 25 (2.9%) babies were below 2.0kg, characterized as Very low birth weight (VLBW); the birth weights of 53 (6.1%) were between 2.0 to 2.49kg, characterized as Low birth weight (LBW) and the birth weights of 796 (91.1%) babies were above 2.5kg, characterized as normal birth weight. The mean birth length of all the babies was 48.0 ± 4.3 cm and the range was 35.0 – 63.0 cm.

Bivariate correlation analysis was used to test the relationship between the birth weights and

birth lengths of all the babies. The Spearman's rho correlation coefficient indicated strong direct correlation between the birth weights and birth lengths of all the babies (rho = 0.378; p = 0.01, 2-tailed). This implies that the taller babies were heavier than the shorter babies.

Of the 874 breast milk analyzed, AFM1 was detected in 665 (76.1%) of them. The Shapiro-Wilk test (p = 0.0001; df = 665) indicated that the AFM1 (ppt) concentration was not normally distributed in the breast milk from the 665 lactating mothers. The box-plot (Fig. 1) of the AFM1 concentrations also indicates that the values were not normally distributed.

The summary statistics of the AFM1 concentrations in all the breast milk samples from all the mothers are presented in Table 3. The median AFM1 concentration was 4.04 ppt and the Interquartile Range (IQR) was 2.05 to 6.62 ppt.

Table 1: Some characteristics of the lactating mothers that participated in the study

	PNG	**NCD**	**EHP**	**ENB**	**Manus**	**WHP**
N	874	300	200	220	54	100
Mean age (yrs)	26.0	25.6	24.6	27.1	26.9	25.7
Standard Dev (SD)	5.5	5.6	4.9	5.7	6.4	5.1
Median age (yrs)	25.4	25.0	24.0	26.0	27.0	25.0
Age range (yrs)	15.0 – 40.0	15.0 – 40.0	15.0 – 40.0	17.0 – 40.0	18.0 – 40.0	17.0 – 40.0
AFM 1 detected in breast milk	665 (76.1%)	174 (58.0%)	155 (77.5%)	220 (100.0%)	52 (96.3%)	64 (64.0%)

Table 2**:** Distribution of all the lactating mothers according to age groups

Age groups (years)	**PNG 874 (%)**	**NCD 300 (%)**	**EHP 200 (%)**	**ENB 220 (%)**	**Manus 54 (%)**	**WHP 100 (%)**
15 – 19	90 (10.3)	38 (12.7)	27 (13.5)	10 (4.5)	6 (11.1)	9 (9.0)
20 – 24	304 (34.8)	109 (36.3)	77 (38.5)	69 (31.4)	15 (27.8)	34 (34.0)
25 – 29	264 (30.2)	83 (27.7)	54 (27.0)	73 (33.2)	17 (31.5)	37 (37.0)
30 – 34	141 (16.1)	43 (14.3)	33 (16.5)	43 (19.5)	10 (18.5)	12 (12.0)
35 – 40	75 (8.6)	27 (9.0)	9 (4.5)	25 (11.4)	6 (11.1)	8 (8.0)

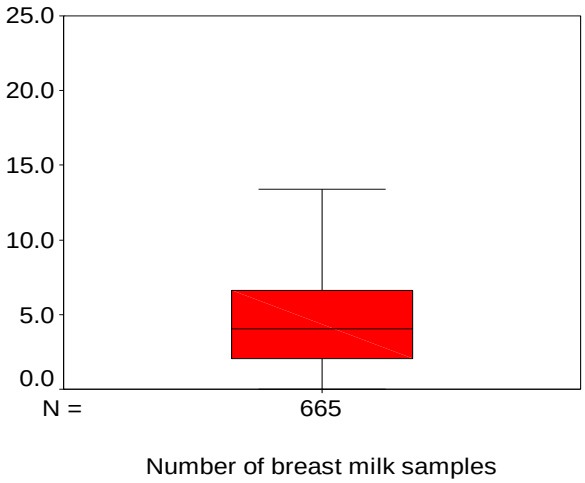

Fig. 1: Box-plot of AFM1 concentrations (ppt) in breast milk of lactating mothers

Table 3: Summary statistics of AFM 1 concentrations (ppt) in the breast milk of lactating mothers

Parameters	PNG	NCD	EHP	ENB	Manus	WHP
N	665	174	155	220	52	64
Median (ppt)	4.04	2.47	7.99	4.20	4.60	2.45
Interquartile Range (IQR) (ppt)	2.05 – 6.62	0.84 – 5.79	2.98 – 13.46	2.79 – 5.74	3.09 – 5.75	1.07 – 3.59
Mean (ppt)	6.51	5.65	9.09	6.62	4.28	3.88
Range (ppt)	0.01 – 93.04	0.01 – 90.71	0.01 – 43.38	0.29 – 93.00	0.9 – 7.69	0.02 – 41.02

Conversions: ppt = ng/kg = pg/g = ng/L = pg/ml

Table 4: Distribution (%) of AFM1 in breast milk of lactating mothers according to the different AFM1 safe cut-off limits

AFM1 cut-off limits	PNG 874 (%)	NCD 300 (%)	EHP 200 (%)	ENB 220 (%)	Manus 54 (%)	WHP 100 (%)
AFM1 = 0.0ppt	209 (23.9)	126 (42.0)	45 (22.5)	0	2 (3.7)	36 (36.0)
AFM 1 > 10.0ppt	89 (10.2)	14 (4.6)	62 (31.0)	10 (4.5)	0	3 (3.0)
AFM1 >25.0ppt	25 (2.9)	10 (3.3)	7 (3.5)	6 (2.7)	0	0

NB: Figures and % are cumulative; thus % do not add up to 100

The 874 breast milk samples were separated according to the recommended AFM1 safe cut-off limits; the distribution obtained is presented in Table 4. AFM1 concentrations were above 10.00ppt in 89 (10.2%) of the 874 breast milk. Thus, according to the Australia / New Zealand / Austria safe cut-off limit, these 89 breast milk were contaminated with AFM1 at the concentration that makes them unsafe for consumption by the babies at the time of collection of the breast milk. Using the recommend cut-off limit proposed by the Codex Alimentarius Commission (CAC), European Union (EU) and the United States of America (USA), the AFM1 concentrations in 25 (2.9%) breast milk were about 25.00ppt. The breast milk samples from these mothers were unsafe for the babies to consume at the time of collection of the breast milk.

Bivariate correlation analysis indicated a very weak non-statistically significant relationship (Spearman's rho = 0.064, p = 0.345, 2-tailed) between the AFM1 concentrations in the breast milk of all the mothers and the birth weights of their babies.

The Spearman's rho coefficient of correlation (rho = -0.102, p = 0.131, 2-tailed) also indicated weak inverse non-statistically significant relationship between the AFM1 concentrations in breast milk and the birth lengths of the babies.

When asked about their knowledge of AFM1, 78.4% (685) of the 874 lactating mothers do not have any knowledge about AFM1. However, most (85%) of the mothers were positive about eating peanuts with mould after wiping them. Some of the mothers (78.0%) were not aware of eating any other foodstuffs with mould, because they do not think mould can appear in any other foodstuffs apart from peanuts.

For more detailed analysis of the data, the 874 lactating mothers were separated according to their locations; the National Capital District (NCD) representing the Southern region; Eastern Highlands province (EHP) and Western-Highlands province (WHP) representing the Highlands region; East New Britain province (ENB) and Manus province representing the Islands region. Of the 874 mothers, 300 (34.3%) were from NCD, 200 (22.9%) from EHP, 100 (11.4%) from WHP, 220 (25.2%) from ENB and 54 (6.2%) from Manus province.

The descriptive statistics of the age of the mothers in the NCD and the four provinces are presented in Table 1. There were no statistically significant differences in the mean ages of the mothers. Table 2 shows the distribution of the lactating mothers into age groups. The highest number was in the 20 – 29 years age group, in NCD 64.0% (192/300), in

EHP 65.5% (131/200), in ENB 64.5% (142/220), in Manus 59.3% (32/54) and in WHP 71.0% (71/100).

The mean birth weight for babies in NCD was 3.0 ± 0.5kg and the range was 1.5 – 4.3kg; for EHP the mean birth weight was 3.4± 0.5kg and the range was 1.9 – 4.4kg; for ENB it was 3.2 ± 0.5kg and the range was 1.3 – 4.2kg and for WHP it was 3.5 ± 0.6kg and the range was 1.5 – 4.7kg.

The proportion (3.0%, 6.0% and 91.0% respectively) of birth weights classified into VLBW, LBW and Normal birth weight, were almost similar among the babies in the NCD and in each of the four provinces.

