



University of Colombo, Sri Lanka

Annual Research Symposium 2014

University-Industry Collaboration to Strengthen
the Knowledge Hub of Sri Lanka

PROCEEDINGS

November 20th - 21st 2014

Proceedings of the Annual Research Symposium 2014

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Multi-disciplinary Knowledge in the Global Presence, Producing
Human Talents of High Quality while Upholding National Values’

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Message from the Vice-Chancellor

University-Industry Collaboration and Higher Education in Sri Lanka



Internationally recognized universities in developed countries have strong University-Industry collaborations, that is mutually beneficial for both partners leading to sustainability of collaborative programs. Even, the University-Government research collaborations are very strong in developed countries where university academics function at advisory levels both for the industry and the government. Developed universities affiliated to the state involve even in classified military research in collaboration for which strictly confidentially “Trust” is the key for all activities, while they always prioritize R&D, *i. e.* Research having the Development component, guided by the *vision* of the state.

Above all, the management of developed Universities has the freedom to implement rules and regulations equally on students and staff. Command- and control-based and multi-layered, out-dated management system which is still practiced in Sri Lankan state universities, is not found in developed universities of developed countries with open economies. The most important factor for a healthy University-Industry collaboration in leading universities is the compatibility of the management systems of universities with that of the Industry, while the governments of respective countries have provided compatible ‘Political-will’. This ‘Political-will’ of the government and the compatibility of University-Industry management system are different from each other, but they are successfully followed by top two highly developed countries, *i.e.* United States of America and People’s Republic of China.

Sri Lanka state follows open economic policies, while the industry in the country is also managed in the open and *competitive knowledge-economy*. But, all the Universities in Sri Lanka are *state controlled* and function in command- and control-based centrally managed outdated system of Administrative and Financial Regulations (AR and FR) system, which is not compatible with those of the modern competitive *knowledge-economy*. Due to this incompatibility, Sri Lankan Universities are not competitive in the open-economy, and cannot reach international University-Industry standards, under the present management environment, which is not supporting the *corporate culture*. Sri Lankan universities need to function in the competitive open economy with self-financing and self-management capabilities, with the correct ‘*political will*’ of the state.

University academics supported by the industry have a major role to play for bringing about significant positive changes.

Research and development is simply written as R&D that is considered as one word, and it has a strong meaning as well, so research is useless if there is no development component in it. Above all, developed universities enjoy *Academic Freedom* coupled with *Academic Responsibility*, indicating without the responsibility, one cannot achieve freedom, and therefore F&R (*Freedom & Responsibility*) is to be considered as one entity. Above all, we should not forget that all above are the realities for organizations functioning in the *open-economy*. In the *open-economy*, one major requirement is the *competitiveness* of organizations, and the most required *innovation* for industry is achieved only through competitiveness. Where does Sri Lanka stand in these aspects?

I congratulate members of the university staff who participate in the Annual Research Symposium 2014. I request you to think about your contribution to the *knowledge-economy* of our country in *financial terms* as the *Human Capital* involved in *Research & Development* (R&D) where international standard output is expected through a local management environment.

Dr. W. Kumara Hirimburegama
Vice-Chancellor
University of Colombo
Sri Lanka

Message from the Chairperson Annual Research Symposium 2014



As the Chairperson of the Organizing Committee, I am delighted to send this message to the Proceedings of Annual Research Symposium 2014 of the University of Colombo. Although there are many international conferences organized by various Departments, Faculties and Institutes of the University of Colombo, the Annual Research Symposium is the occasion where one umbrella theme is addressed from uni-disciplinary, interdisciplinary, and multi-disciplinary perspectives. The overall theme of the Annual Research Symposium

2014 is “University-Industry Collaboration to Strengthen the Knowledge Hub of Sri Lanka”. It is a timely important theme and the committee is thankful to Dr. W. Kumara Hirimburegama, the Vice-Chancellor for proposing this theme and guiding us to conduct this symposium in a productive manner. By considering the nature of the theme, this year’s committee decided to invite the keynote speaker from the industry (Mr. Rohan Pallewatta, CEO, Lanka Harness Company (Pvt) Ltd.) and conduct the panel discussion subsequent to the keynote speech by inviting resource persons from the industry and the academia. As usual, faculties have organized their parallel sessions within their premises and under subthemes decided by each faculty.

The proceedings of annual research symposium 2014 contain 150 abstracts of research papers in total, submitted by academics in the University of Colombo and outcome of joint research projects they have undertaken with their postgraduate students. Out of these abstracts, 17 were from the Faculty of Education, 16 were from the Faculty of Graduate Studies, 26 were from the Faculty of Law, 06 were from the Faculty of Management and Finance, 51 were from the Faculty of Medicine, 30 were from the Faculty of Science, and 04 were from Sri Palee Campus of the University of Colombo. Each and every abstract was sent for blind refereeing and then revised according to comments provided by respective reviewers. No doubt that each and every abstract in this proceedings will contribute to the advancement of the existing knowledge of the disciplines and enhancement of the relevance to the university-industry collaboration to strengthen the knowledge hub of Sri Lanka. I am sure that intrinsic value of this publication can be fully utilized for further development of disciplines, technology, systems, and also, for policy making. Finally, I would like to congratulate all authors, paper presenters, and organizers of this Annual Research Symposium 2014.

Professor H. D. Karunaratne
Chairperson, Annual Research Symposium 2014
University of Colombo
Sri Lanka

FACULTY OF EDUCATION



Message from the Dean



It is with great pleasure I am sending this brief message to the proceedings of research symposium 2014. Research symposium is an important event which provides university academics an opportunity to showcase their research findings and discuss their relevance and validity with their colleagues as well as with other relevant stakeholders who make use of these findings towards national development purposes. Postgraduate students are also taking part by presenting their research findings in the proceedings. This will enhance the quality of post graduate research in the Faculty of Education.

This year the symposium theme is “University Industry Collaboration for strengthening the knowledge hub of Sri Lanka.” This is one of the major trends in the university education throughout the world. Its relevance is very clear when considering the role of the universities in the socioeconomic development of Sri Lanka.

Though the Faculty of Education has no direct collaboration with the industry, it has a close collaboration with the school system in Sri Lanka.

I would like to congratulate the staff and the research students for disseminating and sharing their research findings with other university academics as well as stakeholders.

I would like to take this opportunity to thank the Vice Chancellor and the organizing committees of the University and the Faculty Research Symposia for their efforts to make this event a success.

Professor Chandradasa Wannigama
Dean, Faculty of Education

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Job Satisfaction of Graduate Teachers

W. Chandradasa

Department of Educational Psychology

A teacher occupies an important and unique place in school education. Their job satisfaction is an important factor for the achievement of educational aims and objectives of the school system. This study investigated graduate school teachers' job satisfaction focusing on three research questions. They are; what is the level of job satisfaction of graduate teachers, how teacher related factors associated with job satisfaction and how school related factors associated with job satisfaction.

Research design for the study was descriptive survey. Participants were one hundred graduate teachers who followed the post graduate diploma in education at the Faculty of Education, University of Colombo. A questionnaire was administered for collecting the data related to teacher related factors, school related factors and job satisfaction. To measure the job satisfaction level, Minnesota Satisfaction Questionnaire (MSQ) was used. It consisted of 100 items which measure 20 dimensions of job satisfaction and two main factors (intrinsic and extrinsic). Each item rates the job satisfaction from 1 (minimum) to 5 (maximum). Data analysis was conducted using SPSS. Descriptive statistics, T tests and F tests were used.

Results showed graduate teachers are at a satisfactory level with their job (Mean=3.2, SD= .56). However satisfaction level of extrinsic factors is (Mean=2.9, SD= .6) significantly lower than intrinsic factors (Mean= 3.3, SD= .6). They are highly satisfied with the opportunity they got to serve the society while they are dissatisfied with the salary and physical facilities in the school. Gender seems to be an effective factor for the job satisfaction. Women's satisfaction level is higher (Mean=3.3, SD= .3) than the men's satisfaction level (Mean=2.9, SD= .3) ($t=2.1$ sig= .02). There is no significant correlation between job satisfaction level and Age ($r= .08$) or experience level ($r= .17$). There is no significant effect of school type on the satisfaction level of teachers (1AB Mean=3.3; 1C Mean 3.1; Type 2 Mean=3.1; Type 3 Mean=3.0). However, the national school teachers seemed to be more satisfied (Mean=3.4) than provincial school teachers (Mean 3.0). It seemed that extrinsic factors are more effective for teacher satisfaction than intrinsic factors. This indicates that teachers' salaries and school environment should be made more attractive for the enhancement of the job satisfaction.

**An Inquiry into the Lecturing Strategies Adopted by
Buddhist Priests in Delivering the *Dhamma*:
A Transfer of Learning to Enrich the Teaching-learning
Contexts in Higher Education**

N. V. Karumasena

Department of Science and Technology Education

The lecture method is considered as a teacher centered teaching method and as a less effective teaching strategy. However, Buddhist priests have been using the lecture method for their sermons in an effective manner. This study attempted to identify the strategies used by Buddhist priests in delivering the Dhamma, in order to discern positive features with a view to improve the lecture method in educational contexts. In the process of collecting data Dhamma sermons were observed. Further, discussions with twelve veteran Buddhist priests were carried out to discuss the methods adopted in preaching. A selected sample of discourses from Tripitaka was also perused.

Findings reveal specific features such as, addressing the audience suitably to establish a good rapport, frequent questioning to evoke critical thinking, using necessary quotations, using parables, events and similes to support the imaginations and to highlight facts, refined and organized style of speech. Elaborations to the content in relation to the context, use of synonyms and comprehensible delivery which is not too deep or too simple were also found to be characteristics of Dhamma sermons.

Based on these findings, following characteristics can be recommended as essential

1. Lecturing should not be done for one's own concern.
2. Understand the subject and the learner well before lecturing
3. Plan the lecture to suit the time and requirement without undermining the listener.
4. Use the language of the listener.
5. Do not miss examples.
6. Lecture to suit own personality.
7. Organize the sequence well.
8. The vocalizations should be sonorous, pleasant with modulated sound, use of compatible words.
9. A lecture should provide a ground to learn new things, enhance the present knowledge, improve rational thinking, clarify doubts, refresh one's mind and develop a vision.
10. A learner should be trained to be aware of the beginning, middle and end and also has to learn without undermining the lecture, lecturer, or one's own self.

Effect of Psychological Intervention on Student Aggression

S. Senarath

Department of Educational Psychology

Aggression is a worldwide problem that prevails in schools, and it is also a point of discussion and a concern of schools in Sri Lanka at present. Aggression has become a common feature of the school life of students, and to a certain extent of teachers as well. It is not clear whether the transition from traditional society to modern society which caused loosening of family ties, contradictions between student interests and school demands, agony, and conflict in youth contributed to an increase in aggressive behavior. The objectives of of this research study are to identify familial, psychological, and educational factors that may cause aggression, investigate the level of aggression and examine a psychological intervention effect implemented to decrease the level of aggression in an experimental group in contrast to the control group.

The survey and experimental methods were employed for the present study. An aggressive and nonaggressive sample of students was selected based on the nomination of a student counselor, as well as teacher and peer nominations within the schools. 150 students aged between 11-14 years (75 aggressive students and 75 nonaggressive) were included from Colombo zone. In this study two data gathering instruments were used and they are questionnaires, (standardized tests) and interviews. For the psychological intervention 30 students as an Experimental Group (EG) and 30 Control Group (CG) were selected out of the aggressive students. Psychological intervention consisted with counseling, painting therapy and relaxation. These techniques were applied for five months for the mild to moderate level aggressive students. Pretest and posttest were applied and changes of emotions were measured with the standardized test.

Pre intervention results (pretest) proved that children encountered mild-to-moderate aggression behaviors. The common types of aggressive behaviors were class disruptions, ridiculing and teasing, fighting in groups. Further, negative emotions such as getting angry easily, being frustrated, excessively worrying were also present. Intervention results of the two-way ANOVAs with three measurement times revealed that there was an overall reduction of aggressive behaviors and educational and social relationship difficulties of EG in compared to the CG. The children and adolescents of the experimental group showed a substantial improvement in mood, fearlessness, and states of relaxation.

Principals' Experiences on the Implementation of the Program of School Improvement: Evidence from the Colombo District School Principals

C. Kasturi Arachchi

Department of Social Science Education

This study was planned to explore the experiences of the principals on the implementation of the Program of School Improvement (PSI) in the government schools in Sri Lanka. This program was introduced in Sri Lanka in 2006, and is an ongoing program in the majority of the government schools, as the implementation is compulsory. The Ministry of Education has issued several circulars to support the implementation of this program. According to the circulars, principal is the one who plays the key role in school management; hence, his role is vital in this school management concept. Therefore, this study is aimed to explore the principals' experiences on the implementation of this program in their schools. The nature of this study is qualitative, and case study approach was used to study this research problem. Ten principals were purposively selected from the Colombo district schools to gather information for this study. Semi-structured interviews and informal discussions with the stakeholders of the schools were conducted. Informal observations and survey of relevant documents were carried out. Data were analyzed using thematic analysis and simple statistical tools. The study revealed that the principals of the majority of the schools still played the key decision making role. The majority of the principals believed that the participatory decision making is not very easy to be implemented since stakeholders do not have sufficient knowledge and experiences on school management and the PSI. All principals preferred to implement PSI in their schools, even though they faced many challenges in the implementation. Supply of resources, poor commitments of stakeholders, less support of the higher authorities were the main challenges. The study concludes that it is vital to organize a PSI awareness program for stakeholders. In addition, it is essential to establish a supervisory body to guide the schools that implement PSI. Members of the School Development Committee should be given management training for the effective implementation of the PSI.

Writing is for High Achievers: Improving the Writing Skills of Low Proficiency English Language Learners

M. Perera

Department of Humanities Education

National Assessment and Public examination results in Sri Lanka confirm that English as a Second Language learners' writing skills are generally weak. According to G.C.E. O/L Examination - 2011 English Language Evaluation Report students performance in both the writing tasks are unsatisfactory. It claims that "writing skill has become a barrier for the candidates to perform well in the examination" (p.35). A national Assessment of Grade Eight student 2012 confirms that writing is the weakest skill of the students. According to the findings of this study students of 1C and Type 2 schools performance is very much below that of the students of 1AB and National schools. These reports highlight the need to pay special individual attention to improve the writing skills of low performing second language learners. This paper is based on a collaborative action research conducted in two grade 7 classes in a Type 1C and a Type 2 school in the Gampaha education zone. The main purpose of this collaboration is to utilize a product based approach to improve the basic skills in writing of the low performers as well as facilitating teachers' skill development in improving students' writing skills. The collaborators in this study were a University academic who was the principal researcher, two Regional English Support Centre (RESC) staff and the two teachers of the respective schools. In the first cycle of the action research a pre test designed to test the identified basic competencies in the primary ESL curriculum was administered. The findings revealed that none of the students in the Type 2 school could write a grammatically correct sentence while in the Type 1C school only three students could do so. In the second cycle activities were designed and taught to develop the basic competencies. Analysis of the ongoing activities indicates positive results. A post test would be administered to assess the performance after the intervention. This study would also be an opportunity to train two teachers and for the RESC to implement such programs in the entire zone in the future.

Teaching English Literature to Develop Employability Skills

E. S. Neranjani

Department of Humanities Education

The main purpose of this study was to explore the nature of teaching English Literature in the state schools in Sri Lanka in order to identify the extent to which English Literature is used to develop the employability skills of learners. In the current industrial economy employability skills have become a deciding factor in securing employment in any country. Educationists have identified that competencies such as language and communication skills, personal, social and emotional development, knowledge and understanding of the world, critical thinking and creativity as employability skills that can be developed through teaching Literature. Therefore, it was important to find out issues and problems teachers were faced with in teaching English Literature in schools, whether the teachers who teach English Literature were aware of the employability skills that could be developed through teaching Literature and whether they were aiming at developing these skills in the classroom. Data were collected for the study by administering a questionnaire, classroom observations and interviews on a purposive sample of teachers who taught English Literature in the secondary schools. Both quantitative and qualitative methods were used in analyzing data. Finally, the key findings of this study revealed that, all the teachers in the sample who taught English Literature in schools were not aware of the employability skills that could be developed by teaching Literature. They used the literary texts extensively in the development of four language skills; listening, speaking, reading and writing at the surface level but did not use it in the development of other skills. However, they all strongly agreed that Literature was an effective tool in developing critical thinking and creativity. They stated their strong desire to develop their own literary knowledge and skills. Therefore, the teachers should be given opportunities to develop their knowledge on using Literature to develop employability skills of students because many educationists have identified Literature as an effective tool in developing higher order skills.

Suitability of Second National Language Textbooks (Tamil)

S. Athirathan

Department of Social Science Education

Second National Language (2NL) was introduced as a compulsory subject in junior secondary grades in 1998. Two periods per week were allocated to teach 2NL in these grades. However, the number of periods allocated in the timetable per week is not enough to teach 2NL. Text books were prepared and distributed under the free text book policy by the Education Publication Department (EPD) of Ministry of Education. Existing studies on 2NL teaching revealed that text books are not very attractive to learners there is no logical connection between 2NL syllabuses and the teacher instructional guide (TIG). Curriculum and the syllabus were not developed sequentially, in addition, TIG failed to provide theories and methodologies regarding 2NL Teaching. The research used a descriptive survey design and conducted in Colombo and Piliyandala zones in the Western Province, Sri Lanka. 100 out of 640 students learning in Grades 6-9 in the two zones, and 16 principals and 75 teachers from 16 schools were selected using stratified random sampling. Quantitative and qualitative data were gathered using questionnaires, focus group discussion, and checklist. Findings reveal that 70 % of teachers were of the opinion that the text books give more emphasis on syntax and grammar. 68 % of students had developed negative attitudes towards 2NL learning. 62% of teachers indicated that the objective of teaching 2NL does not match with text books. The content of the text book is organized with the purpose of mastering the language but not to fulfill communication needs. 60% of teachers expressed that the text books and other instructional materials are not attractive for the learners. Students and teachers did not see much difference between L1 and L2 text books. Extended activities for learning 2NL are not adequately included in the text books. Relevant activities for learning 2NL are not adequately included in the text books. There is a big gap in vertical and horizontal integration in content and continuity in text books. The study recommends further research on each of these aspects related 2NL curriculum and materials.

Career Aspirations in Childhood and Adolescence: An Analysis Based on Eli-Ginsberg's Theory

E. Randeniya

Department of Educational Psychology

Although many recent research studies have been carried out on career aspirations of students in primary, secondary and tertiary levels in other countries, only a very few studies have been conducted on career aspirations in childhood and adolescence in Sri Lanka. This study focused on identifying the severance of career aspirations of students in three age groups; up to eleven years, 12-16 years and 17-21 years. The age limits were identified according to career choice theory of Eli Ginsberg. The study also explored the reasons that influenced the career aspirations and identified the persons who have guided and facilitated perceived advantages of the careers which they aspired. This is the phase one of the longitudinal survey and was carried out on a sample of 240 students selected from two schools in rural and urban areas using stratified random sampling method. An equal number of male and female students were selected from grades 6, 9 and 12. Data were collected using a questionnaire and analyzed using quantitative methods through SPSS. Data analysis revealed that both girls and boys in the age group up to eleven years preferred to become doctors. Age 12-16 group differed in their aspirations across the two genders. While girls preferred to become doctors, boys aspired sports related careers in addition to becoming doctors. 17-21 year group also showed a gender-wise difference. While girls aspired to become teachers, boys were inclined towards engineering and accountancy related careers. All age groups had a limited range of career aspirations. The main reason for having specific aspirations given by the two younger age groups is that they wanted to serve the nation. The 17-21 year group made their aspirations with an expectation to gain a satisfaction. However, there was no significant difference in age groups between rural and urban sectors. Further, the study revealed that the parents had guided all the age groups in forming their career aspirations. Majority in all groups stated that financial gain was the main advantage of a career. The study recommended that steps should be taken to appoint career guidance teachers in every school in order to develop and strengthen career aspirations in students with a broader perspective on the world of work.

An Integrated Approach of Formal and Non-formal Education to Improve the Quality of School Education in Sri Lanka: A Fact Finding Case Study

L. M. K. Bandara

Department of Humanities Education

In the lifelong learning society, formal, non-formal and informal are no longer considered as discrete educational segments across the world. A number of arguments have been forwarded in linking them. It would be more efficient and effective to introduce an innovative integrated educational approach, instead of maintaining and expanding the existing separate educational structures, mainly the formal and the non-formal (NFE) to cope with the current socio-economic realities and needs of this century. If these two approaches can provide assistance to each other, it would facilitate better functioning of both. Further, it would provide a more effective service to their clients. In the present operational nature of the formal and non-formal education in Sri Lanka, a link between the two models is not visible. This paper attempts to investigate the perceptions of the stakeholders on the possibilities to integrate formal and non-formal segments. As the first phase of a mixed methods design, a fact finding case study was conducted in the Maho educational zone in North-western province. A purposive sample of 20 students, 5 principals, 5 instructors and the NFE zonal director were selected as respondents. Multiple methods such as, a student questionnaire and structured interviews for instructors, principals and for the NFE zonal director were adopted. The data revealed that the respondents were in favour of the integration of formal and NFE models. They expressed that the integration will help to bridge the gap created by formal education through a possibility to follow skill oriented subject components offered under the spectrum of NFE along with the formal curriculum. Over 70% of the sample proposed that a special unit of non-formal education be established in schools in collaboration with non-governmental and governmental organizations such as German Development Cooperation (GIZ), National Apprentice and Industrial Training Authority (NAITA) in order to facilitate students to choose a skill training component parallel to the formal curricular subjects. The idea, that “recently introduced technology subject stream could have been implemented through this proposed special NFE unit” was stressed by the majority. The study recommended a survey to investigate the prevalence of these views across a nationally representative sample of educational zones of the country.

The Nature of Authentic Assessment: Evidence from Literature Review

C. Chandrakumara

Department of Educational Psychology

The goal of assessment is to facilitate student acquisition of higher-order thinking processes and competencies rather than factual knowledge and basic skills. Authentic Assessment (AA) is a form of assessment in which students are asked to perform real-world tasks that demonstrate meaningful application of essential knowledge and skills. Encouraging the usage of AA methods has become a priority of the Sri Lankan education system because it has been recognized as an effective method across the world. This study is a literature review related to an ongoing research titled 'Usage of AA methods for assessing Sinhala language in schools in Sri Lanka'. This paper analyzes educational reports, textbooks, related articles and e-journals as well as research papers for developing themes such as definitions of AA, characteristics and goals of AA, differences between traditional assessment and AA, advantages and disadvantages or limitations of AA and conceptual framework on AA.

It was revealed that the AA methods have the strength to achieve the goals of effective assessment. AA requires students to use the competencies or combinations of knowledge, skills and attitudes. Most importantly, they are expected to apply learning to real-world situations in the personal life. The conceptual framework of AA identifies and describes the relationships between the elements; instruction, assessment, students' perception and achievement in authentic contexts. Instruction and assessment should be linked and therefore both should be planned at the same time in order to influence student learning. The assessment task, physical context, social context, assessment results or forms and criteria were found as five dimensional framework of AA that can be used to vary the level of authenticity. There are more advantages of AA than the disadvantages or limitations. 32 assessment methods were identified that can be used in Sri Lankan school education context.

The authentic assessment is concerned with the mental processes, deduction and exploration skills through engaging the students with problem solving and proper decisions making for their ages. Limited researches were found

on these trends in the Sri Lankan context. Therefore, the paper recommends a field study on the practices of AA and to initiate a broad discussion in the school education system towards making improvements to teaching, learning and assessment process in General Education of Sri Lanka.

Active Learning in Science through Content and Language Integrated Learning

M. V. Vithanapathirana

Department of Educational Psychology

The purpose of the study was to identify opportunities for active learning of Science in bilingual education settings where Content and Language Integrated Learning (CLIL) model is adopted. In CLIL the subjects are taught through a foreign language with dual-focused aims, namely the learning of content and the simultaneous learning of a foreign language. Today the world's population is becoming bilingual or multilingual than monolingual. In addition to facilitating cross-cultural communication, this trend positively affects cognitive abilities as well. Research has shown that the bilingual brain can have better attention and task-switching capacities than the monolingual brain. Learning science through a second language in a bilingual stream of education is considered as suitable because science is a subject which has extensive contextual support for learning with reduced language demands. Active learning, student-centered pedagogical approaches focus on the learner and what the learner does. However, active learning doesn't just happen. It occurs in the classroom when the teacher creates a learning environment that makes it more likely to occur. The first objective of the study was to review literature on active learning within Science CLIL. More than twenty research papers were reviewed. The second was to generate a framework on active learning through a case study. Hence, a teacher was selected purposively based on basic criteria such as accessibility, training and willingness of the teacher to participate in the study. Findings from the review of research indicated that CLIL lessons are expected to be task based, interactive, cognitively demanding and technology integrated. However, some research indicated that the taxonomy of cognitive questions asked by teachers showed a higher prevalence of questions of lower order thinking skills. In addition the type of active learning tasks were classified into low risk and high risk tasks. Analysis of case study data from multiple sources revealed that a high emphasis was given within Science CLIL lessons towards language support. However, the use of attractive material, discussions, group and pair activities, shared reading, student presentations were within active learning episodes of CLIL. Student perceptions on CLIL methodology were mixed. Study recommended further

studies to understand active learning towards content learning within CLIL. Based on the framework developed on active learning within teaching Science through CLIL a large scale mixed methods study is recommended.

Addressing the Counselling Needs of Primary Students: The Current Practices of Teachers in Colombo South Tamil Medium Schools

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Department of Social Science Education

This study is an ongoing research on the current situation pertaining to the primary student counseling services in the government Tamil schools in Colombo- South. This study will attempt to identify the situations and problems confronted by teachers with respect to counseling provision. This study addresses two objectives such as identifying the socio-economic, physical, psychological, school and family factors influencing the behavioural problems of primary students and to identify the impact of behavioural problems of primary children on their educational achievement.

In order to achieve these objectives, out of the, three national schools, two IC mixed schools and were selected. 50 students, 50 parents, 10 teachers and 5 principals were sampled for the study. This research was done using mixed research methodology. Data was collected by administering a questionnaire and checklist. Qualitative data were also collected.

It was found that the majority of the primary students enrolled in these schools were from disadvantaged socio-economic backgrounds. Most of them are orphans or are neglected by their parents due to foreign employment or other personal reasons. They were unable to participate in the classroom activities enthusiastically. Malnourishment due to low family income, ignorance of parents, unsuitable living conditions and misuse of modern communication technology resulted in a very low interest in studies. They have problems of developing a healthy self concept and suffer from mental agony resulting in uncontrollable behavior directly effecting their education.

Almost all principals reported that the primary sections lacked a counseling service and they were not in a position to address counseling needs of students due to this shortcoming. They too believed that it is essential that teachers are given a proper training in counseling. The study recommended that counseling services be installed in primary sections of schools.

Asking Questions the Right Way: An Analysis of the Questioning Techniques Adopted by Pre-service Student Teachers

R. M. D. Rohan and M. V. Vithanapathirana

Department of Educational Psychology

This paper is based on the first phase of a study aimed at developing the questioning techniques of prospective teachers of English. The objective of the first phase of the larger study was to inquire in to the current situation on the use of questioning techniques during the practice of teaching within the teacher education program. Review of research shows that pre-service teachers do not receive enough practical teaching opportunities during their on campus training. Substandard skills of prospective teachers were noticed when their lessons were observed. The literature emphasizes that among many teaching skills, questioning techniques should be paid special attention, in language teaching. Developed questioning techniques assist teachers in several other aspects in teaching such as class control, building rapport, motivation ...etc. A convenience sample of 30 student teachers was selected from Pasdunrata National College of Education. A checklist comprising of five sections on general aspects of questioning was used to find out the current state of questioning. Observation schedules and field notes were also used to record and analyze the questions and questioning techniques used by the practicing teachers. The data gathered through the above mentioned instruments and methods when triangulated showed that the existing methodology of instruction has not produced effective results in developing the questioning techniques of prospective teachers. Although they had scored reasonably high scores for some sections on the checklist least scored section was for probing skills. This aspect was confirmed as many inaccurate questions were noticed through observation. It was further found that, although the prospective teachers changed their tone in asking questions they rarely used probing questions effectively. Therefore, the study suggested that prospective teachers be encouraged to preplan their questions whenever possible and “micro teaching” be used to develop questioning techniques of prospective teachers since it is found to be a successful technique in improving teaching skills.

Cultural Perceptions of Teachers of English: Bridge or Gap in Language Teaching?

S. R. Tennekoon and W. M. Pragnadarshana

Department of Science and Technology Education

Sri Lanka is a multicultural society. Although schools are segregated on the medium of instruction, teachers of English are increasingly being required to work in schools where medium of instruction is not their mother tongue and therefore, they have to work with students coming from culturally and linguistically diverse backgrounds. Accordingly, the competence of communicating across cultural boundaries has become a prerequisite of professional competence of English language teachers. This includes areas such as attitudes; cross-cultural understanding and multi cultural awareness .which also are important components of intercultural competence. This paper is based on a part of an MPhil research and attempted to identify whether the teachers of English trained by National Colleges of Education (NCOE) possess the positive perceptions on cultural diversity and multicultural awareness in order to handle culturally and Linguistically Diverse (CALD) students.

The paper reports findings from a mixed method study carried out in Pasdunrata National College of Education and data includes a survey based on an attitudinal scale implemented with a convenience sample of 20 second year trainees and 20 internship trainees undergoing training at Pasdunrata NCOE Twenty permanent teachers passed out from the institute who work in schools where medium of instruction is not their mother tongue and telephone interviews conducted with ten teacher trainees randomly selected from the above sample.

Findings revealed that majority of the student teachers trained by the NCOE has negative perceptions on cultural diversity which would ultimately have a negative impact on handling classrooms with students coming from culturally and linguistically diverse backgrounds. This paper suggests practical ways to overcome the defect.

**Student Perceptions:
Family and Classroom Level Support Received
by Secondary Level Bilingual Mathematics Learners
in Sabaragamuwa Province**

D. Keppetigoda and W. Chandradasa

Department of Educational Psychology

Bilingual Education (BE) has gained popularity as a successful educational programme that can be used to enhance the achievement level of students in both non- language subjects and the Target language. In the Sri Lankan context, BE is defined as an educational program conducted using English as the medium of instruction in a few selected subjects including mathematics and Science. BE was introduced to the Education system of Sri Lanka in 2001. However, the promotion of BE in the country has not been successful as expected since its introduction thirteen year ago. Only 1.3 percent of the student population study in the BE stream. Research in this field suggests that it normally takes 5-7 years for a Second language student to become a successful learner. However, learning a difficult subject like mathematics through a language other than the first language is a challenging task for students. Therefore, it is essential that a proper supportive mechanism should be present in the family level and the classroom level until such time that they become successful learners in English which is the language of learning in bilingual education contexts. The main purpose of this paper is to explore student perceptions regarding the support that they receive by both at family level and the classroom level to learn Mathematics in the BE contexts. Perceptions of a randomly selected 170 secondary level Bilingual learners from 12 schools (1AB and 1C type) in the Sabaragamuwa province were surveyed using a questionnaire. The data were analyzed using descriptive statistics and one-way ANOVA technique. Findings revealed that there is a positive perception of students with regard to the support they receive at the family and classroom level. However, a significant difference of the family support between the students in two types of schools was found. 1C schools had a lower value. There is also a significant gender-wise difference with respect to classroom support as perceived by students. It is recommended that guidance of parents (especially in 1C schools) and training of teachers on how to support students (especially male students) learning in the BE mathematics class will be effective for the promotion of BE in the country.