AFM1 was detected in 174 (58.0%) of the 300 breast milk samples from NCD, in 155 (77.5%) of the 200 samples from EHP, in 220 (100.0%) of the 220 samples from ENB, in 52 (96.3%) of the 54 samples from Manus province and in 64 (64.0%) of the 100 samples from WHP.

The distributions of the AFM1 (ppt) concentrations in the breast milk samples from NCD and the four provinces presented in the box-plots in Fig 2 show that the concentrations were not normally distributed. The Kolmogorov-Smirnov tests for normality of distribution also showed that the AFM1 concentrations were not normally distributed (p = 0.001). Thus, non-parametric statistics were used for analyses of the data. Table 3 shows the summary statistics of the AFM1 concentrations in the breast milk of lactating mothers from NCD and the four provinces.

The Mann-Whitney U and Wilcoxon W tests indicated that the AFM1 concentrations in breast milk from NCD was significantly lower (p=0.001, 2-tailed) than the AFM1 concentrations in breast milk from EHP, ENB and Manus provinces. There was no statistically significant differences in the AFM1 concentrations in the breast milk from Manus and ENB (p = 0.828, 2-tailed).

Table 4 shows the distribution of the breast milk from lactating mothers in NCD and the four provinces according to the recommended AFM1 safe cut-off limits.

Concentration of AFM1 was greater than 10.00ppt in 14 (4.6%) of the 300 breast milk samples from NCD, in 62 (31.0%) of the 200 samples from EHP, in 10 (4.5%) of the 220 samples from ENB and in 3 (3.0%) of the 100 samples from WHP. This, according to the Australia / New Zealand / Austria safe cut-off limit, indicates AFM1 contamination of the breast milk samples, making then unsuitable for consumption by the babies at the time of collect of the breast milk.

The number (%) of breast milk from mothers in NCD, EHP and ENB with AFM1 concentrations above 25.00ppt is also shown in Table 4.

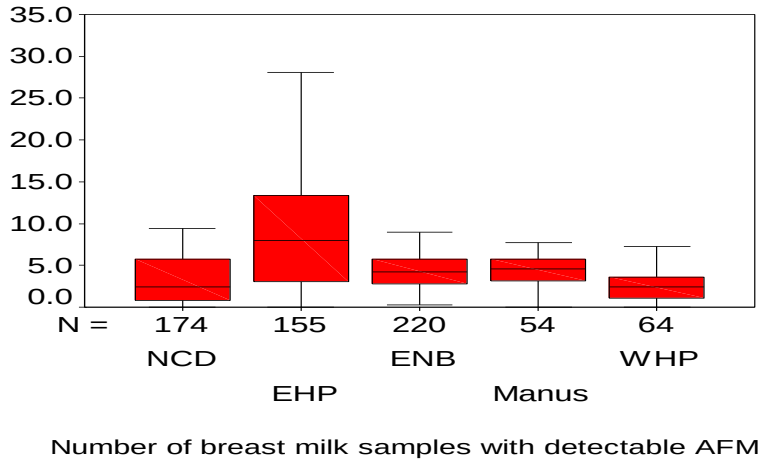

Fig. 2: Box-plots of AFM1 concentrations (ppt) in breast milk of lactating mothers in NCD and the four provinces that participated in this study

Table 5: Aflatoxin M1 levels (ppt) in breast milk of lactating women in different countries

Countries	No of samples	Percent (n) of contaminated breast milk	Mean AFM1 (ppt)	Range AFM1 (ppt)	Median AFM1 (ppt)	Interquartile Range (IQR) (ppt)	Ref
Iran	132	6.0% (8)	9.45	7.10 – 10.80	9.95	--	[26]
Iran	160	98.1% (157)		0.30 – 26.70	--	--	[28]
Brazil	94	5.3% (5)	18.00	13.0 – 25.00	--	--	[29]
Egypt	388	35.6% (138)	--	--	13.50	10.27 – 21.43	[30]
Colombia	50	90.0% (45)	5.20	0.9 – 18.50	--	--	[31]
Iran	87	27.6% (24)	0.56	0.13 – 4.91	--	--	[32]
Isfahan	80	1.3% (1)	6.80	--	--	--	[33]
Turkey	74	89.2% (66)	19.0	9.60 – 80.00	--	--	[34]

DISCUSSION:

The data obtained in the present study indicated that 76.1% (665/874) of the breast milk samples collected from lactating mothers in three of the four regions in PNG have detectable levels of AFM1. This strongly suggests the exposure of some babies to AFM1 within the first few weeks of life. The major source of the AFM1, which is the biomarker of AFB1, was the consumption of Aflatoxin contaminated foodstuffs by the lactating mothers. Since exclusive breast feeding for the first six months of life, and continued thereafter for up to two years, is one

of the major requirements that must always be advocated and implemented, the need to reduce the availability of Aflatoxin contaminated foodstuffs in the markets should be among the top priorities of program planners in the NDOH in PNG.

The high prevalence (76.1%) of AFM1 contaminated breast milk from lactating mothers in PNG in the present study was lower than the 98.1%, 90.0% and 89.2% contaminations reported for breast milk from lactating mothers in Iran [28], Colombia [31] and Turkey [34].

The median (4.04ppt) and IQR (2.05 – 6.62ppt) concentrations in the breast milk of all the lactating mothers in our present study were significantly lower than the corresponding 13.50ppt and 10.27 – 21.43ppt respectively in breast milk from lactating mothers in Egypt [30]. Table 5 shows the AFM1 concentrations reported for breast milk in lactating mothers from various countries.

The relatively high prevalence of AFM1 contamination of breast milk from lactating mothers in NCD (58.0%) was lower than the 77.5%, 100.0%, 96.3% and 64.0% obtained for EHP, ENB, Manus and WHP in the present study, and the 98.1%, 90.0% and 89.2% obtained in Iran [28], Colombia [31] and Turkey [34], respectively. The mean AFM1 concentration in the breast milk from lactating mothers in EHP (7.99ppt) was higher than the mean AFM1 in breast milk from lactating mothers in the other 4 provinces in the present study, and also the values reported for Colombia (5.20ppt), Iran (0.56ppt) and Isfahan (6.80ppt) [31, 32, 33]. The mean AFM1 for EHP (7.99ppt) is, however, lower than the cut-off limit of 10.00 ppm, the mean AFM1 concentrations reported for breast milk from lactating mothers in Iran (9.45ppt), Brazil (18.00ppt) and Turkey (19.00ppt) [26, 29, 34]. The 31.0% (62/200) breast milk from lactating mothers in EHP with AFM1 concentration above the 10.00ppt cut-off limits should be of great concern to the authorities in the EHP and NDOH in PNG, because it indicates availability of foodstuffs with high levels of AFB1 contamination in the markets in EHP.

The correlation between the concentration of AFM1 in breast milk and amount of peanut and other foodstuffs consumed by the lactating mothers was not assessed because of difficulties in recording the quantity of the different foods eaten per day. In addition, a 24-hour dietary recall is needed to obtain such data. However, based on the information from other researchers, it is logical to assume that the AFM1 concentrations in the breast milk of the lactating mothers were due to consumption of AFB1 contaminated foods several hours before the breast milk samples were collected [35, 36]. Studies in African, Asian and other regions have demonstrated correlation between the quantities of AFB1 contaminated

foods eaten and AFM1 concentrations in breast milk of lactating mothers [35, 36].

In the present study, the data obtained from the questionnaires indicated popular consumption of foodstuffs such as peanuts, tubers, root crops, legumes and cereals. Peanut is among the five major cash crops cultivated by small and medium scale farmers in PNG. Peanut is a major component of the diet consumed in both rural and urban households in most of the provinces. The practice of washing Aflatoxin infected peanuts before eating them is of major concern. It indicates the urgent need for intensive nutrition education, food safety information and awareness campaigns to advocate for proper implementation of recommended guidelines to reduce the infestation of peanuts by fungi.

In an effort to improve the export quality of peanuts grown in PNG, the National Agricultural Research Institute (NARI) in PNG in collaboration with stakeholders implemented the "Aflatoxin Contamination and Public Awareness Program on Better Handling Practices" in 2003. This major project was funded by PNG Agricultural Innovations Grant Facility (AIGF) between 2003 and 2005 [37]. The project involved bimonthly collection of peanut samples from registered small and medium scale farmers for analysis of AFB1, production of advocacy materials and newsletters in the local PNG language [38, 39] that were distributed locally to the farmers. The long term impact of this project has not been fully assessed because the project was not accompanied by effective monitoring [37]. There is an urgent need to develop similar programs that can be monitored with the use of mobile phones and other recently developed methods for monitoring such programs among farmers in the rural areas.

In the present study, the age range of the babies was 2 to 6 weeks and they were all breast feeding. Breast milk is the ideal quality food for all babies in this age group, because it provides all the required macro and micronutrients in adequate amounts with high bioavailability. In addition, it provides immunological protection against infections and promotes healthy growth and development. Prolonged exposure to AFM1 may cause stunting and underweight and negatively impact the immune status causing the infant to become prone to infectious diseases [23, 29, 40]. Thus, the need to ensure safe and effective breast feeding of the babies cannot be overemphasized. As already stated, good health, optimal growth and development of a child can be achieved with exclusive breastfeeding for the first six months of life and, continued thereafter for up to two years of age [23, 40]

Thus, to effectively reduce the AFM 1 concentrations in the breast milk of lactating mothers, social mobilization, intensive nutrition education and awareness campaigns, including

communication with all relevant target groups and agencies, like Susu-mama, and the relevant policy makers, are urgently required.

CONCLUSIONS:

The results obtained in the present study indicated that 76.1% (665/874) of the breast milk samples, collected from lactating mothers in three of the four regions in PNG, have detectable levels of AFM1. The concentration of AFM1 was above 10.00ppt in 89 (10.2%) of the 874 samples, which, according to the Australia / New Zealand / Austria safe cut-off limit, make them unsafe for consumption by the babies at the time of collection of the breast milk. The mean AFM1 concentration in the breast milk from lactating mothers in EHP (7.99ppt) was higher than the mean AFM1 in breast milk from lactating mothers in the other 4 provinces.

AFM1 concentration was above 10.00ppt in 14 (4.6%) of the 300 samples from lactating mothers in NCD, 62 (31.0%) of the 200 samples collected in EHP, 10 (4.5%) of the 220 samples from ENB and in 3 (3.0%) of the 100 samples in WHP. In order to reduce the AFM1 concentrations in breast milk of lactating mothers, basic nutrition education, aggressive advocacy, social mobilization, awareness campaigns, including communication with all relevant target groups and the relevant policy makers are urgently required.

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OFFSPRING OF MOTHERS WITH GRAVES' DISEASE FOLLOWED-UP FOR THE FIRST SIX MONTHS OF LIFE: A RETROSPECTIVE STUDY FROM A NIGERIAN TEACHING HOSPITAL.

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ABSTRACT:
The offspring of a mother with Graves' disease is at increased risk of morbidity (both immediate as well as long-term) and mortality. The aim of the study was to retrospectively assess the concentrations of the serum Thyroid Stimulating Hormone (TSH), Thyroxine (T4) and Triiodothyronine (T3) as well as the anthropometric measurements in the first 6 months of life among offspring of mothers with Graves' disease. In this study, the case files of all infants born to mothers with Graves' disease who were referred to the Paediatric Endocrinology Clinic, University of Benin Teaching Hospital (UBTH), Benin City were retrieved and audited. The thyroid function tests (TFT) results as well the anthropometric data obtained in the first 6 months of life for offspring of mothers with Graves' disease were recorded. Of the 10 neonates born to mothers with Graves' disease, the thyroid function was normal in eight (80.0%) and abnormal in two (20.0%). Of the two infants with abnormal thyroid function, one had Transient Hyperthyrotropinaemia (elevated TSH with normal fT4) and the other had Euthyroid Hyperthyroxinaemia (elevated fT4 with normal TSH and no clinical symptoms). No case of neonatal Graves' disease was observed. In the first 6 months of life, there was no statistically significant difference in anthropometric measurements between offspring of mothers with Graves' disease and their counterparts whose mothers did not have Graves' disease. **Conclusion:** Majority of infants born to mothers with Graves' disease had normal thyroid function but the two leading abnormality of thyroid function observed in the newborn were Transient Hyperthyrotropinaemia and Euthyroid Hyperthyroxinaemia. No statistically significant difference was observed in the anthropometric measurements of offspring of mothers with Graves' disease and those of mothers without Graves' disease.

Keywords: Maternal Graves' disease, offspring, neonate, hyperthyrotropinaemia, hyperthyroxinaemia.

INTRODUCTION:

Graves' disease may be present before or emerge during pregnancy. It is often associated with elevated level of thyroid-stimulating hormone receptor antibodies (TSHR-Ab) in the mother. TSHR-Ab has a structure similar to that of immunoglobulin G, a property which enables it to cross the placenta into the fetus [1]. It is

estimated that 10% of the mother's serum level of TSHR-Ab is transferred to the fetus in the 17th to 22nd weeks of gestation and 50% is transferred to the fetus in the 28th to 32nd gestational weeks. Subsequently, the level in the fetus gradually increases and exceeds the mother's level in the term newborn [1]. The TSHR-Ab is heterogeneous in terms of molecular and functional properties and is subdivided into stimulating or blocking or neutral subtypes, depending on their effect on fetal thyroid-stimulating hormone receptor [2-4]. In addition, it may be transformed into a stimulating or blocking activity during gestation [2,3]. The fetal thyroid-stimulating hormone receptor begins to respond to transplacentally-acquired maternal TSHR-Ab from 20th weeks of gestation [4]. Thus, maternal Graves' disease may influence fetal thyroid function when TSHR-Ab cross the placenta, bind to fetal thyroid-stimulating hormone (TSH) receptors, leading to fetal or neonatal hyperthyroidism. However, the placenta acts as a barrier, so usually only neonates whose mothers have high titres are likely to be affected [5]. Although neonatal hyperthyroidism is rare, it is potentially life-threatening. The presence of persistent TSHR-Ab in the mother or ≥ 3-folds increase during pregnancy is a risk factor for neonatal hyperthyroidism [2,6]. In addition, a significant amount of antithyroid drugs used in the treatment of hyperthyroidism in the mother may cross the placenta, leading to fetal hypothyroidism [5]. This is in contrast to thyroxine which only crosses the placenta in small amounts [6]. The onset of overt neonatal hyperthyroidism can be delayed due to maternal antithyroid drugs or coexistence of thyroid stimulating hormone receptor blocking antibodies [3]. Occasionally, the neonate may have central hypothyroidism due to an elevated free thyroxine (fT4) in the fetus arising from maternal or fetal thyrotoxicosis with suppression of the fetal hypothalamic-pituitary-thyroid axis [6]. Goitre in the offspring may be related to the hyperthyroidism or the dose of the antithyroid drug given to the mother [3].

Graves' disease occurs before pregnancy in 0.4-1.0% of women and in 0.2-0.4% during pregnancy, representing the most common cause (85%) of either overt or subclinical hyperthyroidism in women of reproductive age [5,6]. Such pregnancies have been associated with adverse effects on the fetus and the newborn. In this regard, transient neonatal hyperthyroidism occurs in 1.0% of infants born to mothers with Graves' disease, with an estimated incidence of 1 in 50,000 neonates [7]. In addition, other abnormalities of thyroid function in neonates born to mothers with Graves' disease include transient central hypothyroidism, transient primary hypothyroidism and transient hyperthyrotropinaemia (elevated TSH with normal free T4 levels and no clinical symptoms) [8,9]. The reported incidence of the transient neonatal hyperthyrotropinaemia varies from 1 in 17,000 in Japan [9] to 1 in

8,260 in Europe [11]. It is estimated that the incidence of transient hypothyroidism due to the transplacental passage of TSH receptor binding antibodies is 1 in 180,000 neonates [12]. Apart from the above neonatal thyroid disorders, maternal Graves' disease has been linked to intrauterine growth restriction and low birthweight [5,7,13]. Although several reports on transient neonatal hyperthyroidism exist in literature [14,15], recent case studies indicate that this transient clinical condition is still overlooked by clinicians, leading to occurrence of preventable complications [16-18]. In addition, consensus guidelines on management and follow up of offspring of mothers with Graves' disease does not exist [19]. Therefore, there is the need to raise the alertness of physicians on the subject. Fetal hyperthyroidism can be identified by fetal tachycardia (> 160/min), advanced bone age, presence of goiter and increased blood supply, using Doppler ultrasound [4].

Fetal goitre is considered to be present if neck circumference value is above 95th percentile [20]. The clinical manifestations of neonatal hyperthyroidism include low birthweight, tachycardia, exophthalmos, extreme jitteriness, vomiting, diarrhoea, poor postnatal weight gain, sweating and goitre [5,7].

Reports of studies on follow up of infants born to mothers with Graves' disease have produced mixed results. Some investigators found no abnormality [21,22] while others reported impaired intellectual functions and abnormal morphology of the thyroid gland [23,24]. In addition, there is lack of data on many neonatal outcomes. In literature, reports of available studies suggest that breast-fed infants of mothers treated with methimazole (carbimazole) had no thyroid dysfunction or adverse effect on physical and mental development [25,26].

The purpose of this study was to retrospectively assess the concentrations of the serum TSH, T4 and T3 as well as the anthropometric measurements in the first 6 months of life among offspring of mothers with Graves' disease.