Literature Review to Investigate the Relationship between the Level of Emotional Intelligence and the Level of Aggression of Adolescents

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Department of Educational Psychology

This paper is based on a part of an ongoing study, 'Effect of emotional intelligence (EI) intervention on the level of aggression in adolescence,' a quasi experimental study with matching only pre test post test design. This paper is an analysis of research literature that investigated the relationship levels between aggression and emotional intelligence in adolescence.

Research findings presented in this review paper are based on data collected from books, research papers, and reports. The studies reviewed were correlational studies and experimental studies with psychological interventions on emotional intelligence. The themes discussed are namely, aggressive behaviour, emotional intelligence, EI intervention and adolescents.

The literature review proved that adolescents who have more advanced emotional abilities show lower stress levels, fewer signs of aggression, and demonstrate a smaller likelihood of involvement with drugs and alcohol. Adding to the social competencies, those individuals who have higher levels of emotional intelligence are found to be with a stronger ability to empathize, generally leading to their ability to conform better to organizational requirements. This finding is strengthened with a claim, that lower emotional intelligence levels of youth offenders were correlated with higher aggression scores, and these participants scored the highest in physical aggression. It is also revealed that EI influences the development of socially competent behaviors.

Thus it is concluded that lower levels of EI is associated with aggressive and disruptive behaviors in adolescents where as higher levels of EI are connected to lower levels of stress, and social competencies. The ongoing research would reveal the status of the relationship between EI and aggression in adolescents in Sri Lanka.

Expected Language Performance in the First Year of the English Medium Bachelor of Business Administration Degree: A Qualitative Analysis of Content Lecturers' Views

Z. D. Hussain and M. Perera

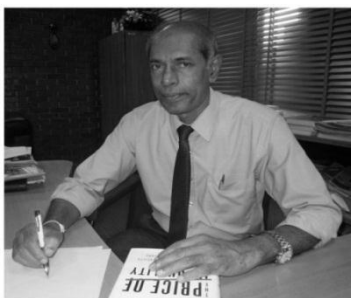
Department of Humanities Education

Low or limited English language proficiency (LEP) is an existing problem among a percentage of Sri Lankan undergraduates pursuing higher education in the English medium. This paper is based on a larger study that aims to identify the English language needs of first year undergraduates of a particular English medium degree program in order to design a specialized English language intervention to prepare LEP students to face the English language demands of this program. The degree program selected for this study is the English medium BBA (Bachelor in Business Administration) program conducted by the Faculty of Management and Finance of a national university. This paper explores the content lecturers' views on the students' English language needs. The lecturers' views were sought as they have first-hand experience with the students' struggle with English medium education. Further, to a great extent, the students' English language needs are defined by the content lecturers' expectations, criteria and attitudes on successful academic performance. In order to access the lecturers' views seven lecturers conducting first year lectures for the BBA program were selected. The tool used to gather this data was the semi structured interview. Interviews were conducted based on a pre-selected set of questions with freedom to add or delete questions based on the interviewees' responses. The pre-set questions focused on the students' language needs, displayed language problems and lecturers' expectations with regard to the students' English language proficiency and possible English language interventions. The qualitative data analyses process of conceptualizing was employed followed by analysis of identified patterns. The data reveals that all lecturers are keenly aware of the existence of low English proficiency among the undergraduates and it also reveals the specific language demands for academic success. Further, the majority of those interviewed were favorable towards a specialized English teaching approach which is based on the content of the first year BBA program and which takes into account the English language demands of this program.

FACULTY OF GRADUATE STUDIES



Message from the Dean



It is indeed with great pleasure that I write this message for the Annual Research Symposium 2014 of the University of Colombo. The Faculty of Graduate Studies (FGS), the winner of Asia's Best B-School award for fourth consecutive years from 2011 to 2014, is a key contributor to the human capital development of Sri Lanka. Its mission is to foster excellence, creativity and value innovation in postgraduate education and research at the University of Colombo.

The Annual Academic Session of the Faculty of Graduate Studies provides an opportunity for the academics and colleagues from private and NGO sectors, members of the public and postgraduate students to exchange views and engage in discussions on a wide variety of topics portraying the multi-disciplinary nature of the FGS. This year's sessions had 29 abstracts and 07 presentations representing themes from Social Sciences, Humanities, Law, Finance, Education and ICT.

I am thankful to all those who worked hard to make this event a reality and I wish the presenters, discussants and participants a fruitful time at their respective sessions.

I wish the symposium great success.

Professor Sunil Chandrasiri
Dean, Faculty of Graduate Studies

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Operator Empowerment Strategy in Human Capital Development for Sustained Growth in the Printing Industry

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This study has examined the impact of operator empowerment strategy in human capital development on sustainable growth in the printing industry. Study was conducted in one of the extra large offset printing organizations in the printing industry through in depth case study. Main objective of this study was to analyze the effectiveness of the operator empowerment strategy in order to achieve business and manufacturing performances. Therefore analyzing the relationship between business & manufacturing performance measures and operator empowerment attributes was a subsequent objective. In order to implement operator empowerment program the key attributes were selected as per the literature and those were, distribute power, information, knowledge, and rewards. Accordingly extensive operator empowerment program was executed at the shop floor to deploy the strategy. Pearson's correlation analysis showed that there was a highly positive relationship between operator empowerment and manufacturing performance attributes, ie. more empowered operators would perform better in terms of cost, quality, speed and attendance. The results of regression and correlation of coefficients of operator empowerment were positive and significant. Hence, empowered operators will help organization to achieve its sustainable growth.

Role of Standards in Human Capital Development for Sustained Growth in Printing Operations

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The paper aims on the role of standards in human capital development for sustained growth in printing operation. In the modern manufacturing environment sustain their operation through stringent manufacturing standards. Especially in multinational organization developed these standards to provide uniformity on their products that manufacture in different location in the globe. As a service driven manufacturing operation like offset printing need to adhere such stringent standards stipulated by those multinational organization for their future sustain in the business. This study shows the importance of the standards in manufacturing operation to sustain in Human resources (HR), Operational performances and financial performances.

Towards a Model for Use and Acceptance of Information and Communication Technologies (ICTs) among University Students in Sri Lanka

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Literature reveals a lack of sufficient interest in individual use and acceptance of ICTs even though ICTs are essential for the present job market demands. Although the Unified Theory of Use and Acceptance of Technologies (UTAUT) is very promising in enhancing our understanding of technology acceptance, it needs adjustments in key determinants and the moderators in outside contexts. Many researchers have found that culture has a strong contextual influence on an individual use and acceptance of ICTs. Review of the existing theoretical frameworks indicated that they do not reflect the unique individual cultural situation of Sri Lanka. Therefore, the current research aims at proposing a model which best describes the use and acceptance of ICTs among university students in Sri Lanka with the intention of promoting usage and future acceptance. This model illustrates the conceptual underpinning of the UTAUT and the Hofstede's Cultural Dimensions Theory and it reflects the scientific theoretical conceptualisation of ICT use and acceptance behaviour.

Physico Chemical Properties of Water Quality Variations in the Negombo Estuary of Sri Lanka

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Present study focused on variations of Salinity, Dissolved Oxygen, Turbidity, pH, Electrical Conductivity, Dissolved inorganic Nutrients, Total Dissolved Solids, Total Suspended Solids, Biochemical Oxygen Demand and Chlorophyll-a of surface water collected from different sampling points of Negombo estuary measured during January 2013 to December 2013. The sampling locations were selected at channels entering to the estuary. The annual pH variation was from 6.7 to 8.1 throughout the year. The maximum salinity variation of 27.0 ppt and EC recorded in 33.1 ms/cm, increased towards the sea mouth as compared to another stations. The DO level was found to be 4.5 to 6.6 mg/L, while BOD level was 12.7 to 28.7 mg/L in all stations. Nutrients (NO_3^- , PO_4^{3-} , and NH_4^+) exhibited an increasing trend from canals entrance to the estuary. TDS values were found to be in the range of 15.2 to 43.2 g/L, and TSS values were high in the northern part of the estuary due to higher amount of floating particles. The concentration of nitrate was 0.6 mg/L to 1.37 mg/L were within tolerance limits. Chlorophyll-a ranged from 3.2 to 12.9 mg/L. The spatial and seasonal variation in water quality parameters were observed with peak periods from May/June and October/November which apparently coincided with the SW and NE monsoon of the island respectively.

Challenges and Prospects of Truth and Reconciliation: A Case Study on Internally Displaced Northern Muslims in Sri Lanka

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Due to the prejudiced defiance of the ruling regimes in the past, many dejected youths in the Tamil community of the Northern and Eastern provinces, converged towards a militant movement called LTTE. They resorted to armed conflict to accomplish their inalienable rights without the support of their Muslim brethren and were annihilated at the end of thirty years old struggle. The LTTE in these provinces also universally conveyed a castigating message and committed the ethnic cleansing with a misconception by forcibly evicting nearly 72,000 ethnic Muslims out of the Northern Province during the latter part of October, 1990 from their traditional homelands of many centuries (Balasundarampillai and Hasbullah 1996). In the absence and persisting undue deferment of a sustainable solution, the forcibly evicted Northern Muslim IDPs (NMIDPs) are living in horrendous condition in and around Puttalam District for the past 24 years (Bulathsinghala 2008).

Violent Internal Conflict in Wukari Town, Taraba State, North-East Nigeria: A Human Capital Perspective of the Education Sector

I. Biu

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Human capital is pivotal to the transformation and upliftment of any society. Studies have shown that northern geo-political zone comprising three regions of North West, East and Central compared with the south within the Nigerian federation though larger in terms of human population and landmass is besieged by a reoccurring violence. The rivalry arising from ethnic and religious differences within an unstable political history has triggered this phenomenon. The study relies on secondary sources within the greed and grievance theory and the discourse of Niccolo Machiavelli to understand the effects of this collective violence on human capital. Wukari town is selected based on recent antecedents of violence and the study tilts its lens on the political leadership appropriateness in the use of retributive and restorative justice within the paradigm of conflict resolution in governance.

Learning Organizations and the Business Performance: Evidence from the Manufacturing Industries in Sri Lanka

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The greatest studies of Peter M Senge (1990) can be regarded as one of the pioneering efforts of introducing the Learning Organizations (LO) concept to the world. He interprets Learning as Meta Noia – fundamental shift of the mind or in Greek it meant a fundamental shift or change, or more literally transcendence ("meta"—above or beyond, as in "metaphysics") of mind ("noia," from the root "nous," of mind) Even though many scholars have made great attempts to investigate the robustness of the Learning Organization (LO) philosophy, a few researchers have made attempts to clarify the relationship between Learning Organizations and Business Performance (BF) since it may vary depending on the robustness of the objectivity of the business performance measures, and even fewer researchers have investigated whether LO disciplines have resulted in better business performance in Sri Lankan Manufacturing sectors in the midst of highly volatile global business environment. The Purpose of the article is to investigate whether manufacturing organizations in Sri Lanka which practice LO philosophy have made business performance improvements.

Among the most prominent findings, the research reveals that the modern Sri Lankan manufacturing companies which have embraced LO philosophy by implementing subordinates empowered, flat hierarchical organizational structures which promote shared vision through collaborative spirit de corps, encourage having holistic view of the entire organization through systems thinking, demonstrate strategic visionary leadership, provide ample opportunities for continuous lifelong personal mastery that encourage innovations and creations of new product development and more efficient work processes have gained a sustainable competitive advantage and better BF in the midst of globalization. Originality of the study is that the article contributes to the literature by discovering more prominent dimensions of LO philosophy in Sri Lankan manufacturing industries concentrating more on the perceived non-financial measures of business performance. This research lays the foundation for future research studies in Sri Lankan manufacturing organizations that are intent on developing learning cultures and internal systems to support ongoing learning in hopes of fostering

creativity and performance. The replication of the study in service organizations which dominates the Sri Lankan Economic sovereignty will result in healthier sustainable economy in the midst of turbulent business environments existing in global markets.

Parental Negligence and Child Abuse: A Critical Analysis on Child Protection Mechanisms in Sri Lanka

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Children are innocent and vulnerable hence protection must be provided for them. Obligations to protect child rights is crucial to all members of the society; who may be either policy makers, public servants, parents, teachers, ordinary citizens or children themselves. However, child abuse prevails in today's society and children are at risk. Therefore the objective of this research is to enhance knowledge on child rights, inculcation of a sense of commitment in parents and community as a whole and to discuss child abuse prevention methods to uphold and protect child rights.

This research examines whether child abuse has rampant due to parental negligence and further examines as to why children continue to suffer abuse and neglect despite the domestic institutional commitments to protect children from violence. It is argued that child rights are not respected within the family, even though family is considered as the primary caretaker in promoting the best interest of the child. While addressing the research further it is argued that despite the domestic institutions established to mitigate the issue of child abuse in Sri Lanka, children are continued to be harassed and victimized due to a number of shortcomings of those organizations.

For the purpose of substantiating the argument, literature on causes of child abuse is reviewed to support the hypothesis that child abuse is caused due to parental negligence and various other causes concerning parents. The research is further based on a case study related methodological approach. It includes both an in-depth study of seven child protection organizations and a few reported cases.

In the course of the research, statutory laws, books, reports, journal articles, articles of related publications will be studied in order to conceptualize and make an in-depth study of: child rights, risk factors for child abuse, consequences of abuse and neglect, and child prevention methods.

Factors Associated with Delaying Re-Engineering Government ICT Projects in Sri Lanka: Projects Planned By ICTA During 2005 to 2010

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The unprecedented advancements of Information and Communication Technologies (ICT) systems from late twentieth century have drastically transformed the society. The proliferation of the World Wide Web (www) in '90s has made the entire world a single global village. Convergence of the Information Technology (IT) and Telecommunication has given the birth of ICT. Governments use the ICT for electronic transactions, which is known as e-government, between government and citizens or businesses. As a developing country, Sri Lankan government aims to computerize the government systems and use the automated systems to transform government by making it more accessible, effective and accountable. The Information and Communication Technology Agency (ICTA) of Sri Lanka plays the major role in this process. ICTA was established in 2003 by Sri Lankan government to carry on the government ICT projects with enhancing the ICT knowledge in all over the country with "eSri Lanka" concept. The ICTA is in-charge of several ICT projects under seven different categories such as; Policy-Leadership & Institutional Development, Information Infrastructure, Re-engineering Government, Human Resources Capacity Building, Investment & Private Sector Development, e-Society and Technology.

According to ICTA, the re-engineering government projects are implemented with the aim to provide citizens' services in the most efficient manner by improving the government processes and activities by re-engineering and technologically empowering government business processes. This research was mainly focused on the projects implemented under the re-engineering government category. There are 27 government's ICT projects belong to this category. Out of 27, only 26 projects were started between year 2005 and 2010. Among these projects some projects were completed, some are ongoing, and others were terminated. Most of the projects did not started on time and the time durations allocated initially were exceeded while the projects are being developed. The main objective of this research is to find out the factors that associated with delaying the delivery

on government re-engineering ICT projects conduct by ICTA. First of all the time schedule of existing re-engineering government ICT projects and the project team and responsibilities of each of these projects were identified. Then the factors for delaying the government ICT projects were identified through feedbacks of the project team members. Finally, for the identified factors ICT project solutions were provided.

This research used the quantitative approach since it referred the close-ended questions. According to the ICTA, 117 members have directly involved for the re-engineering projects, which is selected as the population size for this study. To collect data, focus group interviews were conducted with the project leaders and controllers to know the scope, objectives, strategies, beneficiaries and the current status of each and every project. Structured questionnaire has been used to collect data from project team members. Other than questionnaires and interviews, the secondary data used, which were collected by ICTA. The terminated project information was not considered for the analysis. Data from six projects were not recorded, since there was no responsible person to get the project details as the project managers of those projects were resigned. Few of the members in government and third-party organization did not provided requested information and some were not contactable. Finally it could be gathered 104 number responses from 20 projects.

The reliability of the collected data were checked and then divided into two sections; one is the data by project wise, and the other is by designation wise. Considering the all 26 projects, 46% of projects were delayed; only 19% of the projects were completed on time, 12% of terminated projects and 23% of projects data were ignored from analyzing. After ignoring the terminated and no data found projects, there are 63% projects are delayed and remaining 37% were completed on time.

According to the result, the working experience is a powerful factor to delay a project. The less working experienced team members can be contributing to delay the project due to less knowledge about the subject area and with good experienced team members have high possibility to complete the projects on time. It observed that the project scope change is a major factor to delay the projects. Every ICT re-engineering project with scope changed were delayed. It was identified that some group members' change is also effecting to the delay of projects. And the political issue is positively correlated with the project delay. Procurement process hindrance is another reason to delay the government ICT projects. The highest delay duration is due to bid evaluation, the second highest goes for studying the system by

vendors, and third is for call the quotation. The least time delay is for budget approval. Lesser government organizational management support is another main factor to delay a project. Most of the government workers are not interested in IT related works. Less user support and difficulty of user training is not associated with project delay.

To avoid the delay in procurement process, reduction of time duration spent on bid evaluation, system study by vendors and quotation call is essential. Clearly mentioning the system requirement and the functioning procedure the vendors will get a clear idea about the system. To increase the management support it is essential to motivate them and orient them to have a successful system. It is needed to explain and properly convey the advantages of the proposed project. If a good training on IT can be provided for the government users, they would be interested with the IT related activities. To avoid the scope change in the middle of project development, a good feasibility analysis should be done and clearly identify the system requirements.

An Evaluation of the Level of Online Security Awareness among Undergraduate Students in Sri Lanka – A Case Study of the University of Colombo

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With the rapid development of the technology, the domestic and corporate life of the citizen has become effortless. Availability of internet through broadband, mobile devices, wifi and free internet zones citizens have many opportunities to connect to internet (online) very easily. Furthermore, with the development in the smart phone technology citizens can connect to internet at any time in any place. So, everybody has become a node of the internet with the modern technology. Browsing the internet, communicating over emails, chat or video conference sessions and text messages have become day-to-day obligations of the public. The threatening side of this superb technology utilization is that millions of people become victims of various online frauds daily as their inadequate knowledge of the online safety. This threat is more destructive when it is in a corporate environment as the corporate holds asserts or sensitive information of hundreds or millions of customers.

University students and college graduates are the immediate entrants to these corporate and government institutes at the management level. If this community is equipped with the required timely knowledge on online security, the corporate bodies or the government institutes are safer against the ever growing future threats. Therefore, it is of utmost importance to examine whether this community is competent with the knowledge of online security. Hence, this research finds the answers for the research question "Have the university undergraduates of diverse faculties and year of study congregated enough knowledge about the online security throughout their academic period?"

In this research, the level of online security awareness of the undergraduates in the University of Colombo was examined. Based on the total number of students in the University of Colombo the sample size was determined as 225 by using Krejcie and Morgan sample size table. The research extends to compare the level of this knowledge among different faculties and among

different academic years within the same faculty. The study also examines about the most frequent current sources of this knowledge in the attentive undergraduates while collecting their opinion about the most preferred source of this knowledge if they would have an opportunity to learn the subject.

The study was conducted as a cross sectional study collecting data with a self administered questionnaire which examined the level of online security awareness of the participants selected with stratified random sampling technique. Based on the answers given, Online Security Awareness Score (OSAS) was calculated for each participant. The mean values for OSAS for each group were compared statistically to seek the answers for the research questions.

The study found that the online security awareness knowledge of the undergraduates is moderate and it remains below the acceptable level. The study reveals that the difference of this knowledge among the faculties is not statistically significant though the difference is significant among different years of study within the same faculty. Test results indicate that the students have gained this online security knowledge from friends and the internet as frequent sources, while majority of them prefer to learn it from the university. Frequent internet and computer users were found having a better online security awareness compared to the other groups but it was not significantly higher in the students who use the internet more frequently for academic purposes. The female students were observed having a better online security knowledge compared to the males. However, majority of the students had an inadequate knowledge in certain important aspects of online security.

The study further revealed that, out of the population, 7.6% of the undergraduates had undergone prior information security trainings or workshops and their knowledge level was closer the acceptable limit while it is 10.6% deviated to the plus side from the population mean. In addition, the research found that each undergraduate owned a mobile phone, 35.1% retains a smart phone having additional software installation facility. Out of the undergraduates, 64.4% is using their mobile phone to access the internet. Another finding was that the majority of them use the internet for education purposes. To access the social networking websites and entertainment materials were the follower preferences. Fewer frequencies were observed for online gaming and shopping.

According to the research findings, giving an opportunity to the undergraduates to learn online security is of extreme importance as the

preference of the undergraduates to learn it from the university. Even though some undergraduates have acquired this knowledge from varied sources, the research finding indicates that this knowledge is not consistent from the smallest factor to the greatest. This is emphasis with the research results that the undergraduates have a greater coherence with the internet usage even when this knowledge in the majority remains below the acceptable levels. This education to the undergraduates should ensure the safety and fair use of the online resources while they are studying in the university and even thereafter in their government or corporate entities.

Factors Associated with Delaying Re-Engineering Government ICT Projects in Sri Lanka: Projects Planned By ICTA During 2005 to 2010

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The unprecedented advancements of Information and Communication Technologies (ICT) systems from late twentieth century have drastically transformed the society. The proliferation of the World Wide Web (www) in '90s has made the entire world a single global village. Convergence of the Information Technology (IT) and Telecommunication has given the birth of ICT. Governments use the ICT for electronic transactions, which is known as e-government, between government and citizens or businesses. As a developing country, Sri Lankan government aims to computerize the government systems and use the automated systems to transform government by making it more accessible, effective and accountable. The Information and Communication Technology Agency (ICTA) of Sri Lanka plays the major role in this process. ICTA was established in 2003 by Sri Lankan government to carry on the government ICT projects with enhancing the ICT knowledge in all over the country with "eSri Lanka" concept. The ICTA is in-charge of several ICT projects under seven different categories such as; Policy-Leadership & Institutional Development, Information Infrastructure, Re-engineering Government, Human Resources Capacity Building, Investment & Private Sector Development, e-Society and Technology.

According to ICTA, the re-engineering government projects are implemented with the aim to provide citizens' services in the most efficient manner by improving the government processes and activities by re-engineering and technologically empowering government business processes. This research was mainly focused on the projects implemented under the re-engineering government category. There are 27 government's ICT projects belong to this category. Out of 27, only 26 projects were started between year 2005 and 2010. Among these projects some projects were completed, some are ongoing, and others were terminated. Most of the projects did not started on time and the time durations allocated initially were exceeded while the projects are being developed. The main objective of this

research is to find out the factors that associated with delaying the delivery on government re-engineering ICT projects conduct by ICTA. First of all the time schedule of existing re-engineering government ICT projects and the project team and responsibilities of each of these projects were identified. Then the factors for delaying the government ICT projects were identified through feedbacks of the project team members. Finally, for the identified factors ICT project solutions were provided.

This research used the quantitative approach since it referred the close-ended questions. According to the ICTA, 117 members have directly involved for the re-engineering projects, which is selected as the population size for this study. To collect data, focus group interviews were conducted with the project leaders and controllers to know the scope, objectives, strategies, beneficiaries and the current status of each and every project. Structured questionnaire has been used to collect data from project team members. Other than questionnaires and interviews, the secondary data used, which were collected by ICTA. The terminated project information was not considered for the analysis. Data from six projects were not recorded, since there was no responsible person to get the project details as the project managers of those projects were resigned. Few of the members in government and third-party organization did not provided requested information and some were not contactable. Finally it could be gathered 104 number responses from 20 projects.

The reliability of the collected data were checked and then divided into two sections; one is the data by project wise, and the other is by designation wise. Considering the all 26 projects, 46% of projects were delayed; only 19% of the projects were completed on time, 12% of terminated projects and 23% of projects data were ignored from analyzing. After ignoring the terminated and no data found projects, there are 63% projects are delayed and remaining 37% were completed on time.

According to the result, the working experience is a powerful factor to delay a project. The less working experienced team members can be contributing to delay the project due to less knowledge about the subject area and with good experienced team members have high possibility to complete the projects on time. It observed that the project scope change is a major factor to delay the projects. Every ICT re-engineering project with scope changed were delayed. It was identified that some group members' change is also effecting to the delay of projects. And the political issue is positively correlated with the project delay. Procurement process hindrance is another reason to delay the government ICT projects. The highest delay duration is

due to bid evaluation, the second highest goes for studying the system by vendors, and third is for call the quotation. The least time delay is for budget approval. Lesser government organizational management support is another main factor to delay a project. Most of the government workers are not interested in IT related works. Less user support and difficulty of user training is not associated with project delay.

To avoid the delay in procurement process, reduction of time duration spent on bid evaluation, system study by vendors and quotation call is essential. Clearly mentioning the system requirement and the functioning procedure the vendors will get a clear idea about the system. To increase the management support it is essential to motivate them and orient them to have a successful system. It is needed to explain and properly convey the advantages of the proposed project. If a good training on IT can be provided for the government users, they would be interested with the IT related activities. To avoid the scope change in the middle of project development, a good feasibility analysis should be done and clearly identify the system requirements.

Underlying Causes and Implications of Unintended Pregnancies among Adolescents: A Case Study of the Kalutara District of Sri Lanka

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An unintended adolescent pregnancy carries an extra risk. It is a social problem due to continuing rise and carries an adverse impact on the teenager, their families and society as a whole. The objective was to provide an in-depth analysis of the socio-economic causes of adolescent pregnancies in the Kalutara district of Sri Lanka. The study uses both quantitative and qualitative paradigms. A case study following the qualitative approach has been utilized in analyzing 6 teenage mothers in the Kalutara district at the end of their first trimester. The study was conducted in the month of January 2014. Socio economic factors, occupational deprivation, poverty, alcoholism, unstable families, peer pressure, employing males for domestic work, exploitation by older men, forced sex and media influence show significant impact on unintended pregnancies. Complications such as anaemia, low birth weight, spontaneous abortions, antepartium hemorrhage and preterm deliveries have been recorded.

The unintended adolescent pregnancies in the Kalutara district of Sri Lanka are mainly due to family issues, poor socioeconomic conditions and unawareness. It has an adverse impact on the health of the mother and neonatal.

Scheduling Production to Meet Delivery Due Dates: In High Variety Electronic Assembly

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The factory, which is the focus of this Extended Abstract, assembles electronic components to produce printed circuit boards (PCB). This requires several processes on a number of independent workstations (up to a maximum of nine) constituting a multi-stage serially connected assembly system. PCBs are required to meet varying customer requirements; hence the ensuing product variety is very great. Unless there are defects, there is no back-tracking between workstations. Components inserted into the PCBs are sourced by the factory's foreign principals. Once the components are received the assembly process, including testing, has to be completed within two weeks. The factory has experienced *intermittent* delays in meeting due date requirements. Sometimes they have no difficulty in doing so; sometimes they do. Also this was not related to the volume of work that had to be complete during each two week "time fence". Possible explanations for this state of affairs such as a high defect rate, equipment failure, worker absenteeism, turnover of skilled staff, lack of appropriate skills etc. have exhaustively been considered by the factory management and found wanting and therefore rejected. Workers are multi-skilled and there is no difficulty in dealing with absenteeism. Machines are quite new and reliable with systematic maintenance being conducted. The annual worker turnover was no different to similar Sri Lankan factories. As such, it was suspected that the problem lay in the manner in which production was being scheduled, where the scheduling methodology could not be analytically linked to the two week "time fence". The current procedure was lot-for-lot scheduling where each lot was the quantity of a particular type of PCB that had been ordered. If an analytical framework could be developed to predict, for a given set of batch (lot) sizes, what the makespan would be, a better understanding of the research problem would result. Conversely, if batch sizes of different PCBs were treated as variables and, an algorithm found or developed to find the batch sizes that would minimize the makespan, it would then be possible to know whether the two week period was a reasonable upper limit to complete assembling a consignment of PCBs. If this was so, production could commence using the batch sizes resulting from the application of the algorithm and the factory could empirically test whether the due date requirement could be realized. Literature on Manufacturing Management was perused to identify methods

to determine the batch sizes. Relevant material is listed under references. Approaches to this problem varied from full blown Monte Carlo simulation to application of Queueing theory. The latter would have required trying different combinations of batch sizes; clearly an impractical procedure as, at a minimum, fifty types of PCBs were on order, and therefore at least fifty unknown batch sizes which would have to be varied on a trial and error basis to see the impact on makespan. Queueing theory applications led to intractable analytical complications as there were many as nine workstations, and the associated analytical representation of makespan was a daunting task. Hence, it was decided to attack the problem from first principles using a method described in "Factory Physics" (Hopp, p 497, 2008) which allows ascertaining the effective processing time on a shared resource (workstation) for different products. The task was to obtain an algebraic expression for the sum of such processing times for all the PCBs (on all the relevant workstations) that had to be completed during a two week period and use this expression in a MS Excel spreadsheet to minimize same using the optimizing application package "Solver" available on Excel. The stochastic nature of parameters was dealt with using the Conveyor Model. It was soon apparent that deriving an algebraic expression was even more complex than using queueing theory for the same purpose! However the discovery of a common set of parameters that kept recurring in this expression constituted a breakthrough. To test the logic of the spreadsheet, a case study was conducted using a randomly selected set of 25 products and their associated set-up and processing times. With batch sizes as variables that required to be determined such that the makespan would be minimized, expressions were written for utilization and these used to derive the expression for the makespan encompassing all 25 products. This was entered into one cell of the spreadsheet and "Solver" was used to minimize same. The result was a duration very much less than factory working time for two weeks. Two constraints that were stipulated were that the batch size had to be an integer and that utilization had to be less than one (unity). Using the same approach described in 5.2 above, an actual set of PCBs in excess of 50 were used. The results were the same. This research was conducted during the year 2011. Since then batch sizes for scheduling of production have been determined in the manner described and the author is not aware of any instance where the delivery deadline has not been met.

The expression for the total make span is a nonlinear function of batch sizes and the GRG nonlinear option of "Solver" had to be used. It should be noted that this does not give a "Global Optimum". Rather, it outputs a set of batch sizes that, to date, when used to schedule production, has performed as expected.