SUBJECTS AND METHODS:

During the 5-year period (2012-2016) covered by this review the case files of all (10 in total) infants born to mothers with Graves' disease who were referred to the Paediatric Endocrinology Clinic, University of Benin Teaching Hospital (UBTH), Benin City were retrieved and audited. Information obtained from the case files included maternal age, parity, relevant medication history, results of thyroid function tests (TFT) and antithyroid stimulating antibodies tests. With regard to the infant, information obtained included weight and gestation at birth.

The birth weights and the gestational ages were confirmed from the hospitals where each of the infants was delivered. The infants were

examined by a consultant paediatric endocrinologist and the documented physical findings were reviewed. In particular, clinical evidence of neonatal hyperthyroidism was sought. Consent was obtained from each of the mothers before including mother-infant pair data for analysis. Permission to conduct this study was obtained from the appropriate authority. All the infants (subjects and controls) were followed up till the age of 6 months. The anthropometric measurements of the infants born to mothers with Graves' disease were analysed at the age 3 and 6 months and the results were compared with those of age- and sex-matched infants born to mothers without Graves' disease or any other medical illness during pregnancy.

All the infants (subjects and controls) were breast-fed. The controls were healthy infants whose anthropometric measurements were obtained for another study during the same period. Maternal Graves' disease was diagnosed based on elevated free thyroxine (fT4) and very low or undetectable TSH concentrations in serum and positive TSHR-Ab, using second-generation thyroid-binding inhibitory immunoglobulin (TBII) assay. TSHR-Ab measurements were performed either in the second or third trimester of pregnancy, depending on the time of diagnosis of the maternal disease and availability of fund.

Statistical analysis:

Descriptive statistics such as frequencies, means, standard deviations were used in describing all the variables. The Student's t-test was used, where appropriate, in ascertaining the significance of differences between two means with the p-value set at < 0.05.

RESULTS:

During the period under review, there were 10 cases of infants born to mothers with Graves' disease who were referred to UBTH clinic. These mother-infant pairs constituted the study population. The mean age of the mothers with Graves' disease was 30.7±3.4 years; age range was 25 to 38 years. Three of the mothers were primiparous while the remaining 7 were multiparous. All the mothers had carbimazole and propanolol at some stage of pregnancy. Maternal TSHR-Ab was positive in the mothers but the serum titres were low-to-moderate in concentration. All the infants were delivered at term. Three of the infants were delivered by caesarean section and the remaining 7 were spontaneous vertex deliveries. Of the 10 mothers, 4 were diagnosed before and 6 during pregnancy. All the infants had good Apgar Scores. The mean age of the infants at the time of referral was 5.1±1.3 days, age range 3 to 10 days. The results of the anthropometric measurements in the first 6 months of life of the subjects and the controls are presented in Table 1. There were no statistically significant differences between the two groups.

Table 2 shows that the thyroid function remained normal in the first 6 months of life in the eight infants whose tests were initially normal. Of the 10 neonates born to mothers with Graves' disease, the thyroid function was normal in eight (80.0%) and abnormal in two (20.0%). Of the two neonates with abnormal thyroid function, one had hyperthyrotropinaemia (elevated TSH with normal T4) and the other hyperthyroxinaemia (elevated T4 with normal TSH). Neonatal Graves' disease was not observed in any of the cases. As shown in Table 3, the TSH value normalized by the age of 3 months and remained so till age of 6 months. Similarly, as depicted in Table 4, the fT4 value normalized by the age of 3 months and remained so till the age of 6 months. The developmental milestones of the two infants with an initial abnormal thyroid function test (hyperthyrotropinaemia and hyperthyroxinaemia, respectively) were appropriate for their age. During the first 3 months of life, L-thyroxine was administered to the only infant with neonatal hyperthyrotropinaemia. The other infant with neonatal hyperthyroxinaemia had no treatment but was closely monitored in the first 6 months of life for clinical manifestations of Graves' disease.

Table 1: Comparison of mean weight, length and head circumference at birth, 3 and 6 months of age of infants of mothers with and without Graves' disease

Anthropometric parameter	IGDM	INGDM	p-value
Mean weight at birth	2.99±0.48kg	3.10±0.35	< 0.05
Mean length at birth	46.4±1.6cm	46.5±1.40	< 0.05
Mean OFC at birth	34.0±0.92cm	34.5±0.76	< 0.05
Mean weight at age 3 months	5.1±0.30	5.0±0.40	< 0.05
Mean length at age 3 months	58.0±2.4	58.5±2.2	< 0.05
Mean OFC at age 3 months	36.0±0.90	36.2±0.93	< 0.05
Mean weight at age 6 months	6.2±0.50	6.1±0.45	< 0.05
Mean length at age 6 months	66.0±2.6	66.1±2.7	< 0.05
Mean OFC at age 6 months	41.1±0.87	41.0±0.90	< 0.05

IGDM = Infants of Graves' disease Mothers
INGDM = Infants born to non-Graves' Disease Mothers
OFC = Occipitofrontal circumference

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Table 2: Mean serum TSH, T3 and T4 concentrations of the eight infants with initial normal thyroid function tests

Thyroid Function Tests parameters	Reference interval	At presentation	At 3 months of age	At 6 months of age
TSH µIU/L	0.37-3.50	2.03±0.50	1.92±0.65	1.71±0.55
Free T3 pmol/L	4.4-7.3	5.5±0.34	4.90±0.48	5.30±0.39
Free T4 pmol/L	7.2-16.4	10.2±1.30	10.73±0.85	12.50±0.76

TSH= Thyroid stimulating hormone; T3 = Triodothyronine; T4 = Thyroxine

Table 3: Serial serum TSH, T3 and T4 concentrations of the only infant with hyperthyrotropinaemia (elevated TSH)

Thyroid Function Tests parameters	Reference interval	At presentation	At 3 months of age	At 6 months of age
TSH* µIU/L	0.37-3.50	8.25*	2.60	2.35
Free T3 pmol/L	4.4-7.3	4.20	5.50	6.80
Free T4 pmol/L	7.2-16.4	12.35	10.70	13.45

TSH= Thyroid stimulating hormone; T3 = Triiodothyronine; T4 = Thyroxine;
*TSH = High

Table 4: Serial serum TSH, T3 and T4 concentrations of the only infant with hyperthyroxinaemia (elevated T4)

Thyroid Function Tests parameters	Reference interval	At presentation	At 3 months of age	At 6 months of age
TSH µIU/L	0.37- 3.50	2.25	1.95	2.55
Free T3 pmol/L	4.4-7.3	4.03	4.50	5.8
Free T4 pmol/L**	7.2-16.4	23.63**	14.0	12.60

TSH= Thyroid stimulating hormone; T3 = Triodothyronine; T4 = Thyroxine;
**Free T4 = High

DISCUSSION:

Our data indicate that 80.0% of infants born to mothers with Graves' disease have normal thyroid function. A similar finding (83.5%) has been reported by Mitsuda et al [15]. However, in contrast to the frequency (5.6%) of neonatal Graves' disease reported by Mitsuda et al [15], we did not find any case of neonatal Graves' disease. The absence of neonatal Graves' disease in our present study may be partly explained by the rarity of this clinical condition. Secondly, our small sample size may be another factor. Our study involved only 10 infants compared to 230 in the study by Mitsuda et al [15]. The rarity of neonatal Graves' disease is amply reflected in its estimated incidence of 1 in 50,000 neonates [5]. In addition, the relatively low titres of maternal serum TSHR-Ab may have contributed to our finding. This view is based on the report of previous studies which have shown that the higher the titre of maternal serum TSHR-Ab the greater the risk for neonatal Graves' disease [2,27-29].

In our present study, 10.0% of neonates born to mothers with Graves' disease had transient hyperthyrotropinaemia (elevated TSH with normal free T4 levels and no clinical symptoms). This finding agrees with the prevalence rate of 9.95% reported from Mexico [30]. In another study involving 230 neonates born to mothers with Graves' disease, 7.8% had hyperthyrotropinamia [15]. In the Mexican study, the high prevalence of transient neonatal hyperthyrotropinaemia was attributed to deficiency in maternal iodine intake [30]. A similar high prevalence rate of transient neonatal hyperthyrotropinaemia has been reported from other regions with iodine deficiency [31]. Could this be a factor in high prevalence observed in the present study? According to the criteria proposed by World Health Organisation (WHO), United Nations Children's Fund (UNICEF) and International Council for Control of Iodine Deficiency Disorders (ICCIDD), neonatal hyperthyrotropinaemia prevalence greater than 3% is an indirect index of iodine deficiency in the population under consideration [32]. In addition, other investigators have documented the usefulness of measurement of neonatal TSH level in identifying iodine deficiency in a given population [33]. Whatever the explanation for the hyperthyrotropinaemia observed in the present study, it calls for further research into the subject by simultaneous measurements of serum TSH and urinary iodine concentration (UIC). Measurement of UIC is the gold standard for identification of iodine deficiency in a target population. If such laboratory evaluation protocol confirms the existence of iodine deficiency, targeted iodine supplementation in mothers of reproductive age is warranted in our society. Although our sample size was small, this prevalence rate was by far higher than the reported incidence in Japan and Europe [10,11], countries with relatively adequate maternal iodine intake.