Impact of HIV/AIDS on Employment: An Assessment of the Legal Responses Available in Sri Lanka in Light of International Standards

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HIV/AIDS related issues become workplace issues as the number of HIV positive persons increases due to many reasons such as promotion of tourism, migration for employment, prostitution, trafficking for sex and changes in culture. Discrimination in employment, stigmatization and termination of services are the main HIV/AIDS related labour issues. The prejudices and stereotypes against people living with HIV/AIDS violate their right to equality, right to dignity, right to work and right to life and lead them to economic death. These violations counter John Rawls's theory of justice as fairness. The core International Human Rights Conventions and the ILO Convention relating to Discrimination in Employment provide for non-discrimination on various grounds that include HIV/AIDS status as well by interpretation. The ILO Code of Practice on HIV/AIDS and the World of Work (2001), and the ILO Recommendation Concerning HIV and AIDS and the World of Work (No.200) provide that there should not be discrimination or stigmatization of workers on the grounds of HIV status, and there should not be mandatory HIV testing or screening for employment, and privacy and confidentiality relating to HIV status should be ensured. As Sri Lanka is a State party to all core International Human Rights Instruments and the ILO Convention and a member of the ILO, it has an obligation to give effect to the principles embodied in the international instruments. The main research problem in this paper is whether Sri Lanka is committed to respond to its obligations under these international instruments. The objectives of this research is to identify the important principles relating to HIV/AIDS and employment in the relevant international instruments and assess the obligations of Sri Lanka, and to evaluate the extent to which Sri Lanka responds to the obligations, and to make suggestions, if necessary, to enact a new legislation or amend existing legislation to respond to the obligations. The method for this research is qualitative research based on materials published by the United Nations and International Labour Organization, Constitution of Sri Lanka, legislation, cases decided in Sri Lanka and other

jurisdictions, journal articles and books in Human Rights Law and Employment Law. For this research, the principles relating to HIV/AIDS and employment in the relevant international instruments have been extracted, and thereafter the provisions in the Constitution and other legislation have been analyzed to find out the extent to which the provisions in the Constitution and other legislation respond to the principles in the international instruments. Comparative analysis also has been carried out in light of the jurisprudence developed by the courts in India and South Africa. Sri Lanka does not have any legislation that expressly provides to protect the rights of HIV positive workers. However, any discrimination in opportunity for employment or treatment in employment in the government sector on the ground of HIV/ AIDS status could be considered as violation of the equality clause in Article 12 of the Constitution. In *Hoffmann v. South African Airways* (2000), the Constitutional Court of South Africa held that the refusal by the South African Airways to employ a HIV positive person as a cabin attendant violated his right to equality guaranteed by the Constitution. Discrimination, stigmatisation, humiliation and violation of privacy and confidentiality in the government sector on the basis of HIV status could be construed as ‘inhuman or degrading treatment’ and violation of Article 11 of the Constitution. The provisions in the Constitution do not apply to labour issues in the private sector. However, the provisions of the existing legislation could be used by interpretation or analogy to deal with HIV/AIDS related labour issues in the private sector. Section 23 of the Protection of the Rights of Persons with Disabilities Act provides that no person with disability shall be discriminated against on the ground of such disability in recruitment for any employment. As the phrase ‘person with disability’ in the Act could be interpreted to include a HIV positive person, the provision in the Act may be used against discrimination in opportunity for employment based on HIV status. According to section 48 of the Industrial Disputes Act, a dispute arising in a workplace from discrimination or stigmatization on the basis of HIV status could be considered as an industrial dispute, and it could be referred to an industrial arbitrator for settlement by arbitration. Termination of services of a HIV – positive workman who could work like others becomes unjustifiable termination and the workman could file an application in a labour tribunal under section 31B(1)(a) of the Industrial Disputes Act for relief. When privacy rights of a HIV-positive workman are violated, the workman becomes subjected to stigma, humiliation and discrimination in employment and a hostile and intolerable environment is created at the workplace. It may be construed as constructive termination and the workman could file an application in a labour tribunal for relief. Protection of the rights of the HIV positive persons are also important to

control spread of HIV AIDS in the country. In *MX of Bombay Indian Inhabitant v. M/s ZY*, Tipnis,J. stated that community support, economic support and non-discrimination are necessary for control of the disease. Therefore, the measures that are taken for the protection of the rights of HIV positive workers would not only promote their rights in employment but also protect the country from the disease. Although Sri Lanka has international obligations to take measures to deal with workplace issues relating to HIV/AIDS, it does not have any specific provision in any legislation to deal with them. However, as explained above, the provisions of the Constitution and other legislation could be creatively used by interpretation or analogy to deal with HIV/AIDS related workplace issues. It is suggested to enact a new legislation or make amendments to the existing legislation to deal with workplace issues relating to HIV/AIDS. It will not only promote 'decent work' in employment but also combat spread of HIV/AIDS in the country.

The Impact of Pensions on Well-being of Elderly in Sri Lanka: A Case Study of Contributors Served by Sri Lanka Social Security Board in the Kaduwela Divisional Secretariat Division

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The increase in ageing population is the most important demographic phenomenon witnessed at present in Sri Lanka. Apart from the small segment of the aged who are covered by the existing social security nets, the majority engaged in the informal sector employment are without a reasonable social security scheme, thus precipitating far reaching socio-economic implications. The old age poverty points sharply at the decline of the living standard of the elderly, especially among those whose regular income ceases or reduces with retirement, a universal problem according to (Karunarathna, 2005). The non encouragement of saving habit in general and specially among those who are not covered by any of the schemes implemented so complicates the situation as the numbers are increasing daily. There existed a traditional belief that the progeny, the relations and the welfare state would look after the needy perpetually. The changing life patterns, the market economy, and the immense pressure on the state coffers have shattered the expectations. At present over 10% of the total population of Sri Lanka are senior citizens aged 60 years and above. According to demography specialists this percentage will increase to 22% by year 2030 (De Silva, 2007; Siddhisena, 2005). To counter the present threat, the state is in the process of introducing several different types of social security benefit schemes, while promoting the cooperate sector come in, in a big way to the rescue of the government. The social security pension benefit scheme which was introduced in 1996 under Act No: 13 in 1996, plays a vital role in respect of self-employed in the informal sector. However, it is revealed that the scheme has not gathered the momentum the creators expected at the launch for many a reasons. Majority who were join the scheme in earnest at the beginning dropout before completion of their commitments attributing various reasons. In this scenario the study is to focus and investigate the reasons for this down ward tend and identify ways and means to arrest the situation and propose suitable modifications. Government patronage and

policies with regard to upliftment of the self-employed as well as those in the informal sector and identify sound strategies to reach each and every one in both sectors of employment in a more productive way.

Against this background, the paper investigates the impact of contributory pension on the well-being of informal sector elders in Sri Lanka who are beneficiaries of self-employed pension schemes operated by Sri Lanka Social Security Board, paying attention to the Kaduwela DSD in Colombo District. The specific objectives are, to examine the reasons for the dropouts among elders who were enrolled with pension scheme and to examine the barriers for the expansion of enrolment in the pension schemes. The research design was a primary survey conducted in Kaduwela DSD. The total population consists of around 1111 contributors including 605 pensioners and 506 dropout contributors with some agreed upon benefit. From this total population 150 pension respondents and 150 dropout respondents were selected using purposive random sampling methods. Other than the primary survey and focus group interviews with 5 pensioners, 5 dropout contributors and government officials were interviewed to get sufficient background information about the research problem. A combination of quantitative and qualitative data analysis was used to analyse the data so gathered. Findings of the study also revealed that the pension income of the elderly who are pensioners have positively contributed to enhance their socio-economic well-being. While there is a large majority of people in the community in need of a pension, the existing economic process acts as a barrier preventing them from obtaining membership in a pension scheme. Lack of awareness of the pension scheme among the target groups, unsatisfactory follow-up or feedback mechanisms, lapses on the part of the pension provider in updating on the status when there are lapses, delay in issuing documents and benefits to the contributors, are some reasons that can be attributed to the slackness of the contributors who have enrolled in the schemes. In-depth analysis reveals that the collapse of parallel state organizations awarding pensions has also created loss of confidence in this type of government interventions. According to the worthy pensioners the scheme is of social and economic value, affording social recognition to them in the old age. The pension payment they receive primarily utilized on their medicine, and whatever the balance is spent on the grandchildren and to contribute to the household pool, religious activities etc. Majority of the elderly people who drop out of the scheme are those in the low income group, and whatever the lump sum they receive is run through in no time.

Most of the pensioners enrolled were in the minimum premium instalment pension schemes at the initial stages. At one stage rerouting of part of the

“Samurdhi” benefits as a lump-sum contribution to enrol was tried out. Whatever that was tried out was not that successful against the meagre income of the targets groups, as they always have immediate priorities that need be taken care of before investing for the future. Furthermore with the high rate of inflation and associated high cost of living, they have realised that the amount of pension that would be receive at the end would hardly suffice their needs. Even though there are some who think seriously about social security, the respondents have indicated that they are not well aware about the other benefits of the scheme. Informal discussions revealed that some who have the ability to pay are not seriously interested about the scheme mainly due to low level of expected returns. The District Officers and Grama Niladaries in attaining their enrollment targets have sometimes inadvertently introduced unqualified persons to the scheme. As a whole, pension scheme members felt that the scheme is satisfactory but they were willing to get a higher pension with lower contribution. The elderly people, in the research area consistently show that pensions have a significant impact on the income and poverty status of older people and their households. The survey data provide evidence that pensions enhance elder people’s economic standing, social relation, improvement in life satisfaction and general improvement in their well-being. A significant important factor observed was that the low level of awareness among the self- employed community leads to low willingness to pay and the lack of interest in the scheme also increase the dropout number. In addition the irregularity in other government sponsored pension payments, too have caused some kind of reluctance in the minds of prospective contributors. There were some administrative problems such as lack of coordination between the contributors, grass root level supporting officers and the Social Security Board. In addition, insufficient number of field officers and their poor awareness about the new policies and decisions on the scheme also appear to be constraints also contributed to the failure of this scheme. Therefore, suitable propaganda methods should be adopted to make them aware of the benefits of the scheme and to popularize the program while compulsory adjustments to the premium payment structure in between age group 45- 59 are needed in order to continue this welfare program me. Moreover, Sri Lanka social security board should act in such a way as to avoid delays in issuing policy certificates, pension and insurance payment etc. Follow-up action should be implemented through the Grama Niladari and Social Security Officers throughout the year and should be done regularly.

An Analysis of the Capital Structure of Firms and Its impact on Firm Value: An Empirical Study of Selected Firms Listed on the Colombo Stock Exchange (CSE)

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The capital market is an environment where enterprises raise funds in order to meet their long term financial requirements. Over LKR 100bn was raised in the capital markets in Sri Lanka in the year 2013. The decision makers of the firm are aware of the possible changes in firm value and thereby try to select an optimum financing structure where the firm value is maximized. Since the seminal work of Modigliani and Miller (1958), several subsequent researches have been devoted to the task of finding a coherent explanation as to what influences the choice of capital structure of a firm. The conclusion drawn from the asymmetric information theories is that there is a certain pecking order or hierarchy of firm preferences with respect to the financing of their investments. Analysis of empirical literature indicates that the usage of external financing was also studied by Singh and Hamid (1992) and again by Singh (1995) who used data of the largest firms in selected developing countries. It was evident from their research that firms in developing countries made significant use of external finance to fund their growth requirements, when compared to firms in industrialized countries. Myers (1984), however, suggests that managers will be reluctant to issue equity if they feel that the firms share is undervalued in the market. Agency costs play an important role in financing decisions due to the conflict that may exist between shareholders and debt-holders. It is also stated that by minimizing the WACC, a firm will maximize the firms value. It is evidenced that capital structure compositions of individual listed firms in Sri Lanka vary significantly and reveals that the overall industry averages converge to a range of 0.39 - 0.44. The pilot survey of this research suggests that certain firms do not have the optimum mix of capital structure that maximizes shareholder wealth. Further, we have deduced that firm ownership structures impact the capital raising decision of firms. A problem arises as certain firms may issue equity or debt at the expense of negatively impacting firm value. Thus, the primary objective of this paper is to analyze the historical compositions of the capital structures of the companies listed in CSE.

Moreover, this paper attempts to assess the relationship between the D/E ratio and the market capitalization (firm value) of the selected firms to assess the relationship between both variables. According to the selection process 40 companies are selected as the sample of this study. The selection criterion is based on the Market Capitalization of Firms for the sample period, spanning 13 sectors. Further, key financial indicators such as short term interest bearing borrowings, long term interest bearing borrowings and share-holders funds have been considered.

The Colombo Stock Exchange database will be used to extract the list of the 40 highest capitalised firms and they will be classified based on the industry sectors. The data variable model used by Kayhan and Titman (2007) will be partially amended and used for the accurate identification of the variables to be extracted from financials of firms listed on the Colombo Stock Exchange. Detailed financial statements will be obtained and information relating to short term interest bearing borrowings, long term interest bearing borrowings and share-holders funds will be obtained. Minority interest will be disregarded as inclusion of same will lead to inaccurate results. The market capitalisation will be computed by using the product of closing price as at the year end and the total number of outstanding shares.

Gearing Classifications:

For the purpose of the analysis the firms have been categorized into low geared (<0.35), moderately geared ($0.36 - 0.55$) and high geared (> 0.56). The results will be displayed using a chart with the 'X' axis being Gearing Ratio and the 'Y' axis being denoted as the market capitalisation of the firm. Individual data points will be plotted based on pre-determined periods and trend lines drawn. Volatility of variables will be taken into account via the use of standard deviation. The study does not take into account firms in the Financial Sector (Banking, Finance and Insurance), Investment Trusts and Closed-Ended Funds. The reason for their exclusion is the existence of a different set of determinants that impact the leverage decision due to their different business model. An analysis of the relationship between the market capitalization and gearing ratio of 37 firms in the sample indicates that as debt is added to the capital mix, the firm value is negatively affected. The overall market capitalization of the 37 firms stood at LKR 281Bn when the gearing ratio was at its highest (0.45) whereas, once the ratio started declining the market capitalization increased to LKR 1,260Bn at a gearing level of 0.34. This clearly demonstrates that firm value increases greatly when the equity mix is higher.

* 3 specific firms were removed from the computation due to being classified as outliers due to the abnormally low gearing as a result of being owned by a foreign parent entity. The analysis further revealed a mean D/E ratio of 0.39-0.44x across all industries which may indicate mean reverting tendencies to firms, which lending institutions and investment banks could capitalize on, in order to identify potential issuers of debt or equity. In addition, analysis has clearly established that short term debt is the most preferred form of finance with a mean leverage of 0.21 and a standard deviation of 0.13 whereas long term debt indicated a mean of 0.16 and a standard deviation of 0.19. Firms that had foreign ownership too indicated low levels of gearing with the mean leverage amounting to 0.11. Whilst appreciating the varying leverage compositions in firms across varying industries, it could be safely deduced that many variables influence the capital raising decisions of firms. Despite it being stated that by minimizing the WACC a firm will maximize the firms value (Messbacher, 2004), the study demonstrates that the theory may not hold true under specific instances for firms listed on the Colombo Stock Exchange. Hence, in summation final results further revealed that overall gearing levels may be one of the variables that influence firm value and that additional variables such as revenue, profitability, taxes etc. should be factored in as an area of further study to assess the impact on overall firm value.

FACULTY OF LAW



Message from the Dean



The influence of universities in shaping the knowledge, skills and attitudes that define the development of a nation has never been doubted. In the modern context, this role has assumed paramount importance even as industry continues to evolve rapidly. The Annual Research Symposium of the University of Colombo provides a meaningful forum for academics to share their thoughts on the dynamics between academia and the industry or profession, as the case may be.

In today's complex world, we can no longer afford to live in isolation, whether as departments, faculties, universities or nations. We need to adopt a holistic approach to solving problems, in order that we arrive at the optimum solution. At the heart of this exercise must remain the concern and respect for the basic values that support and sustain humankind. Only then can we produce results that are capable of fulfilling human development.

The Faculty of Law looks forward to this annual event, which helps its researchers to present their latest research and share it with the legal community, with the aim of refining it through constructive review and comment. This no doubt helps to raise the standards of research and critical legal thinking among the staff members.

I thank all those who worked hard to make this event a reality and I wish the presenters, discussants and participants a fruitful time at their respective sessions. I invite you all to reflect on the presentations that are made and to continue to strive in your own fields in order to raise your own standards of research and critique in order that your contribution to society will continue to be meaningful and relevant, aid national development and ultimately, improve the status of your fellow citizens.

V. T. Thamilmaran
Dean, Faculty of Law

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Validity of an Electronic Documentary Bill: The Sri Lankan Response

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In an ever expanding world of domestic and international businesses, electronic commercial transactions or e-commerce has become an inevitable and integral component of almost all activities. This resultantly has brought with it many a challenge posed on the law makers of the system to either streamline existing laws with required modification or even enact new laws altogether in addressing and resolving this pressing challenge. One of the principal problematic areas deserving urgent attention is the legal barrier.

Transactions termed Bills of Exchange (BE) with the requirement of 'in writing' imposed and recognised in the Bills of Exchange Ordinance (BEO) of 1927 make them mandatory for these instruments to be recognised, even when such instruments are made in electronic form. In the context of this paper the following question arises: Should the BEO in Sri Lanka in relation to form requirements of BE not be streamlined with the international e-commerce market bringing the appropriate reforms necessitated towards making it a viable method of payment in the fast growing e-commerce market? Through such market oriented reforms we can arguably ensure the co-existence of electronic negotiable bills as an effective method of payment. Accordingly, one major objective is to examine the barriers in the existing legal framework with regard to negotiable instruments and outline the viable reforms to overcome the identified barriers. The other one is to suggest reforms and identify a model of a Digital Clearing House for Negotiable Instruments. This research is conducted by using a qualitative research method which included an analysis of the existing legal instruments and a documentary review with special reference to the related literature.

The Impact of the Principles of Taxation on Drafting Domestic Income Tax Related Laws

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Income Tax was introduced in Sri Lanka in 1932 by income tax Ordinance and today it is governed by the Inland Revenue Act No. 10 Of 2006 and its amendments. Income tax is charged for every year of assessment in respect of the profits and income of every person for that year of assessment. Economists and jurists have given some interpretation on income tax as principle cannons to the taxation. The principles are the foundation of income tax and it gives a basic philosophy to administrative purposes of the government, drafting tax related laws as well as protect the rights of taxpayers. Haig- Simons, Adam Smith and Ian Lambert are some of the economists and jurists who have given interpretations and philosophies to the concept of income in taxation for the advancement of the administration as well as the nations who have to tolerate the burden of tax.

Adam Smith is generally well-thought-out to be the father of modern political economy. In his “The Wealth of Nations” (1776) he set forth four maxims of taxation, saying that “the evident recommended them more or less to the attention of all nations.” The four maxims have been brief as equity, certainty, convenience and efficiency. After Adam Smith ‘s philosophy Lambert’s Modern Principles of Taxation serve as a foundation for a tax system which is simple, just and lasting for the current context. His principles of taxation were briefly outlined and considered their practical tenders and insinuations. Lambert’s Modern Principles of Taxation establish the foundation of a system of taxation. It is modest, fair and enduring and facility the support of everybody, all parties and all states. The application of such a system of taxation on a worldwide scale is needed for economic reasonableness and concord through the globe and drafting tax related Laws. This argument is supported mainly referring to the relevant Sri Lankan legal authorities with principles of taxation. Thus the objective of this paper is threefold; first is to explore the scope and objectives of tax related Laws; the second is to identify their deficiencies and the third is to make appropriate recommendations to improve the existing legal framework. The methodology adopted in this research paper entails two research methods: literature review and comparative legal analysis with one other country which is practicing a respectable tax law structure.

Do BITs Need a Bit of Change?

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Bilateral Investment Treaties (BITs) constitute one of the most important legal instruments for the facilitation, regulation, liberalization and protection of foreign investment between Contracting States. The World Investment Report 2014 indicates, the year 2013 with the conclusion of 44 international investment agreements (30 BITs and 14 other IIAs), bringing the total number of agreements to 3,236 (2,902 BITs and 334 “other IIAs) by the year end, clearly highlighting their importance in this respect. These BITs contain numerous, usually similar, standards of treatment clauses, severely restricting the Host States’ ability to regulate foreign investment.

However, the 'development' notion in existing BIT's is narrow: with the emphasis being on the Host States transferring some of their sovereign rights in the field of foreign investment in order to achieve economic development. Social and environmental concerns and responsibilities of MNCs and Home States are mostly excluded from the parameters of the objectives of BITs, focus being on the obligations of Host States towards, inter alia, non-discriminatory treatment of the foreign investor and ensuring a stable legal business environment. Consequently, it is generally perceived that existing BITs do not provide a balanced approach that reflects the mutual interests of the Contracting States and that BITs should also address the responsibilities of MNCs and Home States with regard to their conduct in abroad, taking a balanced approach to build healthier environmental and long-term investment projects in the host territory. Therefore, the main objective of this research is to analyze existing BITs and identify how modern BITs could lay greater focus on facilitating real development of the Host State, while balancing overall mutual interests and objectives of all parties.

Keywords: bilateral investment, protection of investment, development, international law

The Social Role of Companies towards Welfare of Multi-stakeholders and Its Influence on Company Performance: Emerging Trends in Sri Lanka

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Corporate Social Responsibility (CSR) is a well-established global concept initiated in the developed world. It is still in its primary stage in the developing world. The recent developments in corporate sector of developing countries such as Sri Lanka show that there is a growing interest in, and demand for, manifestation of CSR. Companies have significantly increased their focus on CSR and engage in a serious effort to integrate CSR into their businesses moving from the shareholders' wealth to stakeholder welfare by adoption of appropriate business processes and strategies. This may be due to the reason that customers, government and other stakeholders place great significance and value on CSR.

A company like a human being is recognized as a citizen in a country with rights and duties and thus there is an expectation on companies to be good corporate citizens. CSR enables the corporate sector to mould itself in a wider role in the society as it recognizes that the businesses have obligations to engage in activities that protect and contribute to the welfare of the societies including general communities, customers, employees, suppliers, shareholders, and the environment which are not limited to charity or mere donations.

There is no commonly accepted CSR definition. The most referred to definition of CSR is given by the World Business Council for Sustainable Development (WBCSD) which defines CSR as "the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large"

The developed countries' viewpoint is that by implementing this concept it brings many significant intangible benefits to both the business and society. Also researches have disclosed that CSR activities as a critical success factor that have contributed to the growth and survival of the firms. This study attempts to identify the benefits of CSR which have discussed by the

developed world and then to investigate what way CSR is related to a company's performance.

In Sri Lanka, the relationship between CSR and Corporate Performance is still under-researched, even though some research has been conducted on the development of the CSR concept, it is not fully understood. This paper examines CSR towards multi- stakeholders and explores its relationship in influencing the performance of companies.

A Critical Analysis of ‘Prior Art’ as Provided by the Intellectual Property Act of Sri Lanka

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In the broad idea of University- industry collaboration for strengthening the knowledge hub of Sri Lanka, promotion and protection of innovations and inventions, with the view of advancing research and development (R&D) of the country, is very important. While universities and research institutions being the most opportune places for developing and creating new knowledge in the form of inventions, the industries are important in light of commercializing and marketing the inventions created by universities. The idea of University- industry collaboration for strengthening the knowledge hub of Sri Lanka can be understood within that context as well.

Patents are granted for inventions if they satisfy requirements called novelty, inventive step and industrial application. Novelty is generally determined by analyzing the fact whether the claimed thing is available in the *prior art* which refers to the existing knowledge of the relevant art.

Intellectual Property Act of Sri Lanka plainly explains novelty, inventive step and the meaning of industrial application. However, when explaining novelty and its determination by referring to prior art, the Act provides a high threshold which is not agreeable with comparatively low technological and the scientific development of the country. This threshold is as high as the threshold available in many developed countries.

Section 64 (2) (a) and (b) provide requirements of prior art. The Act, while applying a universal test (an absolute novelty) in satisfying novelty, further emphasizes that prior art should be something already ‘disclosed’ to the society. Section 64 (2) (b) attempts to backdate prior art by mentioning that the ‘contents’ of a prior patent application can also become a prior art against a claimed invention. This paper analyses the scope and application of prior art as provided by the intellectual property Act in the backdrop of its importance in promoting and enhancing innovations and inventions in Sri Lanka. In the research, a special emphasis is made to explain section 64 (4) (b) of the Act in which the underpinning rationale is not clear and obvious. Prior art is further analyzed in the backdrop of its nexus to public domain issues of the Act.

This research is based on a comparative study done by the researcher with an attempt to find out the rationale of determining the prior art under Sri Lankan law. The research concludes that the rationale of examining and proving prior art in order to satisfy the novelty requirement under the Sri Lankan law should only be understood as a means of promoting research and inventions in the country and not as a one which would undermine that purposes.

Keywords: prior art, novelty, patent application, disclosure

IPRs and Food Choice: Concerns for Developing Nations

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Many people around the world are experiencing a nutritional transition as traditional foods are progressively replaced by less healthy modern diets. Doctors and nutritionists advocate a return to traditional food-ways. Ironically, many of the cultural groups who developed these traditional culinary practices are adopting Westernized diets. The Committee on Economic, Social and Cultural Rights (Committee on ESCR) has placed importance on the right to adequate food. However, the Special Rapporteur on the right to food believes that people should also have the right to access foods that correspond to their cultural traditions. However, this right is being challenged by genetically modified crops that are being promoted by agri-tech companies as an alternative to local crops.

This paper sought to identify reasons for the nutritional transition, focusing on the impact of GM crops on food choice, and considering the options available for Sri Lanka to maintain viable food choice options, including legal responses. It was also attempted to differentiate between food security and food choice and argue that food choice remains a powerful option that promotes a healthy lifestyle, which must be guaranteed even in the wake of the patented seed and plants that the agri-tech industry aggressively seeks to promote. The research suggests that the impact of the proposed Plant Variety Protection Act on food choice should be carefully monitored to ensure that local varieties are not threatened by patented ones.

Keywords: Food choice, GM foods, Developing Nations

Protection of Sri Lanka's Geographical Indications: The Case of Ceylon Tea

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“Consumers use a variety of indicators to build perceptions of ‘origin’ and ‘quality’ which include, but are not restricted to, labels of origin”.

A.Treager et al., 1998

The protection of geographical indications (GIs), which is one of the main themes in the IP law paradigm, has attracted increasing attention among policymakers and scholars, both at international and domestic level. A GI is a source identifier that has great economic potential, especially for a developing economy such as Sri Lanka. As defined in the Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement, a GI is an indication which identifies a good as originating in the territory, region or locality, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographical origin'. In this sense, a GI is a sign used on goods that have geographical origin and possess qualities, characteristics or a reputation that are due to its place of origin. More specifically, “Ceylon Tea”, “Indian Basmati”, “French Champagne”, “Greek Feta Cheese”, “Cuban Havana Tobacco”, “Italian Parma Ham” and “Colombian Coffee” are a few prominent examples for internationally recognized GIs. The underpinning rationale for the protection of GI is to prevent consumers from being misled as to the true origin of a product and also to protect the legitimate interests of the right holders of GIs. Sri Lanka is well-known for “Pure Ceylon Tea” and its pristine quality which remains in the minds of global consumers. It is undeniable that the GI protection in the IP Act of Sri Lanka has been greatly motivated by the tea industry; one of the major earners of foreign exchange in the country. However, the increased number of reported incidents of misappropriation of Ceylon Tea brand abroad reveals the inadequacies of the existing domestic and international legal framework relating to the protection of GIs that have contributed to the violation of Sri Lanka's GI rights to a large extent. Therefore, the main objective of this research is to examine the shortcomings in the GI provisions in the Sri Lankan IP Act of 2003 and to explore the legal options available for strengthening the legal framework of the country in order to accord better protection for Sri Lanka's black gold, Ceylon Tea. Drawing examples from

other jurisdiction such as India, this paper also argues that the establishment of GI register should be the first step in the right direction. It further highlights the need for a concerted effort from GI producing like-minded countries to create an international registry and to extend the special protection for other GI products beyond wine and spirits at international level.

Streamlining Directors' Disqualifications: An Appraisal of Sri Lankan Position

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Companies Act No.07 of 2007 imposes a variety of duties on officers/directors of companies. Some of these are relating to filing of returns or sending notifications to the Registrar of Companies. These duties are backed by criminal sanction. The rest are connected to important duties of compliance which includes satisfying solvency test, duty to act in good faith, duty of care etc. The second category of the duties has serious repercussion that affects every stakeholder. S.481 empowers the Registrar to give notice to the companies to comply and failure may result in Registrar obtaining a court order. Unfortunately, neither the Registrar enforces his powers nor the sanctions are enforced and it seems that non-compliance is ignored. S. 213 provides for prohibitions while s.214 provide for directors' disqualification which may be enforced by court order. This too is never enforced in Sri Lanka and therefore non compliant directors do not get caught. Sri Lankan experience of failed companies in the recent past taught many lessons and the time is ripe to bring the 'too smart directors' to light.

The contemporary law in the United Kingdom, Company Directors Disqualification Act of 1986 (CDDA 1986) is advanced and codified disqualification regime. The provisions amplify the directors' traditional common law duties as well. The Insolvency Services handle the enforcement of the provisions. The CDDA 1986 was amended in 2000 to allow the Secretary of State to accept disqualification undertaking from directors. This change further enhanced the legal regime that existed under the Act. Enormous number of disqualification cases was heard from the time this Act was enacted and the courts have wide discretion. *Re Sevenoakes Stationers (Retail) Ltd*, *Re Baring plc*, *Re JA Chapman & Co Ltd*, *Secretary for State for Trade and Industry v. Swan*, *Secretary for State for Trade and Industry v. Swan* [2005], *Secretary for State for Trade and Industry v. Carr* and *Official Receiver v. Jupe* are some of the recent examples.

In this regard the Companies Act 2013 of India has novel provisions which may be learning from the history of sudden collapse of their companies.

Incompetent individuals accept positions as directors for financial benefit and never concerned about compliance since they are aware that they will not be trapped. It is necessary therefore, in the interest of stakeholders, that errant directors are punished by way of disqualification orders. The researcher envisages suggesting reforms to the Companies Act of Sri Lanka to bring about a more effective mechanism relating to directors' disqualifications. Provisions of CDDA 1986, sections 152, 164 and 165 of Companies Act 2013 of India, Disqualified Director Database maintained by the Insolvency Services of the UK and primary data obtained in Sri Lanka are used for this purpose.

Women, the Unforgotten Species: A Feminist Critique of Some Philosophical Theories on Land Rights

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The way 'rights relating to land' has been defined in a particular legal system is critical in identifying men's and women's rights within and outside family. Many laws are biased against women in rights relating to land. This discrimination has been prevalent both vertically and horizontally. This paper analyses some philosophical theories that have influenced such discriminations. The positivist contention of property rights has been consciously used to regard women as a group in a dominated position, and to deny their right to equality. In positivism women are mere dependents, who hold neither power nor land. It sets the stage where women play the powerless and dominated role, and are neither recognized as independent individuals nor are they appreciated as capable of holding property rights independently of men. According to Locke's labour theory men gain private property rights by using the ability to work and cultivate. In this context women are disadvantaged. The family is seen as a private domain where men rule over women and the law remains silent. Naturalists generally assume that women consent in a form of government based on male-biased assumptions and, justify and defend a male-oriented civil society. According to socialists the concept of private property rights relating to land demarcate class, power and a subordinate status for women. Socialists argue that women's role in agriculture was relatively low, and it eventually led to a system where men owned the land and women did not. According to Rawls's theory property rights arise as a consequence of social contingencies. Sex differences and gender divisions are veiled in the hypothetical original position, and he assumed that all humans are equal. Rawls didn't intend his theory to be applicable to the institution of family, where women are most discriminated in relation to land rights. These theories provide the philosophical underpinning of rights relating to land in many common law and civil law legal systems, and have contributed in recognizing or reinforcing discrimination against women in their rights in relation to private and state land.