Other rare causes of transient neonatal hyperthyrotropinaemia include defects in TSH molecule or the TSH receptor, a mild intrathyroidal synthetic defect, a hemithyroid, or a resetting of TSH-feedback control system [34]. In our present study, the TSH value normalized, suggesting that abnormal TSH molecule or TSH receptor defect was not the cause. Similarly, in a study in Europe, the elevated TSH values spontaneously normalized in 11 of the 16 infants within 6 months [35]. Hyperthyrotropinaemia in the newborn is usually treated [34], a practice in keeping with our management approach in the index case.

In the present study, one neonate was found to have hyperthyroxinaemia (elevated free thyroxine, fT4). This finding is not surprising because previous studies on neonatal screening for thyroid disorders have reported similar finding [36-38]. The differential diagnoses of neonatal hyperthyroxinaemia include neonatal Graves' disease (most common), familial dysalbuminaemic hyperthyroxinaemia (FDH) and resistance of thyroid hormone (RTH) [36]. In addition, other reported causes of neonatal hyperthyroidism are activating-mutation of TSH receptor and gain-in-function mutation of Gsα protein in McCune Albright syndrome [39,40]. Elevated fetal fT4 may be due to maternal thyrotoxicosis and may lead to a feedback suppression of the fetal hypothalamo-pituitary-thyroid axis, resulting in central neonatal hypothyroidism (low fT4 and low TSH) [7,34]. However, we were unable to determine the cause of the neonatal hyperthyroxinaemia in our patient because of inadequate laboratory facilities. Whatever the cause, our finding reinforced the importance of simultaneous TSH and fT4 measurements in neonatal screening for thyroid disorders. Generally speaking, rare thyroid diseases are known to present challenging problems for clinicians because of their rarity and variability in clinical manifestations [41]. However, they should be kept in mind as differential diagnosis of other diseases more commonly seen in clinical practice.

Although the mean birthweight was slightly lower in infants born to mothers with Graves' disease compared to their counterparts born to mothers without Graves' disease, the difference was not statistically significant. Maternal Graves' disease in pregnancy is known to be associated with delivery of low birthweight infants [10]. Post-natally, mean weight, length and occipitofrontal circumference values were not statistically different in offspring of mothers with Graves' disease compared with their counterparts born to mothers without Graves' disease. Other investigators have reported similar findings [22,42].

The management challenges encountered in our patients included late referral, inappropriate timing of measurement of maternal TSHR-Ab,

lack of measurement of cord TSHR-Ab and inadequate laboratory facilities. Factors that contributed to inappropriate timing of measurement of maternal TSHR-Ab were late booking and financial constraints. Some mothers could not pay for the tests until after a few months from the time of request. Together, inappropriate timing and lack of measurement of cord TSHR-Ab hindered classifying the infants into high or low risk groups. Such classification will promote provision of targeted care and follow up. However, in some cases the request for maternal TSHR-Ab measurement was in the third trimester and in others only a single test was performed, making it impossible to assess for persistence TSHR-Ab during the course of pregnancy. Information regarding all these factors are required for assessment of risks of occurrence of neonatal hyperthyroidism [4,28]. Timing of measurement of maternal TSHR-Ab levels is important because its level is known to fall in the third trimester of gestation [2], a situation that may lead to misinterpretation of laboratory results. Therefore, further education of physicians on the management of offspring of mothers with Graves' disease is warranted in our setting. Inadequate laboratory facilities resulted in our inability to investigate the cause of the neonatal hyperthyroxinaemia found in our present study.

In conclusion, in our present study 80.0% of infants born to mothers with Graves' disease have normal thyroid function but the two leading abnormality of thyroid function observed in the 20.0% with disorder were Transient Hyperthyrotropinaemia and Euthyroid Hyperthyroxinaemia.

During the first six months of life, the anthropometric measurements of offspring of mothers with Graves' disease did not differ from those of offspring of mothers without Graves' disease. We recommend that whenever TSHR-Ab positive women are identified during pregnancy, both the neonatal and the paediatric endocrinology units should be informed prior to delivery. In addition, stratification of infants born to mothers with Graves' disease into low and high risk groups for targeted approach to immediate management and follow up is advocated. The benefit of this approach is that it will lead to avoidance of performing unnecessary series of thyroid function tests on infants in the low risk group while promoting careful evaluation including thyroid function tests in those in the high risk group. Follow up of these infants is important because thyroid dysfunction may begin after a few to several weeks of life [34].

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A SURVEY OF HIV RISK-RELATED BEHAVIOURS AMONG PRENATAL WOMEN IN SOUTH-SOUTH, NIGERIA

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ABSTRACT:

Human Immunodeficiency virus infection is a leading pandemic infectious disease of all races, ages and genders majorly transmitted heterosexually and through mother to child transmission. For its effective control the prevention of HIV risk-related practices among women of reproductive age and mother to child transmission becomes crucial. This study evaluated the HIV-risk-related behaviors among prenatal clinic attendees for effective prevention of its vertical transmission. This was a cross sectional study of 241 HIV prenatal clinic attendees at Niger Delta University Teaching Hospital Okolobiri, Bayelsa State. Data collected from 1st September 2016 to 31st March 2017 was analyzed with EPI INFO software. The mean age of the respondents was 30.5± 5.2 years and ranged 18-45 years. Majority of the respondents were of Ijaw ethnicity (57.7%), Christians (97.9%), married (95.4%), attained secondary level of education or below (50.2%) while 25.7% was unemployed. The rate of previous termination of unintended pregnancy was 42.3%, unintended index pregnancy 17.4% and significant among married participants (OR=0.15, P=0.005), non condom use before and during the index pregnancy was 66.4% and significant among the less literate subjects (OR=0.46, P=0.01). Awareness of partners HIV serostatus was 71.0% and significant among the younger participants (OR=0.43, P=0.004), less educated (OR=0.21, P<0.01) and the married (OR=12.47, P<0.03). Sex with multiple sexual partners was 6.6% and significant among those with lower education (OR=4.7, P=0.02) and married (OR=0.16, P=0.03). This data demonstrated significant HIV risk-related behaviors among the prenatal clinic attendees in this setting. This indicated improved prenatal HIV prevention campaign.

Keywords: HIV, Risk-related, ehavior, Prenatal, Attendees

INTRODUCTION:

Heterosexuality is the leading route of HIV acquisition followed by vertical infection of the new-borns from their seropositive mothers. Worldwide, more than 700 children are newly infected daily [1]. For effective control of HIV infection among other measures the Prevention of Mother to Child Transmission (PMTCT) of HIV is crucial.

Risk and incidence of new infection in the course of gestation is possible and important for effective PMTCT. The HIV risk-related

behaviours and practices by women and their partners in the immediate pre-conception period and during the gestation are therefore crucial in maternal infection and subsequently Mother to Child Transmission (MTCT). Then deeper understanding of the epidemiological factors for new infections in reproductive age women and MTCT will ensure an effective prevention and control strategies of HIV/AIDS.

The Nigerian national demographic health survey of 2013 revealed that 93 - 96% of Nigerians aged 15-49 was aware of HIV/AIDS [2]. It noted some reduced knowledge among rural dwellers, the uneducated and that the women from the South –south region of the country were among those more likely to have multiple sex partners. Consistent use of condom and limiting sexual intercourse to one uninfected partner evidently reduces the risk of heterosexual transmission. Young women mostly in sub-Saharan Africa have lower level of accurate and comprehensive HIV knowledge than men of their age [3]. They are less likely to report use of condom in sex [3], as they have little capacity to negotiate safer sex [3,4], access the services they need and utilize the opportunities for empowerment [4]. This is because women especially in low and middle income countries face significant barriers to accessing services due to economic constraints and gender related discriminations [3]. Awareness of one's HIV serostatus is crucial to the control of the scourge. While those unaware of their HIV serostatus inadvertently spread new infection, those infected and aware of their infection who engage in high risk behaviours equally pose a significant risk for the spread of the infection. It was reported that about a third of HIV-infected persons in United States of America are not aware of their HIV status [5-6]. High risk behaviour among the HIV positive persons on antiretroviral drugs leads not only to the transmission of HIV but the transmission of drug resistant strains of the virus [7]. It was evident that unprotected sex and heterosexual contact are leading HIV risk behaviour prior to or after awareness of HIV serostatus [5]. Unprotected sex after learning of a positive HIV test result is still common among HIV seropositive persons. This was more widespread among women relative to heterosexual men, sex workers, those aware of their serostatus longer and those who have been on highly active antiretroviral therapy (HAART). These findings were consistent with the contraction or report of diagnosis of STDs by HIV positive persons [5]. For the persons who trade sex for either money or drug, it was evident that the behavior was difficult to change even after testing positive to HIV testing [5, 8] especially when poverty and economic needs are the driving forces. There is the possibility of misconception of the elimination of transmission risk by HAART use and possible improved health of persons receiving HAART with consequent increase of both protected and unprotected sexual activity. Another HIV risk-