Judicial Approaches in the Application of Rylands v. Fletcher Rule in Contemporary World: A Comparative Analysis of English and Sri Lankan Laws

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The case *Rylands v. Fletcher* established a distinct tort liability in English Legal regime, which came to be known as “Rule in *Rylands v. Fletcher*”. The rule makes liable the person, who for his own purposes brings on his land and collects and keeps there anything likely to do mischief, on the event of its escape. The rule, as shaped by several judicial decisions, has been treated as a fundamental doctrine of strict liability in tort for more than hundred and twenty five years of legal history until the decision of House of Lords in *Cambridge Water co v. Eastern counties Leather plc*. In Sri Lanka, where Roman Dutch Law principles are considered as the foundation of Law of Delict, much reluctance was evident in accepting the rule of English Law as a part of the Law of Sri Lanka. Early Sri Lankan experience raised a debate as to whether the rule needs to be incorporated into the legal system. *Aloysius silva v. Upali Silva* was the only case, where the basis for action was solely framed on the applicability of the rule. The judgement of Court of Appeal without expressing any objections to the basis for action, gives evidence about the acceptance of the rule. Since there are no other reported cases afterwards, the question of applicability is still open before the apex court of the land. While Sri Lankan courts attempt to accept the rule, the courts in the other jurisdictions move far beyond to reshape the rule to face the challenges of the contemporary world. The judgments of House of Lords in *Cambridge Water Co v. Eastern counties Leather plc* and Australian High Court in *Burnie Port Authority V. General Jones Pty Ltd* have challenged the “liability under the rule in *Rylands v. Fletcher*” to a great extent. *Cambridge water case* subsumed the rule into law of private nuisance along with the requirement of foreseeability and *Burnie port Authority case* declared the rule as being dead and pronounce the application of principles of law of negligence to cover the liability. These judgements highlight a major departure on treating the rule as basis for distinct liability. In the opinion of the researcher the question remains open in Sri Lanka should be framed based on the merits of the rule. Retaining the rule within the jurisdiction would enable the judiciary to act more dynamically to respond to the incidents happening more often in the country such as gas leak at chemical factory, accidents reported in power plants sector.

Negative Prescription: A Critique of Sri Lankan Law

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Law of negative prescription in Sri Lanka is currently governed by the Prescription Ordinance No 22 of 1871. There are many deficiencies in this law and it is highly debatable among scholars whether this law should be accepted as a mode of acquisition of ownership anymore. Under the Roman Dutch Law, negative prescription is based on the factors: the title holder being negligent in his title and the possessor actively and openly possessing the land for a reasonable time period. The positive prescription in Scotland is regulated by the Prescription and Limitation (Scotland) Act of 1973. According to Section 1: “A land possessed for a continuous period of ten years, openly, peaceably and without any judicial interruption will be entitled for prescriptive title”. The South African law on positive prescription is regulated by Prescription Act No 68 of 1969. According to section 1: “A person shall by prescription become the owner of a thing which he has possessed openly as if he were the owner...for an interrupted period of thirty years.....” Though the common law requirements of *nec vi, nec calm, nec precario* was taken away by the enactment of this Act, Professor Van der Merwe states that nothing more or less is needed for prescription than *possessio civilis*. *Possessio civilis* in its origin should be *justa causa* and also be a bona fide possession. Requirements established in both jurisdictions therefore tally with Roman Dutch law requirements of negative prescription. However, requirements spelled in the Prescription Ordinance of Sri Lanka are uninterrupted, undisturbed, adverse/independent possession for ten years. Accordingly ‘*justa causa*’ is not essential. Third party can enter into a property of another, forcefully or peacefully, and start possessing it as the owner. If the *mala fide* possessor can survive when the title owner fights to claim his right back that possession will be accepted as adverse possession. In decided cases it has been concluded that although ‘undisturbed possession’ is a requirement by the Ordinance, disturbed possession is an evidence to prove ‘adverse possession’. Therefore, Sri Lankan law gives the impression that it is letting devious people take over unsuspecting people’s lands and making it a legal theft by validating it. This is an injustice done to the Roman Dutch law principles which gives justifiable and reasonable grounds to takeover someone else’s neglected property. Thus it is high time for Sri Lanka to change its laws on negative

prescription to serve the people in its original manner it was created as a mode of acquiring ownership of an immovable property. Main objective of this paper is to study this controversial issue by comparing the South African and Scottish legal systems.

Child's Right to Legal Assistance and Representation

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The International Covenant on Civil and Political Rights (ICCPR) ensures an individual's right to legal assistance which is a fundamental aspect of right to an effective and adequate remedy. As a general rule it has been recognized that the minor does not have the *locus standi in judici*. Since childhood is entitled to special care, protection and assistance the child cannot institute or defend any legal proceedings by himself or herself. Therefore, the child needs the support of an adult person to represent his interest before the court. However, State Parties to the United Nations Conventions of the Rights of the Child (UNCRC) should assure that the child who is capable of forming his or her views has the right to express those views freely in all matters affecting the child. Furthermore, the views of the child should be given due weight in accordance with the age and maturity of the child (evolving capacity). Therefore, child's right to legal representation can be considered through two interrelated aspects. Child's right to legal representation as a vulnerable person and his or her right to legal representation considering the autonomy of the child to present his or her interests before any judicial or administrative proceedings. Moreover, child's right to representation can be explored differently considering the child's relationship with the law. They are protection of child's personal and economic interests, protection of child's interests where the child comes in contact with law and child's right to legal representation where the child comes to conflict with the law. This third aspect can be considered under the juvenile justice system and this is the area where child's legal representation is crucial. Legal assistance is not merely representing an interest before a court. It includes legal awareness, access to legal information and other services through alternative dispute resolution mechanisms and restorative justice process, financial access, participatory access child –friendly legal services and quality of legal aid should be considered. Furthermore, when it comes to child's right to legal representation the mechanisms should comply with the standards such as principle of non-discrimination, evolving capacity of the child and the best interest of the child. This research aims to explore whether the Sri Lankan legal system protects child's right to legal assistance and representation in compliance with the international standards.

An Assessment of the Legal Response to Reconcile Conflict between Work and Family Responsibilities in Sri Lanka

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Work-family conflict affects the employers and workers, and becomes a challenge to eradication of poverty and social development in the country. The Workers with Family Responsibilities Convention of the ILO requires the member states to formulate national policy to provide equality of opportunity and treatment in employment between men and women workers with and without family responsibilities, and to reconcile conflict between work and family responsibilities. Sri Lanka is not a party to the Convention and does not have specific provisions in legislation, except the provisions for maternity leave and nursing intervals, to harmonize the two responsibilities. Any discrimination arising from work-family conflict in the government sectors violates the equality clause of the Constitution. The equality clause in the Constitution is not applicable to the private sector. However, the provisions in the labour legislation could be creatively used to reconcile the conflict. The mechanisms such as conciliation and arbitration could be used to settle the disputes relating to work-family conflict. Labour Tribunals have jurisdiction to hear work – family conflict related termination of services, and make just and equitable decisions. Wages Boards, Employees' Councils, collective bargaining and other forms of social dialogue also could play an important role to promote family-friendly working arrangements at work places. The rigidities relating to working hours, over time work, leave entitlements and night work for female workers and non-provision of paternity leave to the private sector become legal obstacles to reconcile work and family conflicts. It is recommended that Sri Lanka should ratify the ILO Convention, and amend relevant labour legislation to remove the obstacles and infuse flexibilities to promote reconciliation of work and family conflicts. It is also important to create awareness among the employers and trade unions about the benefits of reconciliation of work -family conflicts, and to encourage them to have creative arrangements. Technological developments in the modern society also facilitate innovations for reconciliation of the conflict.

“Dependants, Not Right Holders”
A Critical Analysis of Inheritance Rights of Widows
under the Thesawalamai and Kandyan Laws

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This paper examines the widow's succession right to her husband's acquired property and ancestral property under the Thesawalamai and Kandyan law in light of International standards. While analysing the customary law principles and statutory principles underlying the rules relating to succession in these personal laws, it is proposed to draw attention to the relevant international standards on equality of women under the CEDAW. Sri Lanka is a state party to CEDAW and Article 12 of the Constitution also upholds equality. Hence, widow's status in respect of intestate succession rights in the Kandyan law and Thesawalamai law of Sri Lanka is questionable with regard to women's right to equality and non discrimination. General Recommendation No. 21 of CEDAW on Equality in Marriage and Family Relations affirms the equality of human rights for women and men in society and in the family. Paragraph 34 provides that "*inheritance rights for widows do not reflect the principles of equal ownership of property acquired during marriage. Such provisions contravene the Convention and should be abolished.*" This research will be conducted as a literature review based on secondary sources, including International Conventions, Constitutions, statutes, textbooks, electronic databases, journal and customary principles, etc. The General Law of the country entitles a widow to inherit half share of her deceased husband's entire property, but it does not recognize her contribution to her husband's property. Under the Kandyan law, due desire to keep the family property *paraveni* property (ancestral property) is exclusively inherited by the sons and *binna* married daughter. While only life interest in acquired property is given to the widow. Similarly to Kandyan Law Thesawalamai law tries to protect the family property and provide her a life interest with obligation over the *Muthusam* property (ancestral property). The JMPIO, as interpreted by the judiciary, permit a widow $\frac{3}{4}$ of the entire *Thediathettam* property (acquired property). Unlike General law and Kandyan law when viewed Thesawalamai the concept of Thediathettam includes the role of the homeworkers and amounts to acknowledge of the contributory impact of the ordinary domestic service of the wife upon the accumulating of the husband's income. Having established that the intestate

succession rights of widows in Kandyan Law and Thesawalamai causes discrimination through law, the author suggests recommendations for Constitutional and legislative amendments, judicial activism and creating public awareness.

The Application of the Concept of ‘Remedial Constructive Trusts’ in Relation to Property Rights of Non-owning Cohabitees

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The current tendency in the process of the development of law of property is that the willingness of the courts to consider awarding proprietary remedies in a wider set of circumstances. This propensity has been recognised in many common law jurisdictions. The developments of the proprietary remedies affect reassignment of property rights in numerous aspects. ‘The Remedial Constructive Trust’ (hereinafter mentioned as RCT), is one of the novel ways of proprietary remedies beyond its traditional institutional role, and can be recognized as a remedial device came from the law of trusts to diminish the rigidity in issuing remedies under private laws. This remedy is giving rise to an enforceable equitable obligation and it operates retrospectively to the prejudice of parties at the discretion of the court to the effect of certain grounds. RCT as a proprietary remedy is available for the plaintiff in an action where the defendant has obtained an advantage by acting fraudulently or unconscionably or unjustly without having any fiduciary obligation when the damages or compensation is not adequate. The most important indication is that the RCT is recognised as a remedy for the parties’ rights of financial and non-financial contributions in matrimonial property matters of married, unmarried as well as same-sex couples. However, England, where the concept of trust originated, is most unwilling to recognize RCT in their legal context. In Sri Lanka, constructive trusts are merely institutional and the Trusts Ordinance of No.09 of 1917 has not been used to meet the current developments. Hence, the objective of this research is to discuss the development of RCT as one of the remedies in matters relating to property rights of non-owning cohabitees in selected countries and evaluate the possibilities to introduce RCT in the Sri Lanka.

Child's Right to Education: Evaluation of Laws and Policies in Sri Lanka

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This study mainly focuses on the right to education of children. Education is a fundamental human right of all and important tool for the development of a child. Article 28 of the UN Convention on the Rights of the Child (1989) has recognized the right to education. Article 27 (2) of the directive principles of state policy in the Constitution of Sri Lanka recognizes “the right to universal and equal access to education at all levels” as a state policy. Furthermore, Article 28 (1) of the Sri Lankan Charter on the Rights of the Child has recognized that the State shall provide compulsory education to children from the age between 6 to 16 years. The Education Ordinance No. 31 of 1939 which has been amended several times is the main statutory instrument on education in Sri Lanka. Moreover, the government issued the Regulation of Education (1997 Regulation) under the Education Ordinance in 1997 to enforce compulsory education for every child aged between 5 to 14 years. It is apparent that there is a conflict between the Charter and the 1997 Regulation as to the age limit of compulsory education. Hence, there is no binding legal provision to make it compulsory for children who are aged between 14-16 years to attend school. It is evident that the drafters of these legal instruments have not intended to fully comply with the international standards of right to education of children. Currently, some of children who are above 14 years tend to give up their education due to various social and financial reasons. These children are not only deprived of a child's right to education but also lose opportunities to engage in higher education and decent employment. Therefore State parties have a legal obligation to take positive legal measures to ensure right to education through legislative amendments for the best interest of children. In this context, this paper addresses the question of: should child's right to education be recognized as a fundamental right with a maximum age of 16 years in Sri Lanka? This question is addressed by arguing that there is a need for recognizing child's right to education as a fundamental right in Sri Lanka. And also proposing that the existing age limit of the Regulation should be increased to 16 years of age. This research is a qualitative one which includes an analysis of the domestic legislation, policies and International Conventions.

South Asian Responses to Child Labour and Child Domestic Work: State and Non State Interventions

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This paper examines State and non-State responses to child labour and child domestic work in South Asia. The paper traces the legislative patterns in the region on child labour and child domestic work with a view to identifying different approaches to combating child labour and child domestic work. Forms of child labour in the South Asian region vary from country to country. In some countries, bonded labour and some of the worst forms of child labour are prevalent. Remuneration moreover is negligible and the opportunities for the child to move out of his or her employment minimal. In others, child labour is often confined to the agricultural sphere and operates in the main in family agricultural enterprises and in the informal sectors. Such employment sometimes falls within permissible 'light work' but may nevertheless impact on other rights accorded to children such as the right to education and right to leisure. Domestic work, by its very nature, and the fact that the child is removed from the family environment and may be subjected to neglect and sexual exploitation should be seen as one of the worst forms of child labour. The objectives of the research are to identify the nature of child labour in the region and to look at the different measures that have been taken to combat child labour and child domestic work. The paper will also examine compliance with international standards, legislative responses, enforcement mechanisms, State NGO partnerships for combatting child labour and child domestic work and the relationship between education policies and the elimination of child labour and child domestic work. The paper will seek to identify the best practices in the region in relation to combatting child labour and child domestic work.

The Topical and Controversial Aspects of the Law of Cyber Defamation in Sri Lanka: A Way Forward

G. I. D. I. Udani

Department of Private and Comparative Law

As a consequential outcome of the ‘global and interactive nature’ of the methods of modern communication, “cyber defamation”; which mainly occurs by participating in online forum discussions, uploading, commenting and blog posting has become one of the fastest growing aspects of the law of defamation. As pointed out, by Takach in “*Computer Law*”, “the Internet promises to be the supreme mechanism for perpetrating libelous statements.” Therefore, the main objective of this research is to identify the topical and controversial issues in law of cyber defamation, and to recommend the appropriate legal reforms to eliminate the inadequacies in the existing legal framework of Sri Lanka. The term; ‘Defamation’ has been defined in “*Winfield and Jolowicz on Tort*” as “the publication of a statement which reflects on a person’s reputation and tends to lower him in the estimation of right-thinking members of society generally or tends to make them shun or avoid him.” When analyzing the contemporary context of Sri Lanka, it should be emphasized that, the section 479 of the Penal Code is repealed by the Act, No. 12 of 2002 and therefore, predominantly, the civil law of defamation has become the fundamental safeguard against the wrong of defamation. Nevertheless, the major controversial issues which have been embodied in this area; the liability of the Internet service providers, the problem of anonymity or pseudonymous identity of web users, and ‘libel tourism’ or the uncertainty of the jurisdiction in terms of the applicable law, proper forum and enforcement of the judgments are not successfully addressed by the existing laws of Sri Lanka. When comparing other jurisdictions, the South African High Court in *H v W* declared that, “the common law needed to develop in respect of remedy where infringements of rights, take place on social media”. Likewise, one of the key questions raised in this research is whether existing common law principles in Sri Lanka are sufficient enough for providing an adequate legal protection for the cyber defamation. Moreover, the lack of; legislation, case jurisprudence, authoritative writings and IT knowledge in this area has been created a legal vacuum in Sri Lanka. Therefore, it should be examined that, whether specific statutory provisions, such as, section 05 of the UK Defamation Act (2013) will be more appropriate for Sri Lanka to affirm the legal certainty on cyber defamation, in the light of international legal developments.

Victory for Merit: A Glimpse of Anti-doping Regulation in Sri Lanka

W. A. D. J. Sumanadasa

Department of Private and Comparative Law

In a market-oriented society, sports have become more a lucrative industry than a recreational activity, as it used to be originally. Hence, the use of performance-enhancing substances and other doping methods have increased alarmingly, in tandem with the increase of pressure on sportspersons to win. As pointed out by Simon Gardiner *et al*, doping more than any other type of sports-cheating has transcended sport and entered the public domain. Generally, a proper anti-doping regulation aims to protect athlete's health and to protect the true values or spirit of sports. The rationale behind any anti-doping regulation is that the sport is carried out on a level-playing field and sports should be free from unfair advantages through artificial aids such as the use of prohibited drugs. To avoid the detrimental effect of doping on clean sport, following the global trends, Sri Lanka has enacted the Convention against Doping in Sport Act, No. 33 of 2013 harmonizing national law in compliance with international standards. In this context, this research is intended to explore the implications of regulating doping in sports in Sri Lanka. Pursuant to the Act, the regulation of doping is twofold. First, it introduces a disciplinary procedure for an alleged athlete through Sri Lanka Anti Doping Agency (SLADA). Furthermore, according to Section 2 of the Act, a person who is caught inducing, supplying, administering and trafficking of such banned substances can be indicted in the High Court. It is submitted that the criminalization of doping has a deterrent effect, so that athletes and related parties would be prevented from doping in every means. However, given the fact that most Sri Lankan athletes and medical officers do not seem to be aware of the updates of the prohibited substances, annually issued by the World Anti Doping Agency (WADA), it might be argued that criminal paternalism does not suit Sri Lanka. On the contrary, it is doubted whether the Therapeutic Use Exemption (TUE) which is the only defense available, can be implemented in a successful manner in Sri Lanka as the applicable conditions and the procedure is difficult to follow even for an elite athlete in Sri Lanka. Therefore, it is suggested to further improve the measures of the SLADA and the Institute of Sports Medicine towards awareness on doping, starting from the school level. At the same time, it is worthwhile to have collaborations with the Sri Lanka Medical Council so

that medical practitioners can be made aware of the banned medical substances annually updated by the WADA. It is expected, therefore, that Sri Lanka as an emerging sports nation in Asia would be able to establish a clean sport and fair play through the implementation of anti-doping laws leading to better achievements in near future.

Recognition of Women's Rights in Delict: An Assessment

U. S. Liyanage

Department of Private and Comparative Law

This paper examines whether a feminist point of view could be considered in assessing damages in delict when women are involved in personal injury cases in Sri Lanka. The impact of personal injuries suffered by negligent acts on men is comparatively high compared to women, as men are engaged in high risk activities generally. However, this is not to say that the impact of personal injuries on females is underestimated considering the frequency and seriousness of harm suffered by men. The losses experienced by a female in a personal injury case are twofold. Firstly, as a primary victim of personal injury, the family would miss her services in the home, her consortium and earnings other than pain and suffering experienced by her. Secondly, a female may suffer economic losses as she is unable to attend to her work, if her immediate family member is injured, temporarily or permanently, because of the role that she plays in a family unit as a care taker. However, in the law of delict, loss of services in the home and loss of consortium have been considered as non-economic loss; therefore the courts do not recognize them as quantifiable damages. Also, complementary services of a care taker are not considered as general damages in delict. It is argued in this paper that the patriarchal mindset in recognizing heads of damages in the law of negligence does not take into account the unique situation of a woman as contrasted to a man. Therefore, this paper recommends that the above heads of damages should be recognized as economic damages in the modern law of delict in Sri Lanka. For this purpose, it is required to incorporate feminist concerns in personal injury cases where a woman has suffered loss or damage. The study adopts qualitative approach, and includes comparative legal insights taken from selected jurisdictions where it is relevant.

**Judicial Approach towards Ensuring Socio-economic Rights
of Children through Constitutional Interpretation
in Sri Lanka:
With Special Reference to the Right to Education**

B. L. Akurugoda

Department of Public and International Law

The Right to education is a basic socio-economic right, which creates the 'voice' through which other rights can be claimed and protected. Without the right to education, people lack the capacity to achieve valuable functioning as part of living their life. Despite increased academic interest in both children's rights and socio-economic rights, thus remain comparatively neglected areas. Despite the fact of a long standing free education policy, the Right to education is not a fundamental right (FR) in Sri Lanka.

The apex court has used the equality clause of the 1978 Constitution as a window to expand its parameters to include many other rights which help to achieve the fulfillment of the life of the citizenry. It is believed that constitutional interpretation should reflect the *sui generis* character of a constitution and it is necessary to interpret the constitution towards achieving social justice based on the basic norms and values which are reflected in it. Though, time to time the Sri Lankan judiciary has used Article 12 (1) of the 1978 Constitution to protect the educational rights of the children, the right to education is yet to be recognized explicitly in the country. Arguably, the judiciary has failed to substantiate the discourse on the right to education in a sustained, systematic manner from the perspective of children and the complexity of their status as citizens within contemporary democracies.

In this context, this library based research paper attempts to examine and analyze the effectiveness of the judicial approach towards ensuring and protecting right to education while recognizing it as a socio-economic right of the children in the country through their creative interpretation and justify the argument for granting the right to education as a FR through the Constitution.

A New Paradigm of Criminology: Critical Study on Contemporary Legal Framework in Combating Green Crimes in Sri Lanka

M. A. D. S. J. S. Niriella

Department of Public and International Law

Green criminology, which is known as environmental criminology, represents a branch of criminology. It deals with research into criminality against the environment and associated phenomena such as the impacts on human and non-human life, land, water and air etc. This specific area was not adequately looked at in the traditional criminological research. The harm resulting from green crimes is more severe than the crimes identified under the traditional criminology. Among environmental crimes, the rate of illegal wildlife trade in endangered species, smuggling of ozone depleting substances, dumping and illicit trade in hazardous waste, illegal and unregulated fishing, illegal logging and timber trafficking has significantly increased. Therefore, it is vital to look at environmental crimes as a separate form of crimes as it causes transboundary effect and global threat.

This study intends to review the history of green criminology, including its rationale and issues associated with its definition, then to analyze the green crimes with special reference to economic theory in describing the crime causation of environmental crimes. This study investigates the variety of green crimes and its impact on both human and non-human species with special reference to Sri Lanka. It also evaluates the issue of green policies with respect to efforts to reduce environmental crimes. Finally the study examines how Sri Lanka can further incorporate related international standards to strengthen the relevant national laws.

Relevant information from books, treaties, statutes, journal articles and websites are referred as secondary source and information and statistics gathered by relevant authorities are analyzed as primary sources to complete this research.

This study emphasizes that green criminology is a growing area in criminology and recognizing environment crimes as separate form of crimes is necessary. It further denotes that Sri Lanka should strengthen its legal framework in order to combat environmental crimes.

Keywords: Green Criminology, theories green crimes, forms of green crimes, national laws in Sri Lanka

Challenging the Traditional Map of International Law: The Presence of Non-governmental Organisations in Global Environmental Governance

K. Konasinghe

Department of Public and International Law

This paper explores the challenges that the presence of NGOs at international environmental decision making fora presents to traditional governance structures of international law. The application of international law in the current context of globalisation increasingly demands novel approaches of governance structures, in which the NGOs constitute a vital part. This article denotes the NGOs are gradually moving their influence in global environmental decision making from the peripheries towards the crucial central points of global governance. In this context, many theories of traditional international law are at risk as they mainly encourage state-centric global governance mechanisms. The existing legal frameworks are consistently challenged at various global fora for their inflexibility in admission of highly effective broader NGO involvement. This trend is widely visible in many international environmental fora that take place today.

This paper aims to provide a critical analysis on international law basis on the role of NGOs in global environmental governance and what challenges it poses to the modern interpretation of multi-institutional governance framework. For this purpose, the research approach is based on interdisciplinary approach of international law and international relations.

The formal international law basis for NGO participation can be found within the United Nations Organisation, which is founded on Article 71 of the Charter of the United Nations. According to this provision, NGOs are entitled for “consultative status” within the institutional framework of Economic and Social Council. This arrangement has its limitations in providing sufficient opportunities for NGO involvement. Therefore the paper suggests that there should be alternative approaches that accommodate NGO engagement in the global environmental governance system. Contrary to the positive picture of NGO participation, the paper also focuses on the legitimacy and accountability claims that have ‘popularly’ evolved against the debate on the expansion of NGO involvement in global governance.

Keywords: Non-State actor participation, Global Environmental Governance, Actors in international law

Enhancing Political Accountability and Good Governance at Local Levels: A Comparative Analysis

S. Susarithaa

Department of Public and International Law

In democratic state good governance is an important topic for discussion. For successful representation at local levels, the enhancement of good governance and political accountability becomes indispensable. When beginning the discourse on good governance and political accountability the key questions for discussion are ‘what is good governance?’ and ‘what is political accountability?’ and whether there is interplay between good governance and political accountability. Thus, this paper seeks to analyse the importance of enhancing good governance through political accountability of representatives in local levels.

This study is a qualitative inquiry based on library research. The necessary information is gathered from secondary sources accessible and available in the library such as constitutions, laws, journal articles, textbooks, research and working papers, government publications, newspapers, electronic databases and e - journals.

Enhancement of good governance at local levels and representation in each and every democratic society require upon testing the two areas of ‘decision making’ and ‘policy implementation’. Consequently, testing such political accountability of representatives is primarily rooted upon two theories, namely, Mandate Theory or Imperative Mandate Theory and Free Will Theory or The Free Mandate Theory. This is premised upon the belief that the best representation has to be secured because policy-bearing politicians and policies that public appear to support are not the same. Therefore, this paper seeks to analyse the application of these theories in light of political accountability and good governance. However, both theories are complicated and problematic in their application; neither of these theories can be considered as final and conclusive to enhance the political accountability and good governance at local levels.

Thus, author of the paper seeks to find the best possible theory to be applied to the enhancement of political accountability of representatives and good governance at local levels through comparative analysis of t the applicable

systems in the United Kingdom, Germany, France, Switzerland and Sri Lanka. The author of this paper argues that the combination of both theories mentioned above will be the best possible solution to meet the challenges of good governance and political accountability at local levels.

Keywords: political accountability, good governance

A Review of the Legal Protection of Underwater Cultural Heritage in Sri Lanka: With Special Reference to International Standards on Illicit Removal

M. J. M. U. P. Jayawardana

Department of Public and International Law

Sri Lanka as an island located in ancient silk route has a long and strong historical background for international trade by sea which has been proved by some archeological evidence in the 3rd century BC. Hence, there were number of ancient ports and harbours like *Godawaya*, *Galle*, *Colombo* and *Trincomalee* which had been established and functioned for over 2000 years for admiralty activities and international trade by sea. With these monumental features, ancient Ceylon has become a famous host for cultural and economic relationships. Furthermore, the territorial sea bed and costal area of Sri Lanka possess inherent number of marine antiquities. In fact, some modernization activities, including expansion of existing harbours and establishment of new harbours in Sri Lanka have caused mining and filling the Sri Lankan territorial sea without proper evaluation to the negative archeological impacts. It is also evident that these activities violate the UNESCO Convention on the Protection of the Underwater Cultural Heritage in 2001 (UNESCO Convention).

One major issue is the fact that Sri Lanka has not ratified this Convention. As a result, Sri Lanka is not bound to comply with its obligations such as the specific mechanism designed for protection of underwater cultural heritage recognized under the UNESCO Convention. Rather than taking prompt measures to ratify the Convention, Sri Lanka still relies on outdated national legal frameworks which include the No 9 of 1940 Antiquities Ordinance. The problem of this research is how can these exiting national legal frameworks adequately protect underwater cultural heritage for prevention of major illicit removal of underwater cultural heritage in Sri Lanka despite the fact that Sri Lanka is not yet a state party to the UNESCO Convention on the Protection of Underwater Cultural Heritage?

This paper argues that protective and preventive measures recognized in the Convention should be brought as reforms to the existing legal framework. The main objective of this research is to examine the viability of the existing legal framework applicable to protect the underwater cultural heritage in Sri Lanka.

Unilateral Humanitarian Interventions and the Law of Use of Force: A Critique of Emerging Trends

W. Seneviratne

Department of Public and International Law

A dramatic increase of international interventions based on humanitarian grounds has been seen in the last two decades in many parts of the world. Some of these interventions are carried out without the authorisation by the UN Security Council. Due to this emerging trend, the theme of 'unilateral humanitarian intervention' has been hotly debated in the contemporary world, predominantly in terms of their legality. This research paper explores the legality of such unilateral humanitarian interventions under international law with special reference to the legal regime governing the use of force stipulated in the UN Charter. It attempts to fill a gap in the existing literature on the issue of compatibility of unauthorised humanitarian interventions with the Charter provisions by providing a critical analysis and an interpretation of Article 2(4) of the Charter. The key research problem of the paper is whether humanitarian interventions not authorized by the UN Security Council are compatible with the UN Charter provisions governing the law of use of force. This problem is explored under the ensuing sub research questions: First, what is the difference between 'authorized' and 'unilateral' interventions? Second, can the unilateral humanitarian interventions be justified and legalised through a radical interpretation of Article 2(4) of the Charter? The main objective of the paper is to examine the legality of unilateral humanitarian interventions under the UN Charter regime. The findings of the research establish that unilateral humanitarian intervention is not compatible with Article 2(4) read in the light of its context and the purposes of the UN Charter. It concludes that there is no legality or right of humanitarian intervention within the UN Charter provisions on the Law of use of force despite the emerging trends and actions in supporting a dramatic change based on the pretext of 'humanitarianism'.

Keywords: unilateral humanitarian intervention, use of force, UN Charter

FACULTY OF MANAGEMENT AND FINANCE



Message from the Acting Dean



The main reason for universities to exist in a society is to produce and disseminate knowledge useful to the society's development. Hence, researching is a reason for a university to exist. If researching is neglected, such a university becomes mere a 'tutory' and it may have its own journey deviating from rest of the society as far as the societal development needs are concerned. In that sense, the university system in Sri Lanka seemed mainly in such a status quo up to recent past. It is true that some research studies have been taking place within the university system in Sri Lanka. However, as far as percentage of representation of the academic community in the university system and the relevance of research findings for the improvements of practices and the knowledge base of the society are concerned it cannot be taken as a satisfactory progress. Fortunately at present, a special attention has been drawn, mainly with state financial incentives, to enhance the practice of researching among the academic community. Today there is an increasing trend among university academics to be embarked on researching. I would like to locate the Annual Research Symposium of the university within such a context.

The Faculty of Management & Finance is organizing the annual research symposium with the theme of "Managing challenges at the globalized context" in addition to its regular annual event of International Research Conference to be held in December. Most academics of the faculty have already contributed to the international research conference with their research papers. I thank and congratulate all presenters of research papers to this year Research Symposium to make this important event a success. I hope we would be able to enrich this event with more research findings of contemporary value to make significant changes in the business practices of the society in years to come.

Dr. A. A. C. Abeysinghe
Acting Dean, Faculty of Management and Finance

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International Entrepreneurial Orientation and Performance of Born Global Firms: A Case Study of ICT and BPO Exporters in Sri Lanka

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Recent scholarly attention of entrepreneurship research focuses on the domain of international entrepreneurship (IE) and early and rapidly internationalization firms, known as 'Born Globals' (BG) – internationalize from its inception and are entrepreneurial in nature – is an increasingly emerging phenomenon in this field of research. As Kuivalainen et al. (2007) asserts a growing number of entrepreneurial firms are focusing on rapid internationalization, regardless of the facts of being small, resource constraints and their level of development. Thus, BGs and entrepreneurship are inseparable, international entrepreneurial orientation is an inseparable phenomenon in IE studies. The concept – international entrepreneurial orientation – has been introduced recently into international entrepreneurship, a limited number of empirical studies have been conducted in the context of internationalization and born globals (Jantunen et al., 2008). Thus, findings are with greater contradictions.

The aim of this study is to investigate the impact of international entrepreneurial orientation on the export performance of ICT/BPO exporters in Sri Lanka. Further it examines the moderating effect of international growth strategy on this relation. The proposed model is suggested in the context of Sri Lanka in relation to ICT/BPO exporters whose performance is gradually diminishing since 2009 while all other industry rivals in the South Asian region are growing at a double digit rate. There is a lacuna in this area of research in the context of Sri Lanka.

A sample of 250 ICT/BPO exporters, registered at the Export Development Board (EDB) of Sri Lanka, was selected as the sample of the study. For this purpose, the study will be used two main research instruments as structured questionnaire and interviews, followed by a self-structured questionnaire. Structural Equation Modeling (SEM) will be the main statistical tool of analyzing data with several other descriptive and inferential statistical tools.

This study provides several important suggestions for ICT/BPO exporters on how they could improve their performance, following entrepreneurial oriented behavior. Further, this study contributes to the existing knowledge on international entrepreneurial behavior and born globals and as well contributes to fill the exiting gaps in this research area.

Control Prerogatives Creating Unfavorable Performance: An Analysis of Consensual Spaces of Employees of a Public Sector Organization

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This paper brings a theoretical explanation to why some people in an organisation demonstrate unfavourable behaviour. Motivation theories explain how people are motivated to perform their assigned tasks to the satisfaction of the management. Performance assessments on how far the motivational efforts have resulted in bringing up performance levels are also already explained in theory. The current study attempts to explain how existing control prerogatives (managers' control arrangements) cause organisational members involving any behaviour favourable or unfavourable to the intentions of the organisation. This study uses a new argument on a 'consensual space' (Abeysinghe, 2009, 2010). This new argument illuminates the significance of discretion of employees and how formal and informal control arrangements can influence the discretion of employees having implications on their performance. This study was carried out as a qualitative case study in a state sector organisation, where some office employees of a selected division seemingly having an unrest demonstrated mainly through unfavourable responses to customers. The theories behind the argument on consensual space are labour process theory (e.g. Braverman, 1974; Burawoy, 1979, 1985; Edwards, 1979; Cressey and MacInnes, 1980, Littler and Salaman, 1982; Storey, 1983, 1985; Neimark and Tinker, 1986; Hopper et al., 1987; Knights and Willmott, 1990; Thompson, 1990; Willmott, 1995; O'Doherty and Willmott, 2001; 2009) and Gramsky's hegemonic analysis (Gramsky, 1971; Cooper, 1995). Findings of the study indicate that some rules and regulations and managerial interrelations with subordinates have caused this situation. This provides directions to the organisational management on areas for improvement at the work situation and to bring the organisation under better control.

Exploring Ethical Dilemmas Concerning Self and Sense of Social Well-being: Lessons from Sri Lankan Entrepreneurs

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Entrepreneurs as part of the social system are guided by a group of values and a system of ethical decision making. However, the entrepreneurs in Sri Lanka are influenced by the complex history of the country and individual aspirations whether it is profit making or being altruistic in the process of profit making. Our study explores the contextual realities of Sri Lankan entrepreneurs by close reference to the history of Sri Lanka in relation to development of entrepreneurship, cultural values and the newly emerging social responsibilities of the entrepreneurs. The purpose of this paper is to draw from the history of Sri Lanka and understand the contextual complexities of ethical dilemmas in concerning self and sense of social well-being of the Sri Lankan entrepreneurs that shape organizational work ethicality in Sri Lanka. Qualitative approach was employed to capture the holistic nature of interaction between values and entrepreneurial performance in terms of concerning self (egoistic work ethicality) and sense of social well-being (utilitarian work ethicality). Twenty entrepreneurs were interviewed. It shows that colonization of the state has left strong practices of Western ethicality among the entrepreneurs as against the local cultural beliefs in Sri Lanka. The outcome indicates that rather than a dominant single ethicality, a combination of ethicalities: concerning self and sense of social well-being was preferred by most entrepreneurs. Qualitative insights explored that majority of the selected entrepreneurs are highly concerned on profit rather than social well-being. Further interview data reveals that most entrepreneurs expect to maximize their self well-being while practicing egoistic ethicality in the business, but they reveal that they are practicing some social work in relation to the employees and community. Some entrepreneurs are struggling to understand how to practice ethics and values in a complex context while there are a few scattered individual efforts of practicing corporate responsibility which promotes social service by a few large organizations as a trendy behavior. However, compared to the other type of ethicality, the sense of social well-being or utilitarian

work ethicality seems to be practiced by the entrepreneurs at a nominal level.

Keywords: Entrepreneurship, Business Ethics, Concerning Self, Sense of Social Well-being, Ethicality, Mixed Methodology

Industrial Training Requirement for the International Business Undergraduates: A Study on the Effectiveness Based on Academic Departmental Expectations

S. M. Herath

Department of International Business

Internships are an important element in a business qualification, as it provides the much needed opportunity for students to apply their academic learning at a professional setting. Understanding the success of the industrial training program for an undergraduate specializing in International Business can be of special importance due to the nature of the academic field. The study therefore, analyses the effectiveness of the industrial training requirement to an undergraduate specializing in International Business by understanding whether the desired goals of the academic department were met by the training participants. Using the industrial training records and reports submitted by 41 students (84% of the population) following the Bachelor of Business Administration program, specializing in International Business at the Faculty of Management and Finance, University of Colombo, the present study identifies the level of International Business specialization related knowledge application and self-development, the students could attain during their training. The results of the study prove the importance of the industrial training for the Bachelor of Business Administration in International Business program while also depicting training elements which could be improved.

Keywords: International Business education, Internships, Internship stakeholders

Unequal Earning Opportunities in Industrial Training Programs: A Case Study of Business Administration Undergraduates of the University of Colombo

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Industrial training programs have become an essential part of the curricula of degree programs conducted by almost all the universities in Sri Lanka. Although some degree programs in Sri Lankan universities in natural sciences, such as medicine and engineering, have relatively long experience in incorporating industrial training components into their curricula, social science disciplines like management, commerce, and economics instituted the training component into their curricula in recent past. With five main objectives, the University of Colombo incorporated a three-month industrial training program into the curriculum of its Bachelor of Business Administration (BBA) degree program in 2009. This was implemented for the first time in 2013, when the students were in their final year. All 413 students successfully completed their industrial training program and graduated in 2014. Due to some reasons, it was observed that there had been a significant earnings inequality among the students during their industrial training period.

By using descriptive statistics and decomposable inequality measures such as the Gini coefficient, Theil index and Co-variance, this paper analyses the nature and causes of earning inequalities among students in their industrial training program based on socio-economic characteristics such as gender, age, ethnicity, religion, number of family members, district of residence as well as other factors such as involvement of sports in university and school levels, prior experience of employment or training, source of receiving industrial training, networking etc. Besides, current situation of employment and earning (after nine months of the release of final results) are analyzed using the above dimensions. It is heavily emphasized that policy formulation and implementation with respect to industrial training programs in higher education institutes in Sri Lanka can be strengthened by using findings of this empirical study.

Cross Market Volatility Spillovers between Colombo Stock Exchange and other Regional Exchanges: A Univariate Approach

Y. D. Withanage

Department of Finance

This paper examines the size and the direction of volatility spillovers between Colombo stock exchange (CSE) and three other regional equity exchanges namely India, Singapore and Pakistan over a period from January 2003 to September 2014. Leading market index of each exchange is selected and daily opening and closing prices are examined by using the univariate GARCH model (Engle, 1982 and Bollerslev, 1986) to examine whether there are volatility spillovers effects exist between CSE and other regional markets and to identify the size and the direction of such volatility spillover effects in case they do exist. Due to the overlapping trading sessions between Sri Lanka and other countries, intraday and overnight volatility spillovers are examined. In terms of intraday volatility spillovers, India and Singapore are found to have positive and bidirectional spillover effect with Sri Lanka while Pakistan is showing a positive unidirectional effect towards Sri Lanka. India is found to have a positive unidirectional overnight volatility spillover effect towards Sri Lanka and Singapore is found to have a negative bidirectional overnight spillover effect. From Pakistan to Sri Lanka there is a negative overnight spillover effect and from Sri Lanka to Pakistan the effect is found to have the other way around.

Keywords: Volatility spillovers, Sri Lanka, GARCH model

FACULTY OF MEDICINE



Message from the Acting Dean



It gives me enormous pleasure to issue this message on the occasion of the Annual Research Symposium of the University of Colombo for the year 2014.

Our Faculty boasts of the cream of the medical talent in Sri Lanka and any forum that brings them to one platform is bound to be a feast for the intellect. In the last few years the state support for research has increased and I hope that in this symposium we will be witnessing the results of this development.

We have talented researchers who will present some outstanding research in this symposium. However, we have to be aware of one of the weaknesses of research done in Sri Lanka, in that only a fraction of the good quality research that is presented as free papers or posters will reach fruition as full research papers in journals. I am certain that most of the papers presented here will qualify for publication in the world's best journals. We must encourage our younger colleagues to walk that extra mile to achieve this and mentorship will an important aspect of this journey. The discipline required to have one's work published in a journal is a vital part of the education of an Academic.

I take this opportunity to thank Prof. Nalika Gunawardena and her team for the great effort they have put in to organize this symposium amidst their busy schedules.

I wish the Annual Research Symposium for the year 2014 all success.

Professor Hemantha Senanayake
Acting Dean, Faculty of Medicine

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Risk Factors of Cutaneous Leishmaniasis (CL) in Matara District, Sri Lanka

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In Sri Lanka cutaneous leishmaniasis (CL) is caused by *L. donovani*. Transmission characters are different in Southern and Northern Sri Lanka indicating the need for studies in different geographical areas. The current study examined the prevalence rate and risk factors of CL in the Matara District, Southern Province which reported the highest number of cases during the past decade. Objective was to identify prevalence, risk factors, behavioral patterns and spatial distribution of leishmaniasis in the Matara District.

Total of 2260 individuals from 4 out of 16 District Secretariat Divisions (DS) (0.3% of total population in Matara District) which consisted of 52 out of 650 Grama Niladhari Divisions in Matara District were recruited by multistage cluster sampling. Data was obtained using an interviewer administered questionnaire. Patients with skin lesions were investigated by light microscopy (LM), culture and PCR. Prevalence was calculated and a case control study was conducted to identify risk factors using multivariate analysis. Out of 80 clinically suggestive cases only 38 were confirmed by laboratory tests. District prevalence was 0.005%. 55.3% of the patients were identified from the DS of Dickwella, while the lowest number were from Hakmana (2.6%). Individuals aged between 21-50 years (57.9% of cases) and female gender (male: female ratio 1:2) were commonly affected. Monthly income < Rs. 20,000, (97.4% of cases) and outdoor occupations (36.8% cases) were associated with CL. Only few of them (26.3%) had animal shelters in their gardens within 200 m. The risk factors identified were un-plastered brick walls (89.5%; OR 41.4, 95% C.I 13.78-124.79; p<0.05), minimal use of mosquito repellents (42.1%; OR 10.3, 95% C.I 3.85-26.21; p=0.002), low income (97.4%; OR 33.4, 95% C.I 4.49-248.12 p=0.007), over 4 hrs of outdoor activities (50.0%; OR 22.5, 95% C.I 8.29-

61.09; $p < 0.05$) and not being aware of leishmaniasis (81.6%; OR 10.76, 95% C.I 2.97- 38.80; $p < 0.05$).

Both peri-domestic and outdoor factors are associated with leishmaniasis transmission in the study area. Spatial clustering of cases was also seen. This may be due to the behavior of host coinciding with that of the vector, sand fly. Awareness regarding the disease and appropriate control measures are urgently required to minimize further spread.

Responsiveness to Sodium Stibogluconate in Cutaneous Leishmaniasis in a Cohort of Patients in Sri Lanka

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Cutaneous leishmaniasis is endemic in Sri Lanka. Large number of patients seek treatment from dermatology clinics mostly in dry zone hospitals. The diagnosis is made on clinical and laboratory findings. The majority of the patients receive intra-lesional sodium stibogluconate (SSG) at weekly intervals until complete healing is achieved clinically. The number of treatment cycles and the duration vary. Therefore, it is important to study the duration and number of treatment cycles needed by patients to achieve 'healing' to identify the extent of treatment-failure among CL patients. The main objective of this study was to determine the average duration and number of treatment cycles of SSG needed to achieve complete healing of CL lesions. The number of patients who needed prolonged treatment with SSG, rate of recurrence and non- responsiveness to SSG treatment was also calculated. The study was carried out on patients with CL attending dermatology clinics in Polonnaruwa and Hambantota hospitals. Initial data was obtained from 138 patients using an interviewer administered questionnaire. These patients were followed up. Seventy two patients with laboratory confirmed CL who regularly attended treatment (weekly) were selected for the study. 'Healing' was defined as flattening of nodules/papules, absence of erythema in surrounding tissue and re-epithelialization of ulcers. Lesions in 63 out of 72 patients (87.5%) completely healed following SSG therapy. The number of treatment cycles received by the patients varied from 2 to 35. The average number of weekly treatment cycles needed for complete healing was 10 (9.7). Prolonged treatment of more than 20 cycles was needed in 4 patients for healing. Eight didn't not show any response to treatment and 2 of them received treatment for more than 28 weeks. Recurrence of the lesions was reported in 3 out of 63 patients. SSG therapy was effective in majority of patients with CL. However 15 patients (20%) failed to respond to treatment or had recurrences and needed prolonged treatment.. Therefore, other treatment options should be considered for effective management of such patients.

Development of a Pilot Quality of Life Questionnaire for Children and Adolescents with Epilepsy in a Rural Community in Sri Lanka

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Epilepsy is one of the oldest recognized disorders, affecting people of all ages. Several studies have used health related quality of life as an outcome measure to describe disease burden in epilepsy. To date, there is no culturally sound and population specific tool to measure quality of life (QoL) in adults or children with epilepsy in Sri Lanka. Objective of the study was to develop a multidimensional questionnaire, which can measure the QoL of children and adolescents (aged 0-18 years) with epilepsy (CAWE) in a rural community in Sri Lanka, based on information by the primary caregiver.

We report the preliminary findings of a large ongoing study on proxy assessment of QoL in CAWE in a rural community in Sri Lanka. A qualitative study comprising 24 in-depth interviews with primary caregivers of CAWE (13), CAWE (5), siblings of CAWE (3), parents of healthy children (3), and 12 focus group discussions with primary caregivers of CAWE (1) school children (9) and key informants like school teachers (1) and health-care workers (1) was carried out in Ampara, Monaragala and Hambantota districts representing a multi-ethnic rural community in Sri Lanka. Principal investigator trained in qualitative methodology conducted all interviews in local languages based on age appropriate, pre-tested, semi structured interviewer guides. Interviews were audiotaped with the consent of participants. Tapes were transcribed verbatim and then translated to English. Content analysis was done manually. The construct utilized to develop the QoL questionnaire was health related quality of life, corresponding to the impact of a health condition and its treatment on daily life from the primary caregivers' point of view. Child's physical, psychological, social functioning and general health status were the four major areas identified from the content analysis and literature search, which in turn formed the domains of the pilot questionnaire. Each domain has 3-4 sub-scales. Total of 100 items have been pooled in the pilot questionnaire.

This pilot questionnaire is a unique, culturally sound, tool which can lead to a Sri Lankan health related QoL questionnaire for CAWE in a rural community. We need to validate it and identify the psychometric properties.

Determination of *in-vitro* Equivalence of Phoxymethylpenicillin Tablets

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Biopharmaceutics Classification System (BCS) based biowaiver studies using dissolution characteristics of a drug compound is an alternative to *in-vivo* bioequivalence testing for generic drug products of BCS Class 1 and some Class II and III products as recommended by WHO and other regulatory authorities. The objective of this study was to determine if phoxymethylpenicillin 250 mg tablets supplied to government hospitals, is equivalent to the reference listed product using the *in-vitro* dissolution methodology. Phoxymethylpenicillin was selected because CDDA, Sri Lanka is requesting bioequivalence data for antibiotics from 2015 onwards for registration of generic products and phoxymethylpenicillin is classified into BCS Class I, by the WHO.

The reference product selected as per USFDA recommendation (brand, Oспен by Sandoz) was purchased directly from the local agent. Test product was obtained from the NHSL. Weight uniformity, hardness, friability, identification and assay were performed on 12 dosage units of the products as per USP. *In-vitro* equivalence was determined in pH 1.2 (0.1N HCl), 4.5 and 6.8 (phosphate buffers) prepared according to the USP, using paddle method at 75 rpm. Samples were withdrawn at 5, 10, 15, 20, 30 and 45 minutes and analysed using a validated spectrophotometric method at 267 nm. Results were compared through two model independent methods, the difference factor(f_1) and the similarity factor(f_2). The $f_1 < 15$ and $f_2 > 50$ are acceptable for biowaiver. Similarity factor(f_2) based on the dissolution% between two curves was calculated as the logarithmic reciprocal square root transformation of the sum of squared error as given by WHO.

The weight uniformity, hardness, friability, identification and assay for each tested brands complied with the quality specifications of the USP. The f_1 was 50.04, 2.98, 7.31 and f_2 was 23.35, 58.73, 58.43 at pH 1.2, 4.5 and 6.8 respectively. The dissolution profiles of the two products at pH 4.5 and 6.8

were similar. However the dissolution profile at pH 1.2 was different ($f_1 > 15$; $f_2 < 50$).

The test product and the reference product were not *in-vitro* equivalent as the dissolution profiles were similar only in pH 4.5 and 6.8 media. The tested generic product does not meet *in-vitro* biowaiver criteria.

Validation of a Multiplex Tetra-primer Amplification Refractory Mutation System (T-arms) PCR Assay to Genotype *APOE* Alleles

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Apolipoprotein E (ApoE) has an important role in lipoprotein metabolism as it binds to both low-density lipoprotein and ApoE receptors. The polymorphic *APOE* gene which is positioned on chromosome 19 has three common alleles namely E2, E3 and E4 resulting in 6 genotypes: E2/E2, E2/E3, E2/E4, E3/E3, E3/E4 and E4/E4. E3 (Cys112/Arg158) is the predominant isoform while the other two isoforms, E2 and E4, differ from E3 by only one amino acid at positions 158 (Cys112/Cys158) (rs7412) and 112 (Arg112/Arg158) (rs429358), respectively. These differences influence the biological functions of *APOE* and therefore the isoforms have varying binding affinity to lipids thus affecting an individual's response to statins, risk for cardiovascular diseases (CVD) and predisposition to Alzheimer's disease (AD). Objective was to implement a genotyping assay for *APOE* alleles and to validate the assay and estimate the *APOE* genotype and allele frequencies in a pre-existing DNA sample collection obtained from the Sri Lankan population.

Optimization, validation and implementation of an already existing multiplex Tetra-primer Amplification Refractory Mutation System (T-ARMS) Polymerase Chain Reaction (PCR) assay to genotype *ApoE* alleles in 30 Sinhalese, 30 Sri Lankan Tamils and 30 Moors were conducted. The most frequent genotype seen was E3/E3 (66.7%), followed by E3/E4 (24.4%) and E2/E3 (8.9%). The most frequent allele was E3 (83.3%), followed by E4 (12.2%) and E2 (4.4%), respectively. Only three genotypes, namely E2/E3, E3/E3 and E3/E4 were observed in this cohort.

The commonest genotype reported in North Americans, Europeans and Asians is E3/E3 followed by E3/E4, similar to the findings in our study. The rare E2/E4 genotype along with the E2/E2 and E4/E4 genotype were not identified in this cohort. In all the three ethnicities, the most common allele found was E3 followed by E4 and E2, similar to findings in a Malaysian cohort. E2 allele shows a beneficial effect on CVDs while E4 predisposes to

CVDs. E2 is associated with reduced plasma cholesterol and increased triglycerides. The E3 allele confers a normal lipid metabolism. E4 leads to repressed clearance of lipids thus result in an increased TC, LDL and triglycerides. Therefore, identifying the *APOE* genotype in a patient will allow proper treatment planning, statin therapy and dietary intake. However, the size of the cohort is not large enough to extrapolate the findings to the entire Sri Lankan population.

Validation of a Novel Genotyping Assay for *cyp2c9*, *cyp4f2* and *ggcx* Polymorphisms to Predict Warfarin Maintenance dose

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Warfarin is the most widely prescribed oral anticoagulant drug for treating a wide range of arterial and venous thrombo-embolic diseases. Warfarin has a narrow therapeutic index and a wide inter-individual variability in dose requirement resulting in a risk of under dosing or overdosing. It has been reported that Asians require a higher dose than Caucasians to achieve the same level of anticoagulation. Studies have shown that single nucleotide polymorphisms in the cytochrome P450 2C9 (*CYP2C9*), *GGCX*, *CYP4F2 V433M* and vitamin K epoxide reductase (*VKOR*) genes have significant effects on warfarin dose requirement. Although testing for *CYP2C9**2 and *CYP2C9**3 polymorphisms for warfarin therapy is established in Sri Lanka, *CYP4F2 V433M* and *GGCX* polymorphisms are currently not being tested.

The objective of this study was to validate a genotyping assay for *CYP2C9**2,*3,*5,*6, *CYP4F2* and *GGCX* polymorphisms to predict warfarin maintenance dose.

20 de-identified samples from an already existing population based DNA collection were used to implement and optimize a tetra amplification refractory mutation system (T-ARMS) multiplexed polymerase chain reaction (PCR) test. Two approaches were adopted; single variant T-ARMS PCR and two variant multiplexed PCR. The primers were designed to have a specific 3' end to the variants and troubleshooting, optimization and sequencing were performed to obtain the optimal results.

Bands were obtained by a series of troubleshooting and optimizations. A set of 24 primers and specific PCR conditions were evaluated for accurate and repeatable genotyping of clinical samples. The desired specific bands were obtained by the single variant PCR method and except for one variant; two variants multiplexed PCR method also gave the expected bands.

Further troubleshooting and optimizations are required to achieve substantial optimal parameters, reproducibility and to validate this genotyping assay. As the genetic variants of *CYP2C9*, *CYP4F2* and *GGCX* genes show a significant association with the inter-individual variability in the therapeutic dose of warfarin, it is important to implement this genotyping assay in the diagnostic workup to personalize the therapeutic dose in patients requiring warfarin.

Phenotypic Characteristics of a Cohort of Patients with $-\alpha^{3.7}$ and $-\alpha^{4.2}$ Deletions

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Alpha thalassaemia is caused by defective alpha globin synthesis. Carriers have either one or two defective alpha genes. Three defective genes result in HbH disease and the absence of all four genes cause Hb Bart's hydrops fetalis. Deletional mutations are commoner but non-deletional mutations have more severe phenotype. The $-\alpha^{3.7}$ and $-\alpha^{4.2}$ deletions are very common worldwide as well as in Sri Lanka. The objectives of this study were to describe phenotypic characteristics of individuals with $-\alpha^{3.7}$ and $-\alpha^{4.2}$ deletions and to determine the relationship between red cell parameters, high performance liquid chromatography (HPLC) parameters and red cell morphology with the genotype.

This descriptive study was carried out at the Human Genetics Unit, Faculty of Medicine, Colombo on patients referred for alpha thalassaemia genetic studies. Clinical details, red cell indices, HPLC data and red cell morphology data were obtained from the clinic records. Genotyping for $-\alpha^{3.7}$ and $-\alpha^{4.2}$ deletions were done using gap-PCR methodology.

Thirty one individuals carrying $-\alpha^{3.7}$ and $-\alpha^{4.2}$ deletions were studied. Twenty three (74%) were asymptomatic and initially recognized incidentally. Five (16%) were symptomatic at presentation. Three (10%) were recruited for family screening. Fifteen (48.4 %) were homozygous and 9 (29%) were heterozygous for the $-\alpha^{3.7}$ deletion while the $\alpha\alpha/-\alpha^{4.2}$ and $-\alpha^{3.7}/-\alpha^{4.2}$ genotypes were observed in 5 (16.1%) and 2 (6.5%) individuals respectively. Majority (n =26, 84 %) showed a phenotype compatible with the genotype. The mean corpuscular haemoglobin (MCH) was consistently low in all the study subjects (14-25.9 pg, mean 21.65 ± 2.98). Except for haemoglobin levels (p=0.047) no statistically significant difference of the red cell parameters or the HPLC data were seen between the different genotypes. The presence of different morphological cell types in the blood picture did not vary significantly between genotypes.

The phenotype of the study population showed typical features of α thalassaemia carriers. Patients with atypical features need further genetic testing.

Determination of Frequency of *HLA-B*1502* Allele Carriers in a Cohort of Sri Lankans by *HLA-B*1502* Sequence Specific Polymerase Chain Reaction

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*HLA-B*1502* is biomarker for carbamazepine (CBZ) induced Steven-Johnson syndrome/Toxic epidermal necrolysis (SJS/TEN) among Asian populations like Chinese, Malay and Thai. In other ethnicities, the association between *HLA-B*1502* and CBZ induced SJS/TEN is not well established. According to worldwide population prevalence, the *HLA-B*1502* allele is rarely found outside Asia but it is common in China and Southeast Asia. The reason for the less importance of *HLA-B*1502* as a biomarker for CBZ induced SJS/TEN in other populations could be due to the rarity of the allele. The Food and Drug Administration (FDA) has recommended *HLA-B*1502* screening prior to the administration of carbamazepine, phenytoin, and fosphenytoin in China, Taiwan, Thailand and Malaysia. Furthermore, screening is recommended for ethnic groups in countries with high prevalence of *HLA-B*1502* such as Singapore, Vietnam, Indonesia, Philippines and South Western India. No previous studies have been done in Sri Lanka to determine the frequency of the *HLA-B*1502* allele carriers. Objectives of the study were to implement a Sequence Specific Polymerase Chain Reaction (SS-PCR) assay for genotyping the *HLA-B*1502* allele and to validate the assay and estimate the frequency of *HLA-B*1502* carriers in apre-existing DNA sample collection obtained from the Sri Lankan population.

Ninety three healthy Sri Lankans comprising of 32 Sinhalese, 30 Tamils and 31 Moors were screened after optimizing and implementing a previously described SS-PCR assay to genotype the *HLA-B*1502* allele.

Four out of 93 were detected with the *HLA-B*1502* allele. Hence, the average frequency of individuals who carried at least one allele of the *HLA-B*1502* in the studied cohort was 4.3%. Among them, three were Sinhalese and one was Moor. The carrier frequency based on ethnicity was Sinhalese 9.3% (3/32), Tamils 0% (0/30) and Moors 3.2% (1/31).

The *HLA-B*1502* carrier frequency in this study was comparable to that of South Western Indian populations (1.0-6.0%), where FDA has recommended *HLA-B*1502* screening to reduce the incidence of CBZ-induced SJS/TEN. Large scale studies are required to confirm these findings and to determine the significance of *HLA-B*1502* as a biomarker for CBZ-SJS/TEN among Sri Lankans.

Haplotypes of Heparin Binding Epidermal Growth Factor (HBEGF) Gene and Its Association with Birth Weight of Babies of Sinhalese Mothers

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Low birth weight (BW) increase risk of diseases in adult life. Although previous research has shown that inherited factors influence birth weight, very little information is available about the genes that are involved. Growth restricted pregnancies are characterized by deficient trophoblastic invasion, incomplete spiral artery remodeling and increased apoptosis of placental trophoblastic cells. Similar abnormalities are seen with deficiency of Heparin Binding Epidermal Growth Factor (HBEGF). HBEGF at feto-maternal interface is known to be of maternal origin. Hence, genetic polymorphisms in the maternal *HBEGF* gene could be associated with variation in fetal BW. Objective of the study was to analyse the association of six putatively functional SNPs (rs2074611, rs13385, rs41502, rs4150196, rs1862176, rs2237076) in *HBEGF* gene in relation to BW of babies of Sinhalese mothers using an already available DNA collection.

Samples (n=171) were obtained from nulliparous Sinhalese women who had delivered babies of normal weight following a normal pregnancy. SNP genotyping were conducted with mass array Sequenomplex methodology and newly designed PCR-RFLP assays. Associations of individual SNPs with BW was analysed using one way descriptive ANOVA in SPSS 15. The haplotypes analysis was conducted using UNPHASED software suite.

None of the individual SNPs showed a significant association with the BW in either sex. However, five different haplotypes, all carrying rs2074613 showed significant association with BW suggesting an important role for rs2074613 in determining BW, which is exerted in conjunction with other tested SNPs ($p < 0.05$). The observed BW variation was mediated via either rs2074613G.rs2237076G.rs1862176A or rs2074613A.rs2237076A.rs1862176G haplotypes. The strongest association detected was exerted via the rs13385C. rs2074613G. rs2237076G. rs4150196G. rs1862176A ($p = 0.007$). The highest variation in BW as indicated by the additive value (3.3; CI=0.99-5.56) is brought about by

rs2074613A. rs2237076A. rs2074611C. rs1862176G haplotype. All detected associations showed a trend towards increase in BW compared to the reference haplotype.

This study showed for the first time that haplotypes defined by SNPs in the maternal *HBEGF* gene is associated with variation in birth weight of babies born to Sinhalese women.

Clinical Evaluation and Genetic Study of Tuberous Sclerosis Complex in a Cohort of Sri Lankan Children

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Tuberous Sclerosis Complex is a heterogeneous genetic disorder with autosomal dominant inheritance that affects most organ systems. The disorder is characterized by development of hamartomas in almost all organ systems of the body. Other characteristic features of Tuberous Sclerosis Complex are epilepsy, intellectual disabilities, autism spectrum disorders and organ failure. The aim of this study was to describe the phenotype and genotype of Tuberous Sclerosis Complex in a cohort of Sri Lankan children. The *TSC1* and *TSC2* mutations were analyzed and genotype-phenotype correlation of infantile spasms and polycystic kidney disease were assessed.