related behavior is multiple sex partnership. The larger the number of sex partners either as serial monogamous or polygamous relationship the higher the likelihood to contract the virus. In serial monogamous relationship the spread of HIV infection beyond the couple is not possible unless the relationship is dissolved and a new partnership formed [9] or where it is breached. In contrast, in polygynous e.g. polygamous relationship there is concurrent sexual partnership with its feature of increased number of individuals directly or indirectly sexually connected at any point in time. As a result the HIV is transmitted quickly across the sexual network in any overlapping sexual partnership known biologically to be associated with increased risk of transmitting HIV in high levels of viral load in acute infection of overlapping sexual partnership [9-10]. It is evident that concurrent sexual relationship and HIV prevalence are highest in Africa corroborating concurrency as a major risk factor for HIV spread [11-12]. Prevention of MTCT of HIV is a global interventional program to protect the children from the HIV scourge [13]. The United Nations General Assembly Special Session (UNGASS) on HIV/AIDS identified PMTCT as a key intervention and formulated four-pronged approach for PMTCT in 2001 [13-14]. As the magnitude of various HIV risk -related behaviors among the pregnant women in South-South Nigeria is currently unknown, it is imperative to conduct a study to measure them. Data from the study can then inform improved PMTCT strategy development and implementation.

METHODOLOGY:

Niger Delta University Teaching Hospital (NDUTH) is a tertiary hospital at Okolobiri in Bayelsa State in South-South geopolitical region, Nigeria. The hospital offers among other services prevention of mother to child transmission of HIV. Bayelsa State is a riverine or Niger Delta setting. Its total area is 21,110km2 with the estimated population of about 2 million in 2005. The four main languages spoken in Bayelsa State are Izon, Nembe, Epie-Atissa and Ogbia; these are in line with the four leading ethnic groups in the state. The predominant ethnic group is the Izon (Ijaw); a collection of peoples indigenous mostly to the forest region of Bayelsa, Rivers, Delta, Edo, Akwa-Ibom and Ondo States within the Niger Delta in Nigeria. People from other regions across and outside Nigeria are also resident in Bayelsa State. The state has one of the largest crude oil and natural gas deposits in Nigeria. She is therefore one of the major oil producing states in the country. The main native occupations are fishing and farming. The neighbouring states are Delta to the north, Rivers to the west and the Atlantic Ocean to the east and south.

This was a cross sectional descriptive study on participants recruited from 1st September 2016 to 31st March 2017. The study population was antenatal clinic attendees at NDUTH. Antenatal

attendees who were sero-negative to HIV testing at booking were recruited for the study. The eligible antenatal clinic attendees who declined consent to participation in the study were excluded.

Sample size of 241 attendees was calculated using the formula (n= z2pq/d2) by Cochran [15]; the HIV sero-prevalence rate used was 3.9% [16].

{*Where p = maximum known proportion of the relevant variable, here expressed as the proportion of HIV sero-negative antenatal care clients found to be sero-converted at delivery at term. In this study p=3.9% (or 0.039); q=1-p (proportion of HIV sero-negative antenatal care women at booking who remained so at delivery).This was 1-0.039 or 0.961; d=Allowable error margin of estimate (precision) thus d= 0.03 since the p is less than 10% [17]. z=this is Z statistic for 95% confidence level (value for selected alpha level α=0.05 which is 1.96.*)} .

All the eligible attendees who registered for prenatal care and gave consent for the study were selected at term or in labour at term. A structured pretested quantitative questionnaire with sections on independent and dependent variables was used for data collection. The instrument was used by the researchers and two assistants to collect the data. This was done during the antenatal clinic periods or in labour on one-on-one basis.

Statistical analyses were done with EPI INFO Version 7.1.4.0 developed by Centre for disease control and prevention (CDC) in Atlanta Georgia USA released 11 July 2014 and INSTAT software. The outcomes measured from the primary data included the proportion of the participants involved in HIV risk behaviours in the gestational period; the rate of unintended pregnancy, unprotected sexual intercourse, previous termination of unintended pregnancy, awareness of male partner's serostatus and multiple sexual partners. These were each stratified by the independent variables (sociodemographic characteristics). Statistical testing was done with Fisher's exact test using 2x2 contingency tables. The statistical significance was set at 95% confidence interval excluding nullity of one or $p<0.05$. The hospital Research and Ethical Committee (REC) gave approval for the study. Informed consent for the research was sought and obtained from each participant.

RESULTS:

Table 1 is a display of the socio-demographic characteristics of the participants. Their mean, range and modal age were 30.5±5.2 years, 18-45 years and 30-34 years (37.8%) respectively. About 9 out of every 10 participants attained at least secondary level of education. A similar proportion was married. A little over a tenth of the subjects were in polygamous relationship. Most (97.9%) of the participants were Christians. The mean gestational age at booking and first HIV testing was 16.8±4.2 weeks with the range of 5-28weeks. The

corresponding values at data collection were 38.6±1.4 and 36-42 weeks respectively. From the same table 1, about 7 (74.3%) and 3 (25.7%) out of every 10 participants were gainfully employed and unemployed respectively. Most (80.9%) of the participants have had at least a previous childbirth with a range of 0-12 deliveries. Majority of the participants were Christians with over half of them 139/241 (57.7%) of Ijaw ethnicity.

Table 1: Socio-demographic Characteristics of Participants

Characteristic	Variable	Participants N=241 (%)
Age range (years)	<20	2 (0.8)
	20-24	27 (11.2)
	25-29	73 (30.3)
	30-34	91 (37.8)
	≥35	48 (19.9)
Marital status	Married	230 (95.4)
	Unmarried	11 (4.6)
Parity	0	46 (19.1)
	≥1	195 (80.9)
Educational level	Nil	7 (2.9)
	Primary	26 (10.8)
	Secondary	88 (36.5)
	Tertiary	120 (49.8)
Occupation	Civil servant	61 (25.3)
	Private Org.	22 (9.1)
	Self employed	96 (39.8)
	Unemployed	54 (22.4)
	Student	8 (3.3)
Type of relationship	Polygamous	25 (10.4)
	Monogamous	216 (89.6)
Religion	Christianity	236 (97.9)
	Islam	4 (1.7)
	Others	1 (0.4)
Ethnic Groups	Ijaw	139 (57.7)
	Igbo	41 (17.0)
	Urhobo	16 (6.6)
	Isoko	14 (5.8)
	Ogbia	3 (1.2)
	Yoruba	3 (1.2)
	Nembe	2 (0.8)
	Epie	2 (0.8)
	Hausa	2 (0.8)
	Others	19 (7.9)

Table 2 shows the previous pregnancy termination prior to the index pregnancy among the participants stratified by the socio-demographic characteristics. About two of every five 102/241(42.3%) of the participants has had at least a previous termination of unintended pregnancy. The married participants were slightly less likely (OR=0.88, P=1.00) to have had at least a previous termination of pregnancy. The observed difference was not statistically significant. The participants from Ijaw ethnic group were more (OR=1.25, P=0.43) likely to have had at least a previous termination of pregnancy compared to other participants. The observed difference was not statistically significant. The nulli-parous participants were about 27% more likely to have had at least a previous termination of pregnancy. This however, was not statistically significant. The participants who used condom were some 40% less likely to have had termination of unintended pregnancy.

Table 3 shows the unintended index pregnancy stratified by the socio-demographic characteristics of the participants. About one out of every five 42/241 (17.4%) participants had unplanned index pregnancy. Participants less than 30 years of age were less than 20% (OR=0.81, P=0.61) less likely to have unplanned index pregnancy compared with their older counterparts. The observed difference however was not statistically significant. Married participants were comparatively more than 80% less likely to have unplanned pregnancy. The observed difference was statistically significant (P=0.01). Similarly those who used condom 12 months prior to this interview were statistically similar to those who did not use in unplanned index pregnancy. The employed participants were about 40% less likely to have unplanned index pregnancy while the less literate group were more likely to by same proportion.