Sample included 44 children of all major ethnicities in Sri Lanka. Clinical history, physical examination and investigation findings such as brain MRI, CT and 2D echocardiogram were documented. Sanger sequencing was done for all the exons of *TSC1* and *TSC2* genes as the first line of detection of point mutations and small indels. Multiplex Ligation dependent Probe Amplification was done to look for large deletions or insertions. The mutation detection rate was 85.7% in this study population. There were 9 (21.5%) with mutations detected in *TSC1* gene and 27 (64.2%) with mutations in *TSC2* gene. There were 22 novel mutations in *TSC1* and *TSC2* genes. Fourteen mutations had a high potential of being pathogenic. Renal cysts (Grade 3, 4) was seen in 5 patients and mutations were solely found in the Gap domain of *TSC2* gene. Nineteen patients had a history of infantile spasms. Their mutations were predominantly in the *TSC2* gene (16/19) in the peripheral gene region (13/16). In 6 patients (14.3%) with Tuberous Sclerosis Complex phenotype, no mutations were found in coding regions of either gene.

Though the clinical characteristics of Tuberous Sclerosis Complex in Sri Lankan children were similar to that previously described, many novel mutations were identified. Genotype phenotype correlation of renal cysts and GAP domain mutations of *TSC2* as well as the 6 patients with no mutations in coding region should be investigated further.

Screening for CGG Repeat Expansions in *FMR 1* Gene among Children Attending Special Schools in Sri Lanka

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Fragile X syndrome (FXS), the commonest genetic cause of intellectual disability, is due to expansion of CGG repeats present in 5' untranslated region of exon 1 in fragile X mental retardation 1 gene (*FMRI*). *FMRI* CGG repeats can be divided into four groups: normal (NL: 5-44), grey zone (GZ: 45-54), pre-mutation (PM: 55-200) and full mutation (FM > 200). FXS is associated with a range of intellectual and emotional disabilities such as learning problems, mental retardation, mood instability and autism. Children attending special schools in Sri Lanka have above mentioned symptoms. Prevalence data for FXS among some European populations is available but figures for Sri Lanka is not available. Objective was to assess the prevalence of *FMRI* expansion mutations among children attending special schools in Sri Lanka, using a non-invasive method of DNA extraction.

Using multilevel stratified sampling, a total of 850 buccal swab samples (540-males and 310- females) were collected from children attending special schools and a control group of 240 children were taken from those attending normal schools. Genomic DNA was extracted from buccal cells using method described by Handel *et al.* in 2006. Repeat region was selected for PCR amplification and amplicons were melted after thermocycle. An individual carrying 43 repeat was used to determine cut off temperature. When melt curve profile of a sample drops to baseline at a temperature greater than 43 repeat is considered as expanded.

In the study group, 19 cases were positive for repeat expansion and none in the control group. Accordingly, the prevalence of *FMRI* expansion mutation among special school children was 2.2 %. All positive cases were male. Geographical distribution of cases were 7 (36.8%) from Colombo district, 5 (26.3%) from Gampaha, 3 (18.8%) from Kalutara and 5.3% each from Badulla, Kegalle, Kurunegala and Galle districts.

Screening for *FMRI* expansions using the non- invasive buccal swab DNA is effective in community groups.

Implementation of an Allele Specific Amplification Refractory Mutation System Polymerase Chain Reaction (AS-ARMS PCR) Genotyping Assay for the 1173 C>T Polymorphism in the *VKORC1* Gene

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Warfarin is an anticoagulant widely used in the prevention and treatment of thrombotic disorders. Effective dosing with warfarin is rather challenging due to its narrow therapeutic index as well as its high degree of inter-individual and interracial variability in therapeutic response. Genetic factors such as the 1639 G>A (rs9923231) and 1173 C>T (rs9934438) polymorphisms of the Vitamin K Epoxide Reductase Sub-Unit 1 (*VKORC1*) gene are known to be the main cause of this variability.

Objectives were to implement an already established Allele Specific Polymerase Chain Reaction (AS-PCR) method for genotyping the 1173C>T polymorphism in the *VKORC1* gene and to validate the assay and estimate the frequency of the above polymorphism in an already existing DNA collection obtained from the Sri Lankan population.

An Allele Specific Amplification Refractory Mutation System Polymerase Chain Reaction (AS-ARMS PCR) assay was implemented to genotype the 1173 C>T polymorphism of the *VKORC1* gene in 60 DNA samples. The optimization of the assay was required at different annealing temperatures to get the high intensity bands in agarose gel electrophoresis without the generation of non-specific bands.

The optimized thermocycling conditions of 1173 C>T genotyping were different from the method described by Poe B.L *et al* and the optimum annealing temperature was 55⁰C. The overall variant allele (T) frequency in the Sri Lankan cohort was 5.9%, while the overall wild type allele (C) frequency was 94.1%. The frequency of the genotypes CC, CT and CC was 88.3% (53/60), 11.7% (7/60) and 0.0%, respectively.

The AS-PCR assay is a simple and rapid method to genotype the 1173C>T polymorphism in the *VKORC1* gene. It can be easily implemented in the clinical laboratory setting as a pre-prescription genotyping assay to determine the optimal dose of warfarin to be prescribed for individual patients.

Breast Carcinoma: Are We Detecting It Too Late?

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Breast carcinoma is the commonest malignancy among Sri Lankan women. Tumour stage is the most important prognostic indicator and early detection saves lives. Many breast cancer awareness programmes are carried out throughout the country even though nationwide mammographic screening is not available. Objective was to describe the clinical profile and pathological stage of women undergoing primary surgery for breast carcinoma at the National Hospital of Sri Lanka (NHSL).

The clinical details and pathological findings of 225 women with breast carcinoma undergoing wide local excision or mastectomy at the NHSL from June 2012 to September 2014 were analysed. Women who had received neoadjuvant chemotherapy were excluded. Clinical data was collected through patient interviews and clinical records. Pathological data was obtained from histo-pathological reports.

Age ranged from 29 to 84 years (mean age 56.48 years). Only 7 (3.1%) were below 35 years and 20 (8.9%) had a family history of breast carcinoma. 214 (95.1%) presented with a self-detected breast lump. Only 67 out of 204 (32.8%) presented within the first month of detection. Thirty three (16.12%) presented after 6 months. Only 2 were identified through a screening programme. The majority 152, (68.2%) of tumours were T2 (between 2-5cm) according to the TNM classification. 22 (10.3%) were T3 (>5cm) and 2 (0.9%) were T4 (any size tumour with direct extension to chest wall/skin). Lymph nodes were assessed in 202 patients and 94 (46.53%) had lymph node metastasis. 141 (62.7%) tumours were of TNM Stage II, 50 (22.2%) were Stage III and only 30 (13.3%) were Stage I at surgery. Four patients had carcinoma in situ with no lymph node metastasis.

Majority of women undergoing primary surgery for breast carcinoma at NHSL were at the prime of their lives and presented more than one month after self-detecting a lump. Majority of the tumours were of TNM Stage II or III. Presentation at a higher TNM stage adversely affects the prognosis. Therefore there is need to strengthen the existing breast cancer awareness programmes to reach women at grass root level in Sri Lanka. Screening facilities should be improved to facilitate detection of breast carcinoma early.

A Feasibility Study on Using Voice Recordings to Detect Alcohol Intoxication in Sri Lankan Males

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Accurate detection of alcohol intoxication is necessary for law enforcement and medico-legal purposes. However there are many difficulties. Blood alcohol testing is not routinely available due to its cost and the breathalyser does not have reproducibility or reviewability of test samples. Studies have suggested the use of voice recordings as an alternative method for assessing intoxication. Positive correlation has been demonstrated between certain suprasegmentals of voice patterns and alcohol intoxication. This study attempts to test the validity of those correlations in a Sri Lankan male population based on Sinhalese speech patterns. Objective of the study was to demonstrate the relationship between alterations in voice patterns after alcohol consumption and breath alcohol concentrations.

Fifty healthy Sinhala-speaking males aged 20–50 years were recruited on a voluntary basis after obtaining informed consent. Each subject was asked to provide a voice recording on a pretested sample of Sinhala phrases and sentences immediately before consuming liquor and at 30 minutes and 60 minutes after consumption. On each occasion a Breathalyzer Alcohol (BrAC) reading was also obtained. The voice recordings were then analysed using phonetics analysis software (Praat) for changes in ten suprasegmental features of speech production. These changes were categorized into four evenly distributed BrAC ranges and were statistically analyzed using SPSS software. Statistically significant changes found include decreased frequency, increased pitch, increased duration, increased intensity, decreased Harmonics to Noise Ratio and increased degree of voice breaks. Features of jitter and formants did not show any correlation with BrAC levels. Some features such as voiced to unvoiced ratio and shimmer did not show any fluctuations.

Certain changes in speech suprasegmentals can be correlated with the level of intoxication. There is evidence to suggest that by establishing a database of such voice alterations at different BrAC levels, a prediction model can be developed to identify the level of intoxication using a voice sample. This will lead to the development of a cost-effective and reviewable method for diagnosing alcohol intoxication.

Accessing Medical Knowledge for Evidence-based Practice: Changing Trends in a Developing Country

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Use of reference sources for medical knowledge has changed dramatically over the last two decades with the introduction of online sources of information and improvement in telecommunication infrastructure. This study analyses the medical knowledge seeking behaviours of early career doctors in Sri Lanka.

This cross sectional survey was conducted among two groups; new medical graduates (pre-interns) within one year since graduation and early career doctors who are within 15 years since graduation and are currently following a postgraduate course. The data collection tool was an online self-administered questionnaire (paper based questionnaires were used on request) that probed the patterns of use of reference sources for medical knowledge.

The sample comprised of 52 pre-interns (males; 32%, mean age 25.7 years \pm 0.8) and 34 early career doctors (males; 77%, mean age 33.8 years \pm 8 years). The response rate was pre-interns 54% and doctors 72%. 98% had regular, on demand access to internet. 87% had internet access on a hand held mobile device. The preferred source of reference was text books (37%), online sources (30%) and expert opinion (9%). 29% stated online sources as the second preferred source. General medical references used were Medscape/eMedicine (42%) (WebMD LLC 2014) or UpToDate (© 2014 UpToDate, Inc., USA) (25.6%). For academic and research related information the most popular indexing service was PubMed (88%). Knowledge of other indexing services was poor, < 40% had ever accessed EMBASE, Web of Science, Scopus or Cochrane library. 78% were frequent users of HINARI. 51% were familiar with systematic reviews and 11% were familiar with narrative reviews. 59% claimed to know about meta-analysis but only 5 respondents (6%) could explain the difference between a systematic review and a meta-analysis. Only 43% had ever read a Cochrane

Review and 24% had never heard of it. 35% had never read a systematic review.

The use of online resources by medical practitioners appear satisfactory. Majority of practitioners use reliable online resources as a reference point for medical knowledge. However, a careful look at the usage patterns show that much of the online resources that can be used for more innovative tasks such as evidence synthesis are grossly under-utilized.

Impact of Routine Serum Carbamazepine Level Monitoring in Pregnancy on Seizure Control, Medication Adherence and Adverse Effects

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Monitoring of serum antiepileptic drug (AED) levels in pregnancy is not done routinely in Sri Lanka. Objective of the study was to identify the impact of serum carbamazepine level monitoring in pregnancy on seizure control, medication adherence and adverse effects. Patients with epilepsy who were pregnant or planning pregnancy were recruited from NHSL neurology and DMH clinics. Serum carbamazepine level using immunoturbidometric method (Randox reagents, UK) and medication adherence using validated 4-item Morisky Medication Adherence Scale (MMAS) were assessed at preconception (PC), each trimester (T₁, T₂, T₃) and postpartum (PP) visits. Treatment, seizure control and adverse effects were recorded. Sample consisted of 96 patients, mean age was 28 years (range 18-39); 48 (50%) were primi-gravida. Mean duration of epilepsy was 15.21 years (range 0-35 years). Total of 165 carbamazepine levels were done with a median of 2 per participant. Levels were done at PC 3 (3.1%), T₁ 18 (18.8%), T₂ 46 (47.9%), T₃ 52 (54.2%), and PP 46 (57.9%) periods. Anti epileptic drugs (AEDs) in T₁ were carbamazepine 66 (71.0%), sodium valproate 24 (25.8%), clobazam 18 (19.4%) and topiramate 6 (6.5%). From T₁ to T₃, carbamazepine usage increased significantly to 74 (79.6%) (p=0.043), while valproate usage reduced to 4 (4.3%) (p<0.001). Mean carbamazepine concentrations in mcg/ml were PC=7.32, T₁=6.37, T₂=5.64, T₃=4.82, PP=5.99 and sub-therapeutic levels (<4mcg/ml) were found in PP=1(33.3%), T₁= 2(11.1%), T₂=13(27.7%), T₃=18(34.6%), PP=6(13%). High adherence (MMAS>3) was found in T₁=9 (47.4%), T₂ =33 (61.1%), T₃ =37 (64.9%), PP =32 (58.2%). The median number of seizures over 3 months was 0 in all visits. Adverse effects were drowsiness in 48(50.0%), dizziness 24(25.0%), headache 25(26.0%), visual disturbances 17(17.7%), tremor 11(11.5%), ataxia 9(9.4%), paraesthesia 9(9.4%) and anorexia in 9(9.4%). Serum carbamazepine level correlated positively with daily carbamazepine dose

($r=0.547$; $p<0.001$) and adverse effects($r=0.153$; $p=0.051$). Sub-therapeutic levels significantly correlated with low adherence (MMAS<3); $p=0.009$ but not with seizures ($r=0.037$; $p=0.650$). Adverse effects correlated positively with total carbamazepine dose ($r=0.306$; $p<0.001$) and negatively with MMAS score ($r=-0.222$; $p=0.002$). From T₂ and T₃, carbamazepine total daily dose significantly increased (paired comparison $p=0.018$) despite a reduction in mean carbamazepine levels ($p=0.087$). Significant changes in AED therapy occurred during pregnancy. Seizure control was good with high medication adherence. Sub-therapeutic levels correlated with poor adherence, but not with poor seizure control. Neurological adverse effects were common despite normal blood levels and had a negative influence on adherence.

History of Malarial Disease and Antimalarial Antibody Levels

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Cases of malaria in Sri Lanka have declined dramatically in recent years. However, high levels of anti-malarial antibodies in endemic communities exist in the absence of malaria transmission. This study compares the levels of 4 anti-malarial antibodies of individuals with and without a history of malaria during the past 10 years in an endemic community in Sri Lanka.

Sample consisted of 565 individuals selected randomly from 24 randomly selected Grama Niladhari (GN) divisions (in 12 DS divisions) in the Moneragala district. Serum samples and data on age, gender and past history of malaria were obtained from the participants. Serum samples were subjected to standard ELISA to determine the levels of 4 anti-malaria antibodies namely, anti-MSP1 and anti-AMA1 against *P. vivax* and *P. falciparum* parasites. Demographic characteristics, and antibody levels of individuals without (group A) and with past history (group B) of malaria within the past 10 years were compared.

Age ranged from 1-85 years (mean 23.71) in the total sample. Age ranged from 1-78 years in group A (mean=22.8, median=21) and 1-85 years (mean=25.6, median=23) in group B. The proportion of males and females were similar in both groups. Individuals were classified into 6 age groups. The majority of the population (70.4%) did not have a history of malaria during the past 10 years. Percentage of individuals with a history of malaria within the past 10 years increased with the age, but there was no significant difference between age groups. The median levels of all 4 antibodies were significantly lower in group A compared to group B. There were no significant differences in antibody levels between groups A and B for different age categories. In individuals aged ≤ 45 years, levels of the 4 antibodies levels were significantly higher in individuals with a history of malaria. This difference was not seen in those aged > 45 years.

Antibody levels in individuals below 45 years of age are a good indication of the presence or absence of exposure to malaria during the past decade. |

A Study of Skeletal Dysplasia in a Selected Cohort of Sri Lankan Patients

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Skeletal dysplasia is a group of disorders with diverse manifestation and multiple aetiology. They are associated with variety of systemic complications. The International Classification and Nosology of Genetic Skeletal Dysplasia 2010 revised version describes 456 disorders in 40 different groups. Prevalence of skeletal dysplasia is 1:5000 live births.

Patients were recruited from the Human Genetics Unit, Faculty of Medicine, Colombo, the National Hospital of Sri Lanka (NHSL) and Lady Ridgway Hospital (LRH) in Colombo. Detailed medical history with family history up to three generations, demographic parameters and consanguinity were studied. Clinical characteristics were analyzed according to the international guidelines. Radiological assessment was done by a Consultant Radiologist.

The total of 42 patients, 17(40.5%) male and 25 females were studied. According to the diagnostic criteria osteogenesis imperfecta was present in 9, short stature in 17, craniosynostosis in 5 and other types of skeletal dysplasia in 11. In the group with short stature 6 had achondroplasia. Dysmorphic facial features were seen in 35 patients, 16 had thoracic anomalies, 9 had fractures in long bones, and developmental dysplasia of hip was seen in 15 patients. Eighteen patients had cardiac malformations in addition to skeletal deformities. Two patients had hearing impairment and one was blind. Ten patients were totally disabled, of them 6 had osteogenesis imperfecta. Six were born to consanguineous parents (14.3%) and 8(19%) had affected family members. Twenty two patients (52.5%) from the Western Province, 12 from Colombo and 10 from Gampaha Districts.

Skeletal dysplasia, is a rare but important group of disorders. Patients generally present with morbidity due to defects in bone formation, mineralization and linear growth. We observed diverse groups of skeletal deformities. This indicate the need for community based assessments. Advanced molecular diagnostics with micro array or whole genome sequencing will open a new chapter in genetic counseling, prenatal and preimplantation genetic diagnostics and molecular pathway targeted therapeutics in the near future.

Temporal Changes in Anti-malarial Antibody Profiles in Residents of a Previously Malaria Endemic Region in Sri Lanka: Moneragala District|

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Malaria was a major health problem until a few years ago. However, a significant reduction in incidence was observed after 2002. Maintenance of surveillance is critical during the “malaria elimination phase”. Serology is a good indicator of malaria burden in an area and antibody levels are associated with protection against an epidemic. This study looked at profiles of 4 anti-malarial antibodies over a time period in a previously malaria endemic region.

Minimum required sample size was 500. Individuals were randomly selected from 24 randomly selected GN divisions within Moneragala district. Serum samples and data on age, gender and past history of malaria were obtained from the participants at 2 time points, December 2006 (Group A, n=1134) and December 2012 (Group B, n=565). Serum samples were subjected to standard ELISA to determine the levels of 4 anti-malaria antibodies, anti-MSP1 and anti-AMA1 against both *P. vivax* and *P. falciparum* parasites. Demographic characteristics, antibody levels and sero-prevalence at the two time points were compared using Chi squared test. Mann-Whitney U test was used to compare median levels of antibodies.

Ages ranged from 13-89 years (mean=37.57) in group A and 1-85 years in Group B (mean=23.71). Sero-prevalence rates of antibodies against AMA1_Pf (A:B=67.4:32.6), MSP1_Pf (A:B=67.7:32.3) and MSP1_Pv (A:B=64.7:35.3) were significantly lower in group B compared to group A. Levels of all 4 anti-malaria antibodies were significantly lower in group B when compared to group A. Study population was divided into 6 age groups and median antibody levels and sero-prevalence in each age group was compared between the time points. The mean levels of the 4 antibodies did not vary significantly in the different age groups in group B, but in group A the mean antibody levels in the different age groups varied considerably. The

median level of the 4 antibodies were significantly lower in all age groups in group B compared to group A except in the age group over 75 years.

The levels and sero-prevalence of all the tested antibodies have significantly declined with time but reached a low constant level in the older age groups. This provides indirect confirmatory evidence of declining levels of malaria transmission in this locality.

Educating the Security Forces, a High Risk Group, on Malaria Elimination Efforts in Sri Lanka

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The post conflict areas of Sri Lanka continue to provide a favourable environment for malaria transmission. Between 2008-2012, the number of malaria cases amongst the security personnel serving in the Northern and Eastern Provinces of Sri Lanka remained high while the number of cases among the civilians in these areas reduced. Security personnel are at risk due to increased exposure. Because increasing numbers of security personnel undertake service and training missions overseas, they have become an important portal of possible reintroduction of malaria into the country. Objective was to design, implement and assess an education program to increase knowledge of the security forces operating in previous high malaria endemic areas. It focused on the risk of imported malaria and its prevention, which is of critical importance in the thrust towards malaria elimination.

An interactive seminar was designed to deliver the required knowledge. Fifty seminars in 8 Districts were conducted according to a “training the trainers” model in collaboration with the Ministry of Defence, Sri Lanka. A representative group from the Sri Lanka Army, Navy, Air Force, Police, Civil Defences and Special Task Force were the target group. The level of knowledge on malaria was objectively measured amongst the participants before and after the seminar, using a pre and a post test design. A total of 2373 security forces personnel of different ranks participated. Pre and post test performance was assessed in 1612 who completed both questionnaires. Pre-seminar knowledge on malaria was significantly better in the medical corps, those who had completed secondary education and in Army personnel, compared to other security forces ($p < 0.001$). Post seminar assessment indicated an improvement in all tested domains ($p < 0.001$). The programme was effective in increasing knowledge as demonstrated by the significant improvement in post-test scores. With the vision of eliminating malaria from Sri Lanka by the end of 2014, the Anti Malaria Campaign has been conducting educational interventions targeting important high-risk groups in addition to security personnel.

The Success of a Public-private Partnership in Eliminating Malaria from Sri Lanka

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The end of the civil conflict in Sri Lanka in 2009, revealed a break down in health infra structure and a large number of vacancies in the preventive and curative cadres in Eastern and Northern Provinces. The Anti Malaria Campaign (AMC) faced substantial challenges in parasitological surveillance. These challenges were addressed by successfully establishing a public-private partnership with Tropical and Environmental and Disease and Health Associates Private Limited (TEDHA) to facilitate scaling up of malaria surveillance in the post conflict areas of Sri Lanka. Objective was to assess the contribution made by a private sector organization involved in parasitological surveillance, which would ultimately affect the malaria elimination programme in Sri Lanka.

Passive case detection (PCD), activated passive case detection (APCD) and active case detection (ACD) for malaria parasites is carried out through out the country by the AMC. TEDHA complemented parasitological surveillance through APCD in 47 malaria diagnostic laboratories set up in rural hospitals in the Mannar, Kilinochchi Ampara, Trincomalee and Batticaloa districts and ACD amongst high risk populations and pregnant females in their first trimester. The AMC examined 3,932,562 blood smears for malaria parasites during the period January 2010-December 2013, diagnosing 831 indigenous cases and 268 imported malaria cases. TEDHA examined 832,001 blood smears for malaria parasites during this period reporting 9 malaria positive infections. Eight positives were diagnosed in the Mannar District and one malaria positive was diagnosed in the Ampara district. Active parasitological surveillance detected the last indigenous malaria case reported in October 2012.

The private sector established malaria diagnostic laboratories have contributed significantly towards the malaria elimination programme in Sri Lanka by examining approximately 17% of the total blood smears while operating in the North and East of the Country. With the increase in the number of imported malaria cases reported in the country, maintaining a high degree of parasite surveillance activities is required to ensure that the reservoirs of parasites are detected and treated early to prevent the re-introduction of malaria into the country.

Glucose-6-Phosphate Dehydrogenase (G6PD) Enzyme Deficiency among Selected Persons Attending Teaching Hospitals of Kurunegala and Anuradhapura

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G6PD deficiency can present with a spectrum of disorders following exposure to certain drugs, viral hepatitis, favism, malaria, bacterial sepsis, chemicals and herbal medicine. This study estimated the extent of G6PD deficiency in selected persons attending Teaching Hospitals of Kurunegala and Anuradhapura. 2059 filter paper blood samples were collected between November 2013 and June 2014 (1018 from TH Anuradhapura; 1041 from TH Kurunegala). Blood samples were obtained from consenting persons at the time blood was drawn for testing as part of their health screening/management process at the 'bleeding room' of each hospital. Blood spots were stored individually in zip-lock bags and refrigerated until transported within 7 days to the Department of Parasitology, Colombo. G6PD activity was detected using the modified WST-8/1-methoxy PMS method, which depends on a reaction that yields a strong orange colour, the intensity of which is directly proportional to G6PD activity. WST-8/1-methoxyPMS mixture was purchased from Dojindo Laboratories, Japan. Working assay mix was prepared just prior to each assay. A commercial standard known normal G6PD activity (G6PD control normal, Trinity Biotech) was used to create a panel of internal controls for each assay (normal, moderately deficient: ~30% enzyme activity, severely deficient: ~10% enzyme activity). Inactivated blood was the no-enzyme control. For each assay, a set of controls was spotted onto 3MM filter paper. A single 1/16 inch diameter disc was punched out from each bloodspot and placed in a single well of a 96-well flat bottom microplate. 200uL of assay mix was pipetted and mixed into each well. Plates were incubated for 2h at ambient temperature, and were then inspected by eye by two different observers for qualitative analysis. For quantitative analysis, the optical density was quantified in a microplate reader at OD450nm. G6PD levels were

determined in reference to the control panels. In Anuradhapura 74 (7.11%) and in Kurunegala 142 (13.95%) had G6PD deficiency. G6PD enzyme activity of <10% normal was seen among 25 (2.46%) in Anuradhapura and 18(1.73%) in Kurunegala. 10-30% of activity was observed among 117 (11.49%) in Anuradhapura and 56 (5.38%) in Kurunegala. Modified WST-8/1-methoxyPMS method is a cost effective tool for mass screening. Screening and educational programmes for G6PD deficiency, at least in high risk areas, are necessary to prevent occurrence of disease states related to G6PD deficiency.

Women's Education and Employment in Sri Lanka

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Females constitute 51.6% of the Sri Lankan population. No perceived gender discrimination exists either in education or employment. Objective is to identify gender distribution in education and employment.

Published data of the University Grants Commission for the period 2006-2012, Department of Census and Statistics and Central Bank of Sri Lanka were analysed.

Literacy rate of females in Sri Lanka in 2012 was 91.4% compared to 67.3% in 1963. In 2006, net enrolment rate for primary education was 97.5%, rates were almost equal for girls and boys. From 2006-2012 undergraduate admissions of females were more than males (1.27:1); percentage of females were highest in Arts (78%) and lowest in Physical Sciences (26%). Female admissions to specific courses were highest for Law (82%) and lowest for Engineering (18%), mean (58%). Female registration was higher in external degree programs (70%). Female postgraduate engagement was highest in Education (69%) and lowest in Engineering (23%), mean (45%). Females opted for diploma-level (59%) more than professional-level degrees (40%). Successful completion showed similar trends. Female labour force participation rate was 29.9% in 2012, it was 20% in 1963. Between 2006-2012 average contribution of females to total paid-employment was 34%, the highest was as professionals (61%). However in 2012, highest female employment was in the informal sector (54.1%) while only 10.2% of females acted as employers. Females employed abroad were 49.1%, majority were housemaids (84.9%). Female unemployment rate was 5.8% and under-employment rate was 3.9% as opposed to 2.8% and 2.4% respectively in males. Unemployment rate of females with G.C.E (A/L) was 10.2% (3.9% in males). Under-employment rate of females with G.C.E (A/L) was 1.7% and 6.2% in females with education level of grade five or below.

Sri Lankan female enrolment in all levels of education is satisfactory except in technologically-demanding fields. There is preference shown for postgraduate diplomas and external degree programs. Rate of participation of females in the labour force has increased over the years with majority

engaged as professionals. In contrast majority in the informal sector and those carrying out unskilled jobs abroad are mostly females, with a noticeable proportion of educated females failing to secure jobs. More detailed studies of females in the informal sector and employed overseas employment are required to make specific recommendations.

Knowledge and Attitudes among Nursing Officers about Cancer Care Services for Elders at National Cancer Institute, Maharagama

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Malignancies among the elderly are on the rise as a result of population ageing in Sri Lanka. Therefore, the geriatric cancer care services need to be streamlined.

Objectives of the study were to describe the knowledge and attitudes among Nursing Officers about elderly cancer care services available at the National Cancer Institute Maharagama (NICM).

Nursing Officers who had at least six months of service at NICM were given a self administered questionnaire which assessed the following; knowledge about the services available at NICM, and physiological changes in ageing, factors considered when treating elderly cancer patients, satisfaction about the help from minor staff, waiting time and facilities at wards, clinics, laboratory, Radiology Department and dispensary and perception about the type of services required for optimum cancer care. Factors associated with perceptions was assessed using binary logistic regression.

Sample consisted of 248 Nursing Offices. Of them 95.6%, were females. Majority (68.5%) were aged 25-29 years and 51.6%, were married. Some nurses had no knowledge about the availability of counseling (4.4%), welfare (21.7%), nutrition care (29.8%), and blood bank (4%). Only 63.3% knew that some cancers could be cured and 15.3% said palliative care was the best option. More than 50% were dissatisfied about the help from junior staff, waiting time and facilities available for the elders. More than 90% of Nursing Officers perceived that separate wards, specially trained staff and more welfare services are required for the elders. In binary logistic regression models, facilities in the ward ($p=0.028$), help of the minor staff at laboratory ($p=0.008$) and facilities at dispensary ($p,0.028$) predicted the need of separate wards for the elders. Age of the nursing officers ($p,0.047$), facilities for the elders at wards ($p,0.043$), waiting time in the wards ($p,0.000$) and help of the minor staff at laboratory ($p,0.001$) predicted the

perception of the need for special training; waiting time in the laboratory (p,0.000) and help from the minor staff in laboratory (p,0.001) predicted the perception for more welfare services.

Considerable gaps in knowledge and dissatisfaction about essential services were evident among Nursing Officers. There was a common perception that services for elders need improvement. Establishment of training courses in Geriatric Nursing and improvement of infrastructure facilities and administration are recommended.

Knowledge and Perceptions about Diet among Sri Lankan Adults with Diabetes Mellitus: A Qualitative Study

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Diabetes mellitus (DM) is a rapidly growing health problem in Sri Lanka. Diet is an important modifiable risk factor affecting the incidence, severity and management of DM. Objective was to evaluate the knowledge and perceptions about dietary patterns among a group of adults with DM in Sri Lanka using qualitative research methods.

Fifty adults from a cohort of diabetic patients attending the medical clinics at the National Hospital of Sri Lanka were invited. Data were collected using 10 focus group discussions. Verbatim recording and documenting emotional responses were conducted by two independent observers. Thematic content analysis of qualitative data was done using NVIVO v10.0.

Mean age was 61.2±9.9 years and 46% were males. Mean duration of diabetes was 10.4±7.5 years. All were aware about importance of diet in the management of diabetes mellitus. Most had difficulty in incorporating this knowledge to their lives due to social circumstances. Adherence to dietary control improved after developing complications. Majority described a list of 'good foods' and 'bad food' for diabetes. They believed that 'good' foods can be consumed at all times, irrespective of the quantity and 'bad' foods should be completely avoided. Only few mentioned about the frequency of meals and some of them had increased the number of meals whilst restricting the individual portion sizes. Most believed that high 'sugar' intake is the main cause for developing diabetes. Participants were concerned about the type of rice they consume. The general impression was that red rice and long grain rice varieties are good for diabetics. Many believed that fruits were bad for diabetes, while vegetables were considered as healthy. Majority thought that there were 'special foods' that help to control blood glucose, the commonest being curry leaves and bitter-gourd.

Despite having good knowledge about the importance of dietary control, participants had difficulty following this because of social circumstances. Knowledge about meal frequency and portion size was poor. More evidence is needed to support or refute the claims about 'special foods' believed to be good for diabetes.