Table 4 shows the results of condom use by the participants during the index pregnancy stratified by the socio-demographic characteristics. A majority 160/241 (66.4%) of the participants indicated non condom use in the twelve months preceding the interview. Participants who were younger than thirty years of age were 25% less likely to use condom around and during the pregnancy compared with their older counterparts (OR=0.75,P=0.34). The observed difference was not statistically significant. The married participants were more than twice more likely not to use condom during their index pregnancy (OR=2.48 P=0.19). The difference was not statistically significant. Relative to those who attained tertiary level of education, the participants with secondary level of education or less were significantly less likely not to (OR=0.46, P=0.01) use condom during the index pregnancy .The participants on gainful employment were less likely (OR=0.55, P=0.09) not to use condom in this pregnancy. The observed difference however, was not statistically significant.

Table 2: Previous Termination of Unintended Pregnancy among Participants vs. Socio-demographic Characteristics

Variables	Category, N (%)	Previous Termination of Unintended Pregnancy		OR (95% CI)	P-value
	N = 241	Yes: N (%)	No: N (%)		
Age groups	≤ 29yrs: 102 (42.3) ≥30yrs: 139(57.7)	45 (44.1) 57 (41.0)	57 (55.9) 82 (59.0)	1.14 (0.68-1.9)	0.69
Marital status	Married: 230 (95.4) Unmarried: 11 (4.6)	97(42.2) 5 (45.5)	133 (57.8) 6 (54.5)	0.88 (0.26-3.00)	1.00
Type of Relationship	Polygamous: 25 (10.4) Monogamous: 216 (89.6)	11 (10.8) 91 (89.2)	14 (10.1) 125 (89.9)	1.08 (0.47-2.49)	1.00
Occupation	Employed: 179 (74.3) Unemployed: 62 (25.7)	73 (40.8) 29 (46.8)	106 (59.2) 33 (53.2)	0.78 (0.44-1.40)	0.46
Educational level	≤ Secondary: 121 (50.2) >Secondary: 120 (49.8)	47 (38.8) 55 (45.8)	74 (61.2) 65 (54.2)	0.75 (0.45-1.25)	0.30
Parity	0: 46 (19.1) ≥1: 195 (80.9)	19 (56.0) 83 (42.6)	27 (44.0) 112 (57.4)	1.27 (0.53-3.04)	0.66
Ethnic Group	Ijaw: 139 (57.7) Others: 102 (42.3)	62 (44.6) 40 (39.2)	77 (55.4) 62 (60.8)	1.25 (0.74-2.10)	0.43
Condom use in the last 12 months	Used: 81 (12.1) Not used: 160 (87.9)	28 (34.6) 74 (46.3)	53 (65.4) 86 (53.7)	0.61 (0.35-1.07)	0.10

Table 3: Unintended index Pregnancy among Participants vs. Socio-demographic Characteristics

Variables	Category, N (%)	Unintended Index Pregnancy		OR (95% CI)	P-value
	N = 241	Yes	No		
Age groups	≤ 29yrs: 102 (42.3) ≥ 30yrs: 139 (57.7)	16 (15.7) 26 (18.7)	86 (84.3) 113 (81.3)	0.81 (0.41-1.60)	0.61
Marital status	Married: 230 (95.4) Unmarried: 11 (4.6)	36 (15.7) 6 (54.5)	194 (84.3) 5 (45.5)	0.15 (0.04-0.53)	0.005
Type of Relationship	Polygamous: 25 (10.4) Monogamous: 216 (89.6)	11 (44.0) 31 (14.4)	14 (56.0) 185 (85.6)	4.69(1.95-11.27)	0.001
Occupation	Employed: 179(74.3) Unemployed: 62(25.7)	27(15.1) 15(24.2)	152(84.9) 47(78.0)	0.56 (0.27-1.13)	0.12
Educational level	≤ Secondary: 121(50.2) >Secondary: 120(49.8)	24(19.8) 18(15.0)	97(80.2) 102 (85.0)	1.4 (0.72-2.74)	0.40
Parity	0: 46 (19.1) ≥1: 195 (80.9)	7(15.2) 35(17.9)	39 (84.8) 160 (82.1)	0.82 (0.34-2.00)	0.83
Ethnic Group	Ijaw: 139(55.3) Others: 102(44.7)	25(18.0) 17(16.7)	114(82.0) 85 (83.3)	1.10(0.56-2.16)	0.86
Religion	Christianity: 236(97.9) Islam: 5 (2.1)	41(17.4) 1(20.0)	195 (82.6) 4 (80.0)	0.84(0.09-7.73)	1.00
Condom use in the last 12 months	Used: 81(12.1) Not used: 160(87.9)	14(17.3) 28(17.5)	67(82.7) 132 (82.5)	0.99 (0.49-2.00)	1.00

Table 4: Non-Condom Use among Participants in index Pregnancy vs. Socio-demographic Characteristics

Variables	Category; N (%)	Non-Condom Use		OR (95% CI)	P value
	N = 241	Non-use: N (%)	Use: N (%)		
Age groups	≤ 29 yrs: 102 (42.3) ≥ 30 yrs: 139 (57.7)	64 (62.7) 96 (89.2)	38 (37.3) 43 (10.8)	0.75 (0.44-1.2)	0.34
Marital Status	Married: 230 (95.4) Unmarried: 11 (4.6)	155 (67.4) 5 (45.5)	75 (32.6) 6 (54.5)	2.48 (0.73-8.39)	0.19
Type of Relationship	Polygamous: 25 (10.4) Monogamous: 216 (89.6)	13 (52.0) 147 (68.1)	12 (48.0) 69 (31.9)	0.51(0.22-1.17)	0.12
Parity	0: 46 (19.1) ≥1:195 (80.9)	28 (60.9) 132 (67.7)	18 (39.1) 63 (32.3)	0.74 (0.38-1.44)	0.39
Educational level	≤ Secondary: 121(50.2) >secondary: 120 (40.8)	70 (57.9) 90 (75.0)	51 (42.1) 30 (25.0)	0.46 (0.26-0.79)	0.01
Occupation	Employed: 179 (74.3) Unemployed: 62 (25.7)	113 (63.1) 47 (75.8)	66 (36.9) 15 (24.2)	0.55 (0.28-1.05)	0.09
Ethnic Group	Ijaw: 139 (57.7) Other: 102 (42.3)	88 (63.3) 72 (70.6)	51 (36.7) 30 (29.4)	0.72 (0.42-1.24)	0.27

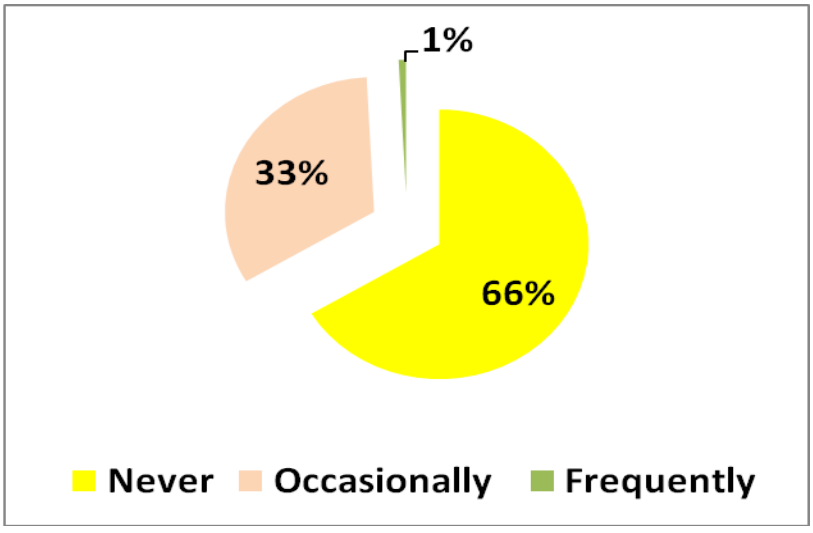

Figure 1: Pattern of Participants Use of Condom in the last 12 Months {N = 241 (%)}. A further subgroup analysis showed that 66%, 33% and 1% of the participants never, occasionally and frequently respectively used male condom during the gestational period or in the previous twelve months from the time of interview (Figure 1).