Knowledge and Attitudes of Common Psychiatric Illnesses among Physical Science Students of Faculty of Science, University of Colombo

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Psychiatric illnesses are a common cause of morbidity. It is a major contributor to the global burden of disease worldwide. Good “mental health literacy” among general public is necessary to facilitate early help-seeking behaviour and access effective treatment. The aim of this study was to describe the knowledge and attitudes of common psychiatric illnesses among Physical Science students of the University of Colombo.

This is a descriptive cross sectional study conducted among 120 students of Physical Science Stream, Faculty of Science, University of Colombo randomly selected from 2 batches. A self administered questionnaire in English was designed to assess the knowledge and attitudes. Knowledge was categorized as adequate or not, according to the mean score.

The findings of the study indicate that the majority of the study population (75%) have adequate knowledge regarding common psychiatric illnesses. However identification of symptoms was poor. Only 36.6% identified hallucinations and 41.1% identified delusions as symptoms. There was poor knowledge about symptoms of anxiety disorders. Depression and associated symptoms were well recognized by the participants. Though there is no significant difference, females had a higher knowledge score than males and those from Gampaha District had a higher score than those from other districts. Increase in income was associated with better knowledge. Though, the attitudes towards psychiatric illnesses were mainly positive there were negative attitudes as well. Of the participants, 50.9% believe that those who had sinned suffer from psychiatric illnesses and 68.7% believe that only people with introverted personalities suffer from psychiatric illnesses. 83% believe that psychiatric illnesses could be treated adequately.

Among the university students the knowledge regarding psychiatric illnesses is good, though identification of symptoms were poor. Though the majority had positive attitudes towards psychiatric illnesses, stigma and misinformation still exist, which will influence the health seeking behavior.

A New Approach to Build Skills on Community-based Health Promotion of Undergraduate Medical Students

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Expectation of a doctor today extends beyond treating illness to contributing to preserving and promoting the health of people. Therefore, community based health promotion should be an integral part of the undergraduate curriculum in Community Medicine. The recently introduced residential community attachment programme, by the Community Stream of the Faculty of Medicine, University of Colombo used a novel approach of a comprehensive health promotional workshop to build knowledge and skills of undergraduates, replacing class room based teaching and small scale community projects. Objectives were to develop knowledge and skills required by a medical student to design and implement community based health promotional activities.

A residential programme was conducted at the Embilipitiya MOH area in April 2014. 215 students of a batch were assigned to 10 groups with one student being the overall coordinator. Concepts of health promotion was discussed at a lecture. Students identified and prioritized health promotional themes through observations and community diagnosis made during the field visits. Several training sessions provided the students with knowledge and skills on promoting health, related to the topic assigned in groups, guided by staff and local resource persons. On the last day, students were provided the opportunity to conduct these activities at the “Suwa Arana” health promotional workshop held at Ranchamadama Vidyalyaya, Embilipitiya. Appropriateness and validity of activities were closely monitored by the staff. Feedback was obtained from students, regional staff, academic staff and other specialists on different aspects of the health promotional activities. Altogether 555 adults and 75 children attended the workshop. Themes selected by students ranged from child abuse and alcoholism to a school health programme. The activities used by the students to promote health included quizzes, group discussions, video clips, poster presentations and clinical demonstrations. Feedback from regional health staff, academic staff members and specialists indicated that dedication and the enthusiasm shown

by the undergraduate students were high. Perceived level of achievement of learning objectives indicated that a majority (75% to 95%) of students rated their achievement of the related areas of knowledge, attitudes and skills as excellent or good.

“Suwa Arana” health promotional workshop was an innovative approach to build skills on community based health promotion of medical students. However the long term effects of this approach need to be further evaluated.

Knowledge, Attitudes and Practices of Medical Undergraduates on the Management of the Emergency Ophthalmological Conditions

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Objectives of the study were to assess the knowledge, attitudes and practice regarding ophthalmological emergencies among medical undergraduates.

One hundred 4th year medical students from Faculty of Medicine, University of Colombo who have completed the ophthalmology training were assessed using a self-administered questionnaire which contained questions on general information, knowledge on emergency ophthalmological conditions and attitudes and practices regarding ophthalmological emergencies.

Mean age was 23.90 years \pm 0.772. There were 66 males and 34 females. Out of a maximum of 5 the mean (SD) knowledge scores were diagnosis of ocular trauma 4.02 (0.77), acute loss of vision 3.78 (0.95) and red eye 3.60 (0.95) (mean \pm SD). Mean (SD) knowledge scores on management of above conditions were 4.06 (1.06), 3.1 (1.25), 3.5 (1.01). 59% of the students had not encountered acute angle closure glaucoma during their clinical practice. Similarly 59% had not seen retinal detachment and 21% had not seen corneal foreign bodies. 60% were not confident regarding management of acute angle closure glaucoma and 22% were not confident regarding management of corneal foreign bodies. 62% felt that the current duration of 2 weeks for clinical appointment in Ophthalmology was not adequate..

According to our study even though the students had adequate theoretical knowledge regarding diagnosis and management of common ophthalmological emergencies, most had not encountered them in clinical practice and were not confident about their ability to manage these emergencies. Most of the participants suggested increasing clinical exposure as the best way to improve knowledge and skills of diagnosis and management of ophthalmological emergencies We recommend inclusion of a new training programme in ophthalmology for medical students and pre intern doctors.

Clinical Characterization of a Cohort of Sri Lankan Families with Inherited Cancer Syndromes

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All cancers are genetic but only 5-10% are inherited. Each type of hereditary cancer syndrome (HCS) has clinical characteristics with or without a positive family history. These are useful in clinical diagnosis, risk assessment, genetic testing and counseling. No previous studies have been done to clinically characterize the HCS in Sri Lanka. The objective of this study was to clinically characterize a cohort of Sri Lankan families with HCS.

Families with HCS were recruited from the Human Genetics Unit, Cancer Institute Maharagama and the National Hospital of Sri Lanka. Complete medical and surgical history was obtained. Clinical characterization was done according to international guidelines.

There were 43 affected and 12 asymptomatic individuals with positive family history of cancer. Hereditary breast and ovarian cancer (HBOC) syndrome was the commonest cancer seen in 15 (34.9%) patients, all were females. Mean age of onset was 43.6 years and 10 (66.7%) had a positive family history. Commonest histology type in HBOC was well differentiated invasive duct carcinoma (40%) and only 3 (21.4%) had triple negative tumor. Hereditary non-polyposis colorectal cancer syndrome was seen in 14 (32.6%) patients, the majority were females (64.3%). Mean age of onset was 43.3 years and 57.1% had positive family history. Distal colon was involved in 11 (78.7%) and extra-colonic features were seen in 2 (14.3%) patients. Eight (18.6%) patients had familial adenomatous polyposis. Their mean age of onset was 33.6 years, presence of family history and extra-intestinal manifestations were seen in 4 (50%) and 2 (25%), respectively. Two (4.6%) individuals had Peutz Jeghers syndrome and another 2 (4.6%) had Von Hippel Lindau disease. Among the 12 asymptomatic individuals, 10 (83.3%), 9 (75.0%), 5 (41.5%), respectively had 1st, 2nd and 3rd degree relatives with various types of cancer.

Clinical characteristics of HCS in Sri Lanka are similar to that reported in other populations with regard to early age of onset and significant family history. However, high frequency of poorly differentiated, triple negative breast tumours and proximal colon involvement with extra-colonic manifestations, commonly reported in HCS, in other population were not observed in this cohort.

Validation of a Tetra Primer Amplification Refractory Mutation System Polymerase Chain Reaction Genotyping Assay for *cyp2c19*2* and *cyp2c19*17* Polymorphisms

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The cytochrome P450 2C19 (*CYP2C19*) is important for the metabolism of several therapeutic agents such as proton pump inhibitors (PPIs), anti-convulsants, anti-ulcer, anti-seizure and anti-depressant drugs such as omeprazole, tamoxifen, clopidogrel, fluoxetine, lansoprazole, S-mephenytoin, tolbutamide, voriconazole and diazepam. *CYP2C19*2*, the most common variant allele of *CYP2C19* alters the reading frame of messenger RNA leading to a truncated protein and is associated with a distinct decrease in platelet response. *CYP2C19*17* is a recently identified variant and carriers of this variant have a significantly lower area under the curve, suggesting that this would give rise to an extensive metabolizer phenotype for *CYP2C19*. Testing for *CYP2C19*2* and *CYP2C19*17* polymorphisms have not yet been established in Sri Lanka. The objective of this study was to validate a genotyping assay for the *CYP2C19*2* and *CYP2C19*17* polymorphisms.

32 de-identified samples from an already existing population based DNA collection were used to implement and optimize a tetra amplification refractory mutation system (T-ARMS) multiplexed polymerase chain reaction (PCR) assay. The primers were obtained from a previously published article and troubleshooting, optimization and sequencing were performed to obtain the optimal results. Bands were obtained using in vitro testing and optimization. A set of 8 primers and specific PCR reaction conditions were evaluated for accurate and repeatable genotyping of clinical samples. We were unable to carry out the PCR cycle of the pre designed PCR primers which were obtained from a previously published article according to their protocol, hence it had to be substantially modified and optimized after troubleshooting for a new PCR protocol. The previously reported band sizes were different from the band sizes obtained. The re-evaluated band sizes were found to be accurate.

Further optimizations are required to achieve substantial optimal parameters and obtain reproducibility and to validate this genotyping assay. Since the *CYP2C19*2* and *CYP2C19*17* polymorphisms show significant association with the therapeutic dose of approximately 15% of all prescribed mainstream drugs, the T-ARMS multiplexed PCR assay should be implemented to genotype these variants in the Sri Lankan population as an adjuvant to personalized therapeutic strategies.

Design and Implementation of a New Assay for Genotyping Pharmacogenomically Important Cytochrome P450 2D6 (*CYP 2D6*) Gene Variants

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There is a vast variability in drug response among different individuals which has an impact on efficacy and safety. Environmental factors, physiologic factors, drug–drug interactions and genetic factors play an important role in this phenomenon. Cytochrome P450 2D6 (*CYP 2D6*) is a highly polymorphic gene and metabolizes around 25% of current drugs. *CYP2D6* variants result in ultra-rapid metabolizers, extensive metabolizers, intermediate metabolizers and poor metabolizers. Different molecular genetic techniques have been employed to genotype *CYP2D6* gene variants, including Polymerase Chain Reaction-Restriction Fragment Length Polymorphism (PCR-RFLP), allele specific PCR methods, and multiplex single base primer extension method. The objective of this study was to design and implement a multiplex allele specific PCR to genotype the *CYP2D6* gene variants.

A multiplex allele specific PCR method was developed for genotyping the nine *CYP2D6* variants (100C>T/rs1065852, 1023C>T/rs28371706, 1661G>C/rs1058164, 1707delT/rs5030655, 1846G>A/rs3892097, 2549delA/rs35742686, 2850CT/rs16947, 2988G>A/rs28371725, 4180G>C/rs113584). These selected variants were reported to be more common among human population and associated with poor metabolizers. The multiplex PCR methods were carried out with four different reaction mixtures. Tested samples were sequenced to validate the results.

A multiplex allele specific PCR method was successfully developed to genotype the 9 variants of the *CYP2D6* gene. All 10 samples used in optimization process were found to be negative for all the mutations. This test was validated by sequencing. There are several very efficient high throughput single nucleotide polymorphism genotyping methods currently in use, nevertheless, these methods require specialized probes, chemicals and

instruments which are highly expensive hence, unaffordable to the public. These reasons led to the limitation of the use of these methods in clinical diagnosis. Multiplex allele specific PCR technique provides an opportunity to amplify many targeted products simultaneously, with several drawbacks. Developing a multiplex allele specific PCR is a tedious task which involves a complex optimization process.

Multiplex allele specific PCR method is a rapid and effective method for genotyping the *CYP2D6* gene variants but this method needs further optimization to increase the consistency of results obtained.

Isolation and Characterization of Alkaline Protease Gene from Native Thermostable *Bacillus* sp.

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Enzymes produced by thermophilic microorganisms are known to have thermostable properties, hence become potential candidates for many industrial applications. Cloning and expression of their genes in mesophilic microorganisms using recombinant DNA technology is a better alternative method for production of thermostable enzymes. Alkaline protease hydrolyses proteins with broad specificity for peptide bonds. In recent years alkaline protease has gained considerable importance in the industrial market and is used extensively in detergent, leather, laundry and food processing industry. Objective was to isolate, clone and characterize alkaline protease gene from thermostable *Bacillus* sp.

The bacterial population present in a water sample collected from a hot water spring at Nelumwewa in Polonnaruwa district, Sri Lanka was cultured at different temperatures (30^oC to 60^oC). A bacterium which had the optimum growth at highest temperature (55^oC) was selected. Biochemical tests and 16s rRNA analysis were carried out to identify the bacterial species. Gelatin hydrolysis and skimmed milk agar hydrolysis tests were conducted for the detection of extracellular protease production. Two primers with restriction enzyme sites (NcoI and BamHI) were designed to amplify alkaline protease gene. The purified gene was ligated into pGEM^R-T vector and transformed into *E.coli* (JM109) competent cells. Rapid screen test and double digestion followed by DNA sequencing were performed to confirm the insertion. Glycerol stocks were prepared from transformed recombinant *E. coli* cells and stored at – 80^oC. Alignment and comparison of amplified gene was conducted using reference nucleotide and protein sequences from Genbank and UniProt databases.

Gram positive rod shaped bacterium with extracellular protease activity was observed. 16s rRNA analysis showed 99% identity with *Bacillus licheniformis*. Rapid screen test and plasmid double digestion confirmed the successful transformation of *E.coli*. The complete protein consisted of 380 amino acids and the sequence showed 95.8% identity with alkaline protease

(Subtilisin Carlsberg) from *B. licheniformis* strain ACTT. Alkaline protease gene from a native thermophilic *Bacillus licheniformis* strain was successfully isolated and cloned in *E. coli*. The gene can be inserted into an expression vector and transform into a mesophilic host for characterization and production of thermostable alkaline protease.

X Linked Severe Combined Immunodeficiency Mutations Reported in Sri Lanka

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Mutations in IL2RG gene cause X linked severe combined immunodeficiency (XSCID) disorder. Objectives were to detect different pathogenic mutations in IL2RG gene in Sri Lankan patients and carriers.

We tested seven boys, who were clinically suspected to have X linked severe combined immunodeficiency (XSCID), by sequencing IL2RG gene to confirm or exclude XSCID. Mothers of these positive patients were tested for carrier stages.

Three out of seven male patients showed single nucleotide substitutions in exon 4, 5 and intron 6 of the IL2RG gene separately, confirming patients' hemizygous state. In the first patient a single nucleotide substitution was detected in exon 5 of the *IL2RG* gene in the X chromosome. This substitution, designated 737C>A, is a missense mutation, which results in the substitution of Serine by Arginine at amino acid position 241 in the common gamma chain. In the second patient a single nucleotide substitution was detected in intron 6 of the *IL2RG* gene in the X chromosome. This substitution designated IVS6+2T>G, is a mutation, which results in the substitution of Thymidine by Guanine at splice site position c.854+2 in the common gamma chain. In the third patient a single nucleotide substitution was detected in exon 4 of the *IL2RG* gene in the X chromosome. This substitution designated 521G>A, is a nonsense mutation, which results in the substitution of Tryptophan by a stop codon at amino acid position 174 in the common gamma chain. Each patient's mother shared the same genetic mutation with her affected male child, being heterozygous carriers for the same mutations. 43% of clinically suspected patients were confirmed to have IL2RG gene mutations by molecular genetic analysis.

Three pathogenic mutations in IL2RG gene responsible for XSCID were detected; in exon 4 designated 521G>A, exon 5 designated 521G>A, and intron 6 Splice site mutation designated c.854+2. All three mothers carried the same pathogenic mutations that their male children were harboring, confirming heterozygous carrier state and excluding de novo mutations in the locus of interest.

Phenotypes of Genetic Eye Disorders in Sri Lanka

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Genetic eye disorders cause significant visual impairment in affected individuals and burden families. Limited data is available regarding genetic and heritable visual impairment in Sri Lankan children and adults. Hence we present an initial study which explored the phenotypes of genetic eye disorders seen in Sri Lanka. Objective was to phenotype the genetic eye disorders present in Sri Lanka.

Clinical genetic evaluation, genetic counseling and genetic risk assessment of 59 patients seen at the ophthalmo-genetic clinic of the Faculty of Medicine Colombo was carried out. 54 patients (92%) had isolated eye disorders, while the remaining 5 patients had syndromic phenotypes. Isolated eye disorders include, retinoblastomas 40 (68%), retinitis pigmentosa (RP) 8 (14%), Stargardt disease 2 (3%), isolated Aniridia 2 (3%), isolated Coloboma 1 (2%) and Epithelial Basement Membrane type corneal Dystrophy (EBMD) 1 (2%). Those with significant eye involvement as part of rare Ophthalmo-genetic syndrome include; Waardenburg syndrome with heterochromia iridis 2 (3%), Mobius syndrome with defective abduction of eyes 1(2%), blepharophimosis, ptosis, Epicanthus Inversus Syndrome (BPES) 1 (2%) and Edward syndromic baby with a Coloboma 1 (2%). Fourteen patients had a positive family history (24%), while 45 were simplex cases (86%).

Phenotypes detected in retinoblastomas, BPES, Aniridia, EBMD and Stargardt disease are similar to phenotypes in the reported literature. Some patients with Retinitis pigmentosa, Waardenburg syndrome and Moebius syndrome exhibited atypical clinical features. Although autosomal dominant

(BPES, Aniridia, EBMD) and autosomal recessive (Stargardt disease, RP) inheritance patterns were detected in this cohort, the majority (86%) were simplex cases. Reduced penetrance, variable expressivity, de novo mutations, (germline) mosaicism and two hit hypothesis are the possible explanations for negative family history. Clinical genetic evaluation, genetic testing, genetic counseling including risk assessment is recommended for patients and families suffering from ophthalmo-genetic conditions that are prevalent in Sri Lanka. Wider research (population based screening programs and surveys) including genetic testing should be implemented to explore the phenotypic and inheritance patterns in Sri Lanka.

Trafficking of HLA-I Alleles during HIV Infection

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It has long been understood that certain HLA-I alleles increase the susceptibility while certain alleles confer protection to HIV. Interestingly most of the protective alleles known to date are HLA-B alleles; e.g. B57, B27, B51. The protection induced by HLA-B alleles have been attributed to polyfunctionality, greater clonal turnover and higher avidity of HLA-B restricted T cells compared to HLA-A restricted T cells. We previously demonstrated that cytoplasmic domain of HLA-B partially resist HIV mediated down-regulation that in turn leads to comparably higher presentation of HIV antigens on the surface of cells expressing HLA-B compared to HLA-A. The difference in susceptibility of HLA-I to HIV was pinpointed to a sequence difference in cytoplasmic tail. In this exercise we try to study details of the differential trafficking of HLA-I alleles in HIV infection.

We used ‘wet lab and in-silico prediction (secondary/tertiary structure and protein modification prediction programs)’ to determine the mechanism behind differential down-regulation. Jurkat cell lines expressing chimeric HLA-I alleles were infected with lab strain HIV-I IIIB virus. Nef and AP-1 binding was assessed after co-immunoprecipitating chimeric HLA-I. Co-localisation studies were carried out to observe trafficking of the molecule through endosomal, golgi and lysosome compartments.

Almost all HLA-A alleles are down-regulated from the cell surface compared to HLA-B which is partially down-regulated. Chimeric HLA-I alleles co-localise with EEA-1, Rab7, Lamp1 and beta COP to different degrees, partially explaining the differential down-regulation of HLA-I alleles. In addition, secondary structure of the cytoplasmic domain of HLA-B was predicted to be more tightly wrapped compared to HLA-A. There were comparatively less phosphorylation sites on HLA-B and –C cytoplasmic tail

compared to HLA-A.

Differential phosphorylation predicted by protein prediction programs support the *in vitro* findings that we have observed. More studies that include surface Plasmon resonance will provide more insight to differential susceptibility of HLA-I to HIV.

Use of Traditional Ayurvedic Medicines for Treatment of Diabetes Mellitus among Sri Lankan Adults

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A wide array of medicinal plants and their active constituents are known to prevent and treat diabetes. Ayurveda, a science that uses herbal medicines extensively, has been adopted by the mainstream medical systems in some European countries. In Sri Lanka, Ayurveda is an accepted treatment modality. Ayurvedic medicines are used for the treatment of diabetes, though their efficacy has not been studied extensively.

Objectives were to describe the use of Ayurvedic treatment for treatment of diabetes by Sri Lankan adults and identify their association with glycaemic control and complications of diabetes.

A sample of 5,000 adults was invited from 7 provinces of Sri Lanka. Patients with diagnosed diabetes were included in the analysis. The presence of symptoms and complications, anthropometric parameters and biochemical parameters were compared between those who were receiving and not receiving Ayurvedic treatment.

Sample size was 343 of which 36.7% were males. Mean age was 57.0 years. Of the study population 39 (11.4%) were using only Ayurvedic treatment at the time of the study and 95 (27.8%) had used Ayurvedic medication at least once. Mean age of patients currently using Ayurvedic medication was 58.05 years. Majority were females (71.8%), 89.7% were Sinhalese, 64.1% were from the rural sector. The symptoms of nocturia (43.6% vs. 27.5%) ($p=0.038$), polydypsia (38.5% vs. 23.8%) ($p=0.049$) and eye complications (23.7% vs. 10.6%) ($p=0.020$), history of DKA or HONK (25.6% vs. 8.7%) ($p=0.001$) and hypoglycaemic episodes (79.9% vs. 46%) ($p=0.002$) were significantly more common among patients receiving Ayurvedic medication, than those who were not. There was no significant difference in the fasting blood glucose, total cholesterol, HDL cholesterol or LDL cholesterol between patients receiving Ayurvedic treatment and those who were not.

In this study population, use of Ayurvedic treatment has not demonstrated a significant difference in outcomes compared to the use of Western medications though there seem to be a significant increase in hyperglycaemic and hypoglycaemic episodes. Combined use of complementary treatment modalities have to be investigated further.

SLGVD – A Public Resource of Genetic Variations in Sri Lankans

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The human genome hosts a variety of genetic variations. Demographic and evolutionary events have contributed to the diversity of these variations observed among populations. Existence of population-specific mutations for single gene disorders as well as ethnic differences in the frequencies of genetic variations involved in complex disorders highlight the need for country/population specific databases.

A preliminary database (Sri Lankan Genetic Variation Database-SLGVD) to collate data on genetic polymorphisms in Sri Lankans has been created by the Human Genetics Unit of the Faculty of Medicine, University of Colombo. Objective of this study was to optimizing SLGVD to meet international standards, enhance functionality and provide access to genetic information of the local population to clinicians and scientists.

The database was redesigned with new fields and relations for disease associated traits and bridge relations were introduced to accept multiple cardinality. A web application was designed to interact with data which consists of new search criteria so that the database can be explored with multiple categories of keywords. A log in based user area was implemented with restricted user roles to maintain data security. Data from journal articles identified by searches in online resources and via personal communications with researchers were used to update the database.

Currently SLGVD has 256 SNP records belonging to 76 genes. This comprises of population data with allele and genotype frequencies of different ethnicities as well as clinical data of disease traits and associated genetic variations. The web based interactive user interface provides query oriented results with annotations and links to reliable sources thus acting as a

portal for the users with limited knowledge on bioinformatic tools. SLGVD can be freely accessed online at <http://www.slgvd.hgucolombo.net/>. This resource increases the efficiency and quality of the data mining process. With the added features, SLGVD has the potential to be developed as a national repository and a secure digital data sharing center of Sri Lankan genetic variations. The knowledge thus made available would facilitate research in the local population and also provide useful information for improving clinical genetic testing services in the country.

Design and Implementation of Allele Specific Polymerase Chain Reaction (AS-PCR) Assay to Genotype the V600E Mutation in the *BRAF* Gene

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BRAF V600E mutation found in approximately 59% of malignant melanomas. They are found in 40-70% of papillary thyroid carcinomas and 18% of colorectal cancers. Molecular genetic testing of *BRAF* gene helps to differentiate sporadic colorectal cancers from Lynch syndrome. In colorectal cancer, the mutated *BRAF* gene affects the response to anti EGFR monoclonal antibodies in the patients with wild type *KRAS*. However, around 40-60% patients do not response to such therapy. This ultimately leads to a combined therapy consisting both EGFR and *BRAF* inhibitor drugs which are beneficial for individual patients. *BRAF* V600E mutation is a marker in colorectal cancer patients which serves as a diagnostic, prognosis and treatment response predictor. Objective was to design and implement the rapid, specific and low cost As-PCR test to detect the *BRAF* V600E mutation in Formalin Fixed Paraffin Embedded (FFPE) tissue.

20 DNA was extracted from formalin fixed paraffin embedded tissue. The multiplex allele specific tetra-primer amplification refractory mutation system PCR (T-ARMS-PCR) was designed to generate three products based on the presence or absence of the mutation with multiplexed in a single-tube PCR assay to assess the allelic status at each SNP locus. The PCR products were electrophoresed on a 2 % agarose gel and visualized under UV light. The PCR products were sequenced by Sanger sequencing using a BigDye terminator v3.1 cycle sequencing kit and analyzed on an ABI 3730XL Genetic Analyzer to validate the variant allele.

The expected bands for the wild type allele and mutant allele were obtained. The mutant band was not detected among the screened samples although, validity of the PCR assay was confirmed by Sanger sequencing.

We have designed the allele specific PCR to detect the *BRAF* V600E mutation, which offers consistent results. Further validation is necessary with positive controls.

Design and Implementation of Novel Allele Specific Multiplex Polymerase Chain Reaction Assay to Genotype Exon 19 Deletion and L858R Mutation in the EGFR Gene in Patients with Non-small Cell Lung Carcinoma

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Lung cancer is the leading cause of cancer death worldwide. Approximately 80% of lung cancers are grouped as Non Small Cell Lung carcinoma (NSCLC). Mutations in Epidermal Growth Factor Receptor gene (*EGFR*) have been associated with improved response to tyrosine kinase inhibitors in patients with NSCLC. The two most common mutations, exon 19 deletion (E746-A750del) and exon 21 L858R single nucleotide polymorphisms (SNP's) account for approximately 90% of all *EGFR* mutations.

The aim of this study was to design and implement a new PCR assay to screen the two most common therapy-related *EGFR* mutations in tumour samples based on Multiplex Allele Specific PCR method.

Multiplex Allele specific tetra ARMS PCR primes were designed to detect the most common exon 19 deletion (E746-A750del) and exon 21 L858R SNP. The genomic DNA was extracted from Formalin Fixed Paraffin Embedded (FFPE) tumour sample using QIAamp DNA FFPE Tissue Kit. The assay was validated and further confirmed by sequencing the two positive samples by Sanger automated sequencing.

PCR reactions were carried out in a single tube after optimization of the PCR conditions such as primer concentration, annealing temperature, and MgCl₂ concentration. The designed assay provided the predicted amplification pattern for both mutant and wild type genotypes, in addition to being fast and easy to perform in routine a laboratory.

The allele specific multiplex PCR assay we designed is fast and easy to perform in routine diagnostic laboratory compared with other proposed method for detection of *EGFR* mutations in NSCLC such as Sanger sequencing, pyrosequencing, real-time polymerase chain reaction, and capillary electrophoresis single-strand conformation analysis. PCR reaction

could be carried out in a single tube with inexpensive reagents using standard PCR techniques which can be easily implemented at any clinical laboratory. This assay is sensitive and cost effective for initial *EGFR* testing and will help to identify patients who will benefit from tyrosine kinase inhibitors.

Design and Implementation of a Polymerase Chain Reaction (PCR) Test to Genotype the *CCR5* Delta 32 Base Pairs Deletion

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Human CC chemokine receptor gene (*CCR5*) is a co-receptor for the entry of Human Immunodeficiency Virus type 1 (HIV 1) which infects human macrophages and monocytes. A 32 base pair deletion of *CCR5* gene, delta 32*CCR5* mutation results in the truncated protein which is protective against HIV-1 infection in homozygotes and delays progression of the disease in heterozygotes people. The anti retroviral therapy response is high among the individuals with the delta 32*CCR5* mutation than in those with the wild type. Objective was to design a conventional allele specific Polymerase Chain Reaction (AS-PCR) to genotype the *CCR5* 32-basepair deletion.

Genomic DNA samples of 45 individuals were obtained from an already existing population-based DNA collection maintained in our unit for studies of this nature with the approval of the Ethics Review Committee of the Faculty of Medicine, University of Colombo. We designed a novel PCR to genotype the delta 32*CCR5* mutation by designing new AS-PCR Primers. Genomic DNA from a heterozygous and a homozygous individual was used to validate the PCR assay. The assay was validated and further confirmed by sequencing the two positive controls by Sanger automated sequencing on an ABI Prism 3100-Avant Genetic Analyzer (Applied Biosystems, CA, USA), using Big Dye Terminator chemistry version 3.1 (Applied Biosystems).

A 260 bp products was seen in the 45 individual, indicating the absence of the *CCR5* 32-basepair deletion. However, the presence of the 260 bp and 228 bp products respectively were seen in the heterozygous positive control. Furthermore, the presence of a single 228 bp product was seen in the homozygous control. Hence, the designed assay generated the expected bands for the normal, homozygous and heterozygous individuals.

We designed a sensitive, specific and low cost PCR assay to genotype the *CCR5* delta 32 deletion. This test can be easily implemented as a routine test for genotyping of the *CCR5* delta 32 base pair deletion.

Design and Implementation of a New Assay to Genotype 460G>A and 719A>G Polymorphisms in the Thiopurine S-methyltransferase (*TPMT*) Gene

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Thiopurine S-methyltransferase (*TPMT*) is a cytosolic enzyme involved in S-methylation of aromatic and heterocyclic sulfhydryl compounds including the anticancer agents, 6-mercaptopurine, 6-thioguanine and the immunosuppressant, azathioprine. People with intermediate or low activity of *TPMT* enzyme have an increased risk of hematopoietic toxicity when treated with conventional doses of drugs which are metabolized by *TPMT* enzyme. *TPMT* enzyme deficiency is inherited in an autosomal recessive manner. Presence of point mutations in the *TPMT* gene lead to variation in sensitivity to above mentioned drugs. *TPMT*3C* is the predominant mutant allele reported in Asian and African populations whereas *TPMT*3A* is the predominant mutant allele found in Caucasians. The tetra-primer Amplification Refractory Mutation System ARMS assay described here provides genotyping for two common *TPMT* mutations 460G>A, and 719A>G seen in the South Asian region, and offers a simple, cost effective, precise and rapid option for screening of patients in clinical settings. To date, no tests have been designed in Sri Lanka to determine the frequencies of the *TPMT* alleles that are important in the metabolism of the thiopurine drugs. Objective was to design and implement a new assay to genotype 460G>A, and 719A>G polymorphisms in the *TPMT* gene.

We designed a tetra-primer ARMS-Polymerase Chain Reaction PCR to genotype polymorphisms in the *TPMT* gene.