Table 5: Multiple Sexual Partners in Index Pregnancy vs. Participants Characteristics

Variables	Category, N (%)	Multiple Sexual Partners		OR (95% CI)	P-value
	N = 241	Yes: N (%)	No: N (%)		
Age groups	≤ 29 yrs: 102 (42.3) ≥ 30 yrs: 139 (57.7)	5 (4.9) 11 (7.9)	97 (95.1) (43.1) 128(92.1)	0.60 (0.20-1.78)	0.44
Marital status	Married: 230 (95.4) Unmarried: 11 (4.6)	13 (5.7) 3 (27.3)	217 (94.3) 8 (72.7)	0.16(0.04-0.67)	0.03
Type of Relationship	Polygamous: 25 (10.4) Monogamous: 216 (89.6)	12 (48.0) 4 (1.9)	13 (52.0) 212 (98.1%)	48.92(13.84-173.0	<0.001
Occupation	Employed: 179 (74.3) Unemployed: 62 (25.7)	13 (7.3) 3 (4.8)	166 (92.7) 59 (95.2)	1.54(0.42-5.60)	0.77
Educational level	≤Secondary: 121(50.2) >Secondary: 120 (49.8)	13(10.7) 3(2.5)	108(89.3) 117(97.5)	4.69(1.30-16.93)	0.02
Parity	0: 46 (19.1) ≥1: 195 (80.9)	1(2.2) 15(7.7)	45(97.8) 180(92.3)	0.27 (0.03-2.07)	0.32
Ethnic Group	Ijaw: 139 (57.7) Others: 102 (42.3)	11(7.9) 5(4.9)	128(92.1) 97(95.1)	1.67 (0.56-4.96)	0.44

Table 6: Participants Awareness of Partners' HIV serostatus vs. Sociodemographic Characteristics

Variables	Category; N (%)	Aware of Partner's Sero-status		OR (95% CI)	P-value
		Yes: N (%)	No: N (%)		
Age groups	≤29 yrs: 102 (42.3) ≥30 yrs: 139 (57.7)	62 (60.8) 109 (78.4)	40 (39.2) 30 (21.6)	0.43 (0.24-0.75)	0.004
Marital status	Married: 230 (95.4) Unmarried: 11 (4.6)	169(73.5) 2(18.2)	61(26.5) 9(81.8)	12.47 (2.62-59.35)	0.0003
Type of Relationship	Polygamous: 25 (10.4) Monogamous: 216 (89.6)	10 (40.0) 161	15 (60.0) 55	0.23 (0.10-0.54)	<0.001
Occupation	Employed: 179 (74.3) Unemployed: 62 (25.7)	131 (73.2) 40 (64.5)	48 (26.8) 22 (35.5)	1.50 (0.81-2.78)	0.20
Educational level	≤ Secondary: 121 (50.2) >Secondary: 120 (49.8)	68 (56.2) 103 (85.8)	53 (43.8) 17 (14.2)	0.21 (0.11-0.40)	<0.001
Parity	0: 46 (19.1) ≥1: 195 (80.9)	36 (78.3) 135 (69.2)	10 (21.7) 60 (30.8)	1.60 (0.75-3.44)	0.28
Ethnic Group	Ijaw: 139 (57.7) Others: 102 (42.3)	100 (71.9) 71 (69.6)	39 (28.1) 31 (30.4)	1.12 (0.64-2.00)	0.77

Table 5 shows the results of multiple sexual partners by the participants stratified by the sociodemographic characteristics. About 16/241 (6.6%) of the participants had multiple sexual partners during the period of the study. The married participants were significantly more than 80% less likely to have multiple sexual partners.(OR=0.16, P=0.03). On the

other hand, those with secondary education and below were statistical significant close to fivefold (OR=4.69, P=0.02) more likely to have multiple sexual partners in the index pregnancy. The participants of Ijaw ethnic group and their employed counterparts were about twice respectively more likely to have multiple sexual partners. However, none of the observed differences was statistically significant.

From Table 6 the results of participants awareness of their male partners HIV-serostatus stratified by socio-demographic characteristics were shown. About three out of every ten 70/241 (29.0%) of the participants were not aware of their male partners HIV serostatus. Those participants younger than 30 years of age were about 60% less likely to know the serostatus of their partners (P=0.03). The observed difference was statistically significant. Similarly, those with secondary level of education and less were about 80% less likely to know the serostatus of their partners (OR=0.21, P= <0.01). The observed difference was statistically significant. On the contrary, the married ones were significantly more than 12 folds (OR=12.47, P=0.003) more likely to know the HIV serostatus of their male partners. The nulliparous participants compared with their parous counterparts were close to twice (OR=1.6, P=0.28) more likely to know the serostatus of their male partners. However, the observed difference was not statistically significant. About 71% of the subjects knew the serostatus of their spouses while 29% did not (Table 6).

DISCUSSION:

This data demonstrated a high incidence of previous termination of unintended pregnancy (42.3%), unintended index pregnancy (17.4%) significant among those in polygamous relationship and non-condom use (66.4%) significant among more literate participants. Others are sex with multiple partners (6.6%) worst among the polygamous participants, poorly educated and the unmarried while lack of awareness of spouse HIV serostatus (29.0%) mostly the polygamous participants, the younger, the unmarried and the less educated.

Earlier reports in the literature noted high risk sexual behaviours among pregnant women in some parts of Africa predisposing them to increased HIV transmission in pregnancy [18]. Women from the south-south region of Nigeria have been associated with increased involvement in multiple sexual partners [19]. The rate of sex with multiple partners in this study was low at 6.6% and could not corroborate this. The incidence of unintended index pregnancy was high in this data. This was significant among those in polygamous relationship and the unmarried. More than one out of every ten of the participants was in polygamous marriage. This is associated with concurrent or overlapping sexual partnership

[9-10]. In a case of an open circuit polygamous relationship, any sexual transmitted infection in one of the partners exposes the entire network in unprotected sexual relationship to the risk of the sexual transmitted infections including HIV.

The rate of previous termination of unintended undesired pregnancy of over 42% was high in this study. This is an indication of increased HIV-related risk behavior of lack of pregnancy planning. Consistent use of condom as demonstrated in this data is effective in preventing unintended pregnancy, its termination and HIV transmission. There is a fairly quality prenatal care with well organized and intense HIV prevention campaign at this study centre. This is expected to have positively influenced the HIV risk behaviour in this population. The 29% proportion of the women that did not know the serostatus of the father of their index pregnancy in this study was significant. The finding is consistent with the report of other researchers [20]. This indicates low rates of HIV serostatus disclosure among sexually active couples [20]. Sexual intercourse with partners of unknown HIV serostatus is one of the confirmed HIV related risk behaviours. Awareness of spousal serostatus has been shown to have the potential of reducing MTCT of HIV by engendering intense and earlier preventive measures [2]. Consistent use of condom and limiting sexual intercourse to one uninfected partner evidently reduces the risk of HIV transmission [19, 21]. The few participants that occasionally used condom in this study were probably for contraception prior to index pregnancy though this data did not explore the reasons for their use of condom. In addition descriptive observational study has the inherent limitation of exploring the reason for an observed outcome. Condom offers the dual protection from HIV and other sexually transmitted infections and unintended pregnancy making it an effective option for prevention of HIV for both concordant and discordant seropositive partners. Such couples are candidates for correct and consistent use of condom [14, 22], planned pregnancy [14] and semen preparations and assisted reproductive techniques to avert the woman infection and MTCT [23].

The rate of previous termination of unplanned pregnancy in this data was high indicating poor use of contraception therefore increased level of unmet need for contraception. This equally was a reflection of the participants' poor practice of protective sex for prevention of both unintended pregnancy and STI/HIV infection outside pregnancy and the latter during pregnancy. Unplanned pregnancy has been identified as an important risk factor for MTCT and a militating factor against PMTCT of HIV [13-14]. .This risk behavior though relatively low in this study; it cut across almost all the categories of the participants.

There was a marked reduction of unplanned pregnancy from about 42% previously to 17% in index pregnancy; a reduction of over 60%. Probably most of the previous unintended pregnancy and the terminations occurred premarital. Again the design of this study did not explore the timing of the previous pregnancy terminations.

The rate of condom use was low among the participants especially among the married ones possibly due to low perception of possible risks. Though the Level of awareness of partners HIV serostatus was relatively low at 71% for HIV scourge prevention, it was particularly high among the older, educationally and economically empowered participants. This confirms the evidence of women empowerment in enhancing their capacity to enquire about their partners and negotiate sex [19, 24-27] and the importance of intimacy of couples in marriage for information sharing.

Currently, there is an emerging practice of HIV testing among intending couples prior to contraction of marriages.

Limitation of this study: This was a hospital based data that might not be generalizable. Again the questions on sexuality are sensitive and involve self-reporting of one's behavior known to be associated with underreporting bias.

CONCLUSIONS:

There was high rate of unplanned index pregnancy and previous termination of unintended pregnancies signaling huge unmet need for contraception in this setting. The awareness of partners HIV serostatus among the participants was low in this data indicating poor disclosure of serostatus or low HIV testing among the male partners. Protective sex by the use of condom was low in this population; however there was low involvement in sex with multiple partners among the study population.

Women educational and economic (employment) empowerment was still inadequate indicating more governmental involvement to stem the socioeconomic role in HIV transmission in order to sustain the campaign against the scourge.

HIV-related risk behavior was significant in this population strengthening the need for quality prenatal care as an effective entry point for prevention of MTCT and by extension prevention of HIV infection.

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