Out of the 30 samples used, none were found to be heterozygous or homozygous for both mutations. All were of the wild type genotype (*TPMT*3C* – AA and *TPMT*3B* – GG).

This assay can be used to detect and analyze more variants of the *TPMT* gene by designing tetra primers for each polymorphism in order to identify patients who are at risk of developing hematotoxicity in response to treatment with thiopurine drugs.

Knowledge and Self Perceived Barriers Regarding Diabetic Foot Care in Patients with Type Two Diabetes Mellitus without Foot Ulcers Attending a Tertiary Care Institute

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Objective were to assess the knowledge and self perceived barriers regarding diabetic foot care among in-patients with diabetes mellitus but without foot ulcers. These patients were assessed using an interviewer-administered questionnaire.

Sample consisted of 397, there were 216 males and 181 females. Mean age was 56.58 years (SD 9.74). Mean fasting blood sugar was 158.27 mg/dl (SD 63.30). 39.3% were aware about HbA1c test and 23.42% knew their last HbA1c. Average HbA1c was 7.34% (SD 1.13). 68.5% had comorbid hypertension and 49.1% had hyperlipidemia. 72% had been educated about diabetic foot care. 57.9% acquired knowledge about diabetic foot care from the diabetic clinic. Only 21.2% knew that regular foot examination has to be done and only 18.7% were doing regular foot examination. 30.2% were not aware about how to cut nails. 76.6% were not aware about proper footwear. 49.9% were aware about the distribution of sensory loss in diabetes mellitus. 29.7% and were not aware about the importance of dietary control and 53.4% did not know that smoking cessation prevent foot complications. Majority (55.7%) considered forgetfulness as a barrier to regular foot examination. 36% considered lack of knowledge about the proper technique and 39.3% lack of time as barriers. 30% considered foot care as not important and 15.4% physical limitations as barriers respectively.

The above data shows that a significant proportion of patients lack knowledge regarding aspects of diabetic foot care such as foot examination, foot wear and factors that increase foot complications. Most of the barriers to regular foot examination can be minimised by patient education. There is a need for proper foot care education and review of practices among diabetic patients.

A Maternally Inherited Partial Trisomy 1q (q44qter) and Partial Trisomy 15 (pterq22) in a Child with Silver Russell & Partial Trisomy 15q Syndrome

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A male infant who was examined at the age of 1 ½ months and died at the age of 8 months with partial trisomy 1q syndrome and partial trisomy 15q syndrome 47,XY,+der(15)t(1;15)(q44;q22) is described. The baby presented with feeding difficulty, developmental delay and dysmorphic features including macrocephaly, triangular face, high nasal bridge, low set ears with a simple and malformed left ear, long philtrum, bilateral single palmer creases, bilateral syndactyly and atrial septal defect. He was the only child of non consanguineous parents with a history of a previous first trimester miscarriage. Objective was to determine the phenotype and genotype correlation of this patient by using standard cytogenetic and Fluorescence *in situ* Hybridization (FISH) techniques.

Chromosome culture and karyotyping was performed on peripheral blood lymphocytes of the baby and both parents according to standard procedures. A preliminary FISH experiment was performed on the harvested whole blood lymphocyte cell suspension of the baby using commercial fluorescent labeled probes of chromosomes 1 and chromosome 15.

Chromosomal culture and karyotyping showed a marker chromosome resulting in an unbalanced structural abnormality. Further analysis by parental screening showed a balanced translocation between chromosome 1 and 15 in the mother; 46, XX,t(1;15)(q44;q22) and the father having a karyotype with no structural and numerical abnormalities (46,XY). Therefore the marker chromosome that was present in the child was the derivative chromosome 15 inherited from the mother. The origin of the additional material on chromosome 15 from the long arm of chromosome 1, suggested by GTG banding pattern, was confirmed by (FISH) results.

According to our knowledge this is the first report of a patient with maternally inherited 1q trisomy showing Silver Russell phenotype. We conclude that this patient shows both features of Silver Russell Syndrome and partial trisomy 15q.

Child with a Novel Homozygous Mutation in the Treacher Collins-Franceschetti Syndrome 1 (*TCOF1*) Gene Presenting with Ambiguous Genitalia, Cranio-facial Dysmorphism and Multiple Congenital Malformations

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Many gene mutations are associated with disorders of sex development (DSD) and hence, the exome sequencing approach represents a relatively rapid and cost-effective approach to understand the aetiology. This study was undertaken to identify disease-causing mutations in an 8 month old Sri Lankan male child with ambiguous genitalia, cranio-facial dysmorphism and multiple congenital malformations using the exome sequencing approach.

Clinical information and peripheral blood samples were collected from the proband and his parents after obtaining their written informed consent. Paired-end sequencing was performed on the Illumina HiSeq2000 platform using TruSeq v3 chemistry. Potentially pathogenic mutations were verified using classic Sanger sequencing. The proband was the first child born to healthy, consanguineous parents. Ambiguous genitalia and cranio-facial dysmorphism were recorded at birth. Genital examination showed evidence of micropenis (<2cm), peno-scrotal hypospadias, bifid scrotum with bilateral palpable testes in the scrotum. He had multiple cranio-facial dysmorphic features such as microcephaly, narrow forehead, low set ears, down slanting palpebral fissures, strabismus, bilateral epicanthal folds, broad nasal tip with anteverted nostrils and micrognathia. Other congenital anomalies included anteriorly placed anus, ostium secundum atrial septal defect and ventricular septal defect, dysplastic, multicystic pelvic kidney and asymmetrically dilated right lateral and third ventricles. His karyotype was 46,XY. Analyses of the exome dataset showed a homozygous mutation in exon 7 of the Treacher Collins-Franceschetti Syndrome 1 (*TCOF1*) gene [NM_000356.3 (*TCOF1*): c.889G>T; p.A297S; ENST00000323668]. This change causes a non-synonymous substitution within the *TCOF1* protein, which is predicted to be deleterious. Both parents were carriers of the mutation. This mutation

in the heterozygous form was previously reported (rs112039991) in 9 of 4395 African American alleles and in 2 of 192 Luhya from Webuye, Kenya, all of whom were healthy (1000 Genomes Project). It has never been reported in the homozygous state. The *TCOF1* gene mutation identified in this child has not previously been reported in either the heterozygous or homozygous state in Treacher Collins Syndrome (TCS) patients. This finding sheds more light on the molecular pathogenetic basis of TCS and demonstrates the phenotypic variability associated with mutations in the *TCOF1* gene.

Ring Chromosome 21 in a Child with Dysmorphic Features

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Ring chromosome 21, r(21) is a rare chromosomal aberration associated with recognizable dysmorphic features, congenital malformations and mental retardation. This report describes a six month old baby boy referred for cytogenetic testing and counseling due to dysmorphic features suggestive of Down Syndrome. The phenotype included flat occiput, mildly low set ears, upward slanting eyes, epicanthal folds and flat nasal bridge. He had near normal developmental milestones. A 2D echocardiogram showed the presence of an ostium secundum atrial septal defect. The objective was to identify the chromosomal aberration in this patient using Fluorescence in situ hybridization (FISH) technique and to determine the genotype-phenotype correlation in this patient.

Conventional cytogenetic analysis was carried out on peripheral blood lymphocytes according to the standard protocols using the GTL banding technique. FISH test was performed on the same peripheral blood lymphocytes using commercial DNA probes for Down Syndrome Critical Region 4 Gene - *DSCR4* on 21q22.13; Nuclear Receptor Interacting Protein 1 Gene - *NRIP1* on 21q11.2 and Phosphofructokinase L Gene - *PFKL* on 21q22.3 according to the manufacturer's instructions.

Initial cytogenetic studies showed that the karyotype of the proband was 46,XY,r(21) in which one of the two chromosomes 21 was replaced with a ring chromosome 21, r(21) in every analyzed spread. Parental karyotypes were normal. FISH analysis showed duplication of the probe signals *DSCR4* at 21q22.13 and *PFKL* at 21q22.3.

The ring chromosome 21 detected in this patient is *de novo* as the cytogenetic analysis of parents were normal. The phenotypic features of the baby resembling Down syndrome correlated with the duplication of the *DSCR4* and *PFKL* genes. Microarray and sequencing techniques can be used to find out the exact breakpoints of the ring chromosome 21.

Molecular-cytogenetic Analysis of a Ring Chromosome 18 in a Sri Lankan Female Child with Congenital Malformation, Heart Defects and Global Developmental Delay

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Ring chromosome 18, (r18) is a rare chromosomal disorder. It can be formed when a part of one or both ends of chromosome 18 have been deleted and joined together. As a result, clinical features of patients with ring chromosome 18 depend on the extent of the deleted region at the chromosomal ends. Ring chromosome 18 can also arise without any deletions due to dysfunctional telomeres.

A two year old girl with congenital malformation, heart defects and global development delay was referred for genetic evaluation. She had a complete left side cleft lip and cleft palate and severe growth failure. At the age of 2 years, her weight was 4.5 kg, head circumference was 39.5 cm and the length was 59 cm. CT scan of the brain did not identify any structural malformations of the brain. The objective of the study was to determine the phenotype-genotype correlation in this child using the Fluorescence *in situ* Hybridization (FISH) technique.

Conventional karyotyping was done in the peripheral blood lymphocytes of the patient and parents. FISH probes RP11-317F19 (specific for *GLARI* gene at 18q23 position) and RP11-1082M21 (specific for *TGIF1* gene at 18p11.3) were used during FISH analysis of the patient's chromosomal spreads.

An abnormal karyotype containing a ring chromosome 18 was detected in all analyzed chromosome spreads of the patient. FISH analysis of the patient, detected a deletion of the *GLARI* gene at chromosomal position 18q23. Karyotypes of the parents were found to be normal. Majority of the patients with ring chromosome 18 show symptoms of 18q deletion (18q-) syndrome while the others show symptoms of 18p deletion (18p-) syndrome symptoms or both 18q- and 18p- syndromes. Mental retardation, developmental delay, heart defects and facial dysmorphism have been reported with many cases of ring chromosome 18.

Deletion of the *GLARI* gene at chromosomal position 18q23 in this patient, suggested a terminal q arm deletion associated with severe growth retardation. Further FISH analysis with more probes and molecular studies need to be employed to determine the exact break points of ring chromosome 18.

A Patient with Turner Syndrome with a Karyotype of 45,X[38]/46,X,r(X)[16]

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Turner syndrome (TS) mosaics with a ring chromosome X have been reported in the literature with varying phenotypes from sterility and mild dysmorphism to severe dysmorphic features with mental retardation. The severity of the phenotype depends on the size of the ring X and the presence of a functioning *XIST* gene (*cis*-acting gene in the X-inactivation centre). With a smaller ring X, it is more likely to find mental retardation and dysmorphic features mainly due to failure of dosage compensation by X inactivation due to lack of a functioning *XIST* gene. Patients with r(X) with intact *XIST* gene lack the severe phenotypic characteristics and exhibit a mild variant of TS phenotype.

This paper describes a 15 year old girl with suspected TS due to primary amenorrhoea, short stature and mild dysmorphic features: wide carrying angle, widely spaced nipples and a wide sandal gap. She had no significant past medical or surgical history. She was of normal intellectual ability as indicated by normal school performance. She had poor height and weight gain since early childhood; height: 134 cm and weight: 21 kg at the age of 15 years which were less than the 3rd percentile for height and weight at her age. Objective was to identify the chromosomal aberration in this patient using Fluorescence in situ hybridization (FISH) technique and to correlate the findings with the phenotype.

Conventional cytogenetic analysis was done followed by FISH technique. The X centromeric probe (to confirm that the ring chromosome was a chromosome X) and the *XIST* specific probe were used to check the presence of the *XIST* gene in the ring chromosome X.

Cytogenetic analysis showed that the patient was mosaic for two cell lines: 45,X[38]/46,X,r(X)[16]; a TS mosaic with ring chromosome X. Results of FISH showed that the *XIST* gene in the ring chromosome X was not deleted.

The unaffected *XIST* gene could be the reason for her mild phenotype with normal intelligence in comparison to several other turner mosaics with severe dysmorphism and mental retardation due to a smaller ring X and a deleted *XIST* gene.

Paternally Inherited Chromosomal Translocation (8;11) in a Child with Dysmorphic Features and Seizures

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Reciprocal translocations are frequent structural rearrangements observed in human where two different chromosomes exchange segments. The overall incidence of reciprocal translocation in general population is approximately 1 in 500. We describe a one year old child with dysmorphic features and seizures harboring translocation between chromosome 8 and 11. The objective was to assess a possible genotype-phenotype correlation in a patient with dysmorphic features.

The proband was the 1st child of 3rd degree consanguineous parents born by normal delivery. The child had mild dysmorphic features including microcephaly, hypertelorism, upward slanting eyes, epicanthol fold, flat nasal bridge, low set ears, short neck and overlapping toes. The child was hypotonic with mild developmental regression and had two episodes of convulsions at 8 months and 1 year of age respectively.

Conventional Cytogenetic analysis of peripheral blood lymphocytes was carried out in the patient and his parents using standard protocol of GTL banding. FISH was performed on the patient's metaphase chromosomes using gene specific FISH probes.

Cytogenetic analysis revealed a translocation between chromosome 8 and 11; t(8;11)(q24.3;p13) in the patient. Further investigations were carried out by parental screening. A similar translocation between chromosome 8 and 11 was found in the father and the mother had a normal karyotype. FISH analysis showed that *TRAPPC9* nor *PAX6* genes are intact in the genome but *PAX6* gene has been translocated into the derivative chromosome 8.

The father of the child had a translocation with normal phenotype, but the child had dysmorphic features and other clinical manifestations which indicated that the child has an unbalanced translocation; extra or missing genetic material which has been inherited due to malsegregation during meiosis or any other copy number variants which could not be detected by automated karyotyping or FISH. Array comparative genomic hybridization (aCGH) or Exome sequencing should be performed for better understanding of disrupted genes and for genotype-phenotype correlation.

A Case Report of a Patient with Mosaicism for Ring Chromosome 6 and Monosomy 6 Cell Lines: *FOXC1* Gene Deletion with No Associated Eye Anomalies

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Ring chromosome 6 is a rare chromosomal disorder which usually occurs *de novo*. The formation of the ring chromosome is a sporadic phenomenon and arises due to post zygotic replication error. The phenotype of ring chromosome 6 has a wide phenotypic range including short stature, normal appearance, normal or mild psychomotor development to growth failure, eye anomalies and mild to moderate mental retardation. The clinical presentation of the patient depends on the structure and size of the ring chromosome as well as the level of mosaicism. Monosomy for an autosome with viability for life is an extremely rare incident and generally not compatible with life unless in a case of low grade mosaicism. Objective was to assess the genotype phenotype correlation in a patient with dysmorphic features using cytogenetic and molecular cytogenetic techniques.

Chromosomal analysis and Fluorescence in Situ Hybridization (FISH) study was carried out using peripheral blood lymphocytes. The karyotype was done by using GTL banding technique and maximum banding resolution obtained was 450, in which 10 metaphase spreads were karyotyped and 40 metaphases were analyzed. The FISH technique was carried out using *FOXC1* and *SMOC2* gene specific probes which are located at terminal regions of short arm and the long arm of chromosome 6.

Chromosomal analysis of the patient showed mosaicism for the ring chromosome 6 and monosomy 6. In the analyzed chromosomal spreads, 90% cells had normal chromosome 6 replaced by ring chromosome and 10% of cells were monosomy for chromosome 6 which was designated as 46,XX,r(6)(p25q27)[36]/45,XX,-6[4]. The Fluorescence in Situ Hybridization revealed a deletion of *FOXC1* gene in ring chromosome 6 whereas the *SMOC2* gene was intact in both normal and the ring chromosome 6 cell lines.

Most of the literature reported an association between deletion of *FOXC1* gene and anterior eye chamber disorders. In our patient such abnormalities were not found. Therefore our finding suggests *FOXC1* located in 6p25 is not the candidate gene for eye anomalies. Further clarifications are required to confirm the role of *FOXC1* gene in the regulation of embryonic and ocular development.

Partial Monosomy of the Long Arm of Chromosome 13 Involving 13q32 Band: A Case Report

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The 13q deletion (13q-) syndrome is characterized by structural and functional monosomy of the long arm of chromosome 13. The wide spectrum of phenotypes associated with this condition varies depending on the location and the size of the deleted region. This syndrome is classified into three groups with regard to the 13q32 band. Group 1 consists of deletions proximal to q32, group 2 includes deletion in q32 and group 3 has deletions in q33-34.

A 2 years and 9 month old girl had short stature, microcephaly, partial ptosis with a divergent squint and hazy iris, low set ears, broad nasal root with shallow bridge, micrognathia, short philtrum, open mouth with thin lips and cleft palate, clinodactyly, brachydactyly, clitoromegaly and overriding second toe. Molecular cytogenetic analysis was carried out to confirm the partial monosomy of the long arm of chromosome 13 involving 13q32 band and to correlate the phenotype of the patient with what is described in the literature. Conventional karyotyping was performed on peripheral blood lymphocytes obtained from the child and both parents. Further confirmation of the cytogenetic aberration in the child was carried out using Fluorescence *in situ* Hybridization (FISH) technique.

A deletion in the long arm of chromosome 13 was observed in all the analyzed spreads with the karyotype 46,XX,del(13)(q31→qter). Cytogenetic examination of the parents showed normal karyotypes. FISH performed using custom made probes RP11-1-96J5 (*GPC5*-13q31.3) and RP11-412K14 (*ARHGEF7*-13q34) showed FISH signals for *ARHGEF7* in both chromosomes 13, which indicated that the patient did not have a terminal deletion as suggested by the conventional cytogenetic analysis. The signals for *GPC5* were seen in only one chromosome 13, confirming its deletion in the derivative chromosome 13.

Conventional cytogenetic analysis suggested that the patient had a terminal deletion in chromosome 13 but FISH studies showed that it was an interstitial one, 46,XX,del(13)(q31-q33). The patient's phenotype correlated with the deleted 13q32 critical region. In contrast to previously described cases with 13q32 deletions, this patient has demonstrated relatively longer survival.

Molecular Cytogenetic Characterization of the First Reported Sri Lankan Child with a *de novo* 9p Inverted Duplication (p13.3; p23)

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Compared to other rare chromosomal disorders, duplication of the short arm of chromosome 9 (partial trisomy9p) is not uncommon. The first reported case was in 1970 and more than 150 patients have been reported so far. Trisomy 9p is the fourth common chromosome anomaly seen in live births next to chromosomes 21, 18, and 13. In majority of reported patients, the trisomic segment of 9p duplications was transmitted from a parent carrying a reciprocal balanced translocation and only in a small number were they *de novo* duplications. The 9p22.1-p23 region had been proposed to be the critical region for the 9p duplication syndrome phenotype.

A four year old boy born with developmental delay who presented to the Human Genetics Unit was clinically evaluated. Conventional karyotyping was performed on the patient and his parents' peripheral blood lymphocytes according to standard methods. Fluorescence *in situ* Hybridization (FISH) was performed on the metaphase chromosome spreads of the patient using BAC clones for 2 specific genes; RP11-627M21 for *DMRT 1* gene located at 9p24.3 and RP11-145E14 for *RMRP* gene located at 9p13.3.

The child presented with the following features; strabismus, low set anteverted large ears (bat ears), broad nasal root, short philtrum, a mouth with downturned corners with a prominent lower lip. Cytogenetic analysis detected a karyotype of 46,XY,add(9pter). The parents' karyotypes were normal, therefore this was a *de novo* rearrangement. In the FISH analysis, the probe targeting the *RMRP* gene at 9p13.3 confirmed an inverted duplication 9p and the probe targeting the *DMRT1* gene at 9p24.3 terminal verified no terminal deletion/duplication. Hence the final karyotype of the patient after molecular-cytogenetic characterization was 46,XY,dup(9)(p13.3-

Molecular cytogenetic characterization confirmed that the phenotypic features observed in this child are in concordance to the spectrum of clinical features seen in children with duplication in the proximal 9p region which involves the duplication of the 9p22.3-p23 critical region.

FACULTY OF SCIENCE



Message from the Dean



This year's theme for the Annual Research Symposium is University – industry collaboration for strengthening the knowledge hub of Sri Lanka which harmonizes with the curricula of the Faculty of Science. The industry oriented courses offered by the seven departments and the industrial training as well as internship programmes are intended to strengthen proficient task force of the country and to develop enthusiasm among the undergraduates to become entrepreneurs. The postgraduate programmes offered by the Faculty of Science are deemed to strengthen the competent human resources in the disciplines of sciences and mathematics. The latest addition to our M.Sc. programmes is on Actuarial Science which is introduced to accustom our students to the requirements in actuarial and banking sectors.

During past 10 months over 300 postgraduates have enrolled in our postgraduate programmes and at the last postgraduate convocation, our postgraduate programmes have produced 5 Ph.D.'s 117 M.Sc.'s and 57 Postgraduate Diplomas to strengthen the work force in the country. At this Annual Research Symposium 30 abstracts will be presented on 21st November 2014 at the Faculty of Science reflecting inventive research carried out by our postgraduate students under the able guidance of the proficient academic staff.

The endeavor in the preparation of abstracts and making the presentations are affectionately acknowledged. My sincere gratitude is extended to the reviewers and the research committees at the faculty and the other committees of the University for the successful Completion of their assignments. On behalf of all the academic and nonacademic staff of the Faculty of Science, I send my profound gratitude to the organizing committee and all the participants at this Annual Research Symposium 2014 and my good wishes for a very rewarding and productive event.

Professor K. R. Ranjith Mahanama
Dean, Faculty of Science

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Investigation on Suitability of Several Alternative Substrates for the Growth of an Edible Mushroom, *Schizophyllum commune*.

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Schizophyllum commune is an edible mushroom and is known to be a good source of proteins and vitamins. Although it is commonly found all over the world, records on commercial production are scarce. This study was carried out to investigate the potential of locally available substrates to grow *S. commune*. Alternative substrates including dried banana leaves, coconut leaves, paddy straw and coir dust were compared with saw dust (rubber) which is the commonly used substrate for commercial production of other edible mushrooms. Banana leaves, coconut leaves and paddy straw were cut into 1 cm × 0.2 cm pieces. Each substrate was added with 10% (w/w) rice bran, 2% (w/w) CaCO₃ and 0.2% (w/w) MgSO₄ were separately added. The mixture was filled into 200 gauged polypropylene bags and autoclaved. Each bag was inoculated with a 1 cm² block from the actively growing region of a *S. commune* culture maintained on potato dextrose agar (PDA) and incubated under dark at room temperature (27 ± 3 °C) for 2 weeks. Mycelial growth was measured weekly to determine the mycelial growth rate. After two weeks, once the fructification commenced, fully grown fruiting bodies were harvested. The weekly mushroom yield was recorded as fresh weight. The experiment was laid on a completely randomized design and the data was analyzed using MINITAB 14 statistical package. Highest rate for mycelia growth was observed in substrate of banana leaves (10.35 ± 0.02 cm/week) and coconut leaves (9.24 ± 0.03 cm/week). Coir dust (7.96 ± 0.12 cm/week) and rubber saw dust (7.32 ± 0.10 cm/week) containing media showed intermediate rate of mycelia growth whereas paddy straw containing media showed no signs of mycelia growth. Highest mushroom yields were obtained for coconut leaves (9.59 ± 0.66 g) and coir dust (9.18 ± 0.17 g) containing media, after 4 weeks of incubation and are significantly different compared to other substrates. Based on mycelia growth rate and fruiting body yield obtained in this investigation, coconut leaves and coir dust based media can be recommended for the cultivation of *Schizophyllum commune* to obtain fruiting bodies.

Optimizing Environmental Parameters Affecting *in-vitro* Rock Phosphate Solubilization by a Native *Burkholderia* sp.

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Rock phosphate (RP) is a cheap, environmental friendly Phosphorus (P) source that can be used as an alternative to chemical P fertilizer. However the direct application is limited only for perennials due to its low solubility. It has been reported that the introduction of phosphate solubilizing microorganisms (PSMs) can improve the solubility of RP. The main purpose of this study is to optimize the growth parameters: incubation time, aeration, carbon (C) and nitrogen (N) concentrations, affecting *in-vitro* RP solubilization by a native *Burkholderia* sp. to make application of RP for annual crops feasible.

To determine the optimum incubation time, 1 mL of 1×10^8 cfu mL⁻¹ of *Burkholderia* sp. was inoculated in to 50 mL of Pikovskaya medium modified by replacing Ca₃(PO₄)₂ with Eppawala rock phosphate (ERP) quantitatively (7.2 g L⁻¹) (PVK-ERP). Samples were incubated at room temperature, at 100 rpm oscillation, for different time periods: 24 h, 48 h, 72 h, 96 h and 120 h. To determine the effect of aeration, same simulations were maintained as still cultures. Soluble P concentration of the filtered samples was determined by using Murphy and Riley method (1962). After identifying the appropriate conditions from the above experiments, the same procedure was carried out with varying N and C concentrations and the data were statistically analyzed using SAS 9.0 version, at 5% level of significance. For all the experiments three replicates were maintained and 1 mL of sterile distilled water added PVK-ERP medium served as the control.

Aeration significantly increased the RP solubilization by *Burkholderia* sp. ($p=0.000$). The highest solubilized phosphate concentration was observed in the aerated samples for 96 h (106.74 ± 4.72 mg L⁻¹) compared to that of non-aerated samples. Statistical analysis (one way ANOVA) indicated that the phosphate solubilization by the bacterium under different N and C concentrations were significantly different ($p=0.001$) in PVK- ERP liquid medium. This study reveals that *in-vitro* P solubilization of *Burkholderia* sp. was optimum in aerated PVK-ERP medium containing ammonium sulphate 3 g L⁻¹ and glucose 12 g L⁻¹ at ambient temperature for 96 h.

Rapid and Sensitive Detection of Sugarcane White Leaf and Sugarcane Grassy Shoot Diseases by Loop Mediated Isothermal Amplification (LAMP) Assay

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Phytoplasma born sugarcane white leaf (SCWL) and sugarcane grassy shoot (SCGS) diseases have a major impact on the yield of sugarcane (*Saccharum officinarum* L.), a high potential cash crop in Sri Lanka. Sugarcane plants with phytoplasma disease symptoms were first reported in Sri Lanka in 1990. These phylogenetically closely related phytoplasma strains are categorized under 16SrXI group. Accurate disease diagnosis and proper disease management is crucial in increasing the yield of this crop.

Loop mediated isothermal amplification (LAMP) is a powerful innovative gene amplification technique emerging as a simple rapid diagnostic tool for early detection and identification of microbial diseases and has been adopted for many phytoplasma diseases. Here we report the study undertaken to establish a rapid and sensitive diagnostic tool for detection of SCWL and/or SCGS diseases by LAMP assay.

Partial nucleotide sequences of leucyl tRNA gene of both SCWL and SCGS diseases generated by nested PCR products, revealed 100% identity between these two phytoplasmas and the consensus sequence was used accordingly to design the LAMP primers; Sugar F3, Sugar B3, Sugar FIP, Sugar BIP using Optigene LAMP designer (Optigene, UK). On agarose gel analysis, the LAMP amplicons produced a ladder like pattern in contrast to a single band as observed in PCR. All symptom positive samples scored positive under both detection methods. The LAMP assay was sensitive enough to detect up to a minimum level of 125 ng of total template DNA by agarose gel electrophoresis. Comparison between conventional thermocycler and the thermostatic water bath methods for LAMP showed similar results on 2% agarose gels suggesting that water bath can be used for field level detection.

This study revealed that the established, single step isothermal DNA amplification assay has potential to be used as an accurate and rapid diagnostic assay for SCWL and SCGS diseases in laboratories with low resource settings.

Keywords: Sri Lanka, Sugarcane, Phytoplasma, nested PCR, LAMP assay

***In vitro* and *in vivo* Haemostatic Activity of Sri Lankan Wild Type *Carica papaya* L. Mature Leaf Concentrate**

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Haemostasis is a complex process which activates the clotting cascade during an injury and prevents excessive bleeding. Most of the haemostatic disorders are treated with external haemostatic agents. Plant derived haemostatic agents offer a safe, stable and inexpensive alternatives to synthetic drugs.

The present study evaluated the *in vitro* and *in vivo* haemostatic activity of mature leaf concentrate of *Carica papaya* (MLCC) Sri Lankan wild type variant using rats to fill the existing knowledge gap. *In vitro* haemostatic activity was measured using calcium induced clotting time of the MLCC (0.5, 1, 1.5, 2 and 2.5 mg/ml doses) (N=3) and saline as the control. In the *in vivo* assay, Wistar rats (N=6/ group) were gavaged with 3 doses (low: 0.18, mid: 0.36 and high:0.72 ml/100g body weight) of the MLCC and clotting time was measured at 1st, 2nd and 3rd hrs post treatment. The effect on prothrombin time (PT) was measured at 3rd hr post treatment following the administration of the highest dose.

The MLCC elicited marked procoagulation activity in both *in vitro* and *in vivo* assays. Significant ($P < 0.05$) and dose dependent ($r^2=0.92$) reduction in *in vitro* clotting time of rat blood was observed with all tested MLCC concentrations (0.5, 1, 1.5, 2 and 2.5 mg/ml) compared with saline. Similarly, 0.18, 0.36 and 0.72 ml/100g of MLCC showed significant ($P < 0.05$) and concentration dependent ($r^2=0.91$) reduction in *in vivo* clotting time at 3rd hr post treatment (low dose; 43.42%, mid; 53.89% & High; 60.09%), where mid (40.53%) and high (44.9%) doses significantly ($P < 0.05$) reduced the clotting time at 2nd hr post treatment. Further, compared with the control, PT was significantly ($P < 0.05$) reduced at 3rd hr post treatment by 26.26% indicating that the extrinsic pathway of clotting cascade is activated by the MLCC.

The present study established that the mature leaf concentrate of Sri Lankan wild type *C. papaya* possesses both *in vitro* and *in vivo* haemostatic activity of rat blood and has potential to be developed as a haemostatic agent.

Keywords: bleeding disorders, haemostasis, *Carica papaya*, mature leaf concentrate

Impact of Land use on Occurrence, Species Composition and Diversity of Stream Fish in the Kalu Ganga River Basin

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Land use in the riparian areas influences stream ecology and aquatic fauna. Although adverse impacts of anthropogenic land use changes have been well documented globally such information are seriously deficient in Sri Lanka. This study focused on the investigation of impacts of different land uses on the occurrence and diversity of fish in the streams of Kaluganga river basin. Investigations were carried out in streams of natural forest and tea, rubber and paddy plantations where the geomorphology was similar. Standard protocol were followed during a period of 5 months starting from August 2013 with at least 15 field visits per site. A total of 3568 individual fish belonging to 19 species (7 families) were found during the study period and sixty eight percent of them (13 species) are endemic to Sri Lanka. Family Cyprinidae was the most dominant taxa with 10 species. The highest number of fish was found in the forest (total of 1481, belonging to 11 species) followed by paddy (781 individuals of 8 species), tea (638, 6 species) and the lowest numbers were in the rubber plantations (573, 7 species). Overall, the lowest diversity was recorded in the streams in paddy fields and the lowest abundance in rubber cultivations. Species occurrence showed a significant difference across different land use practices (Pair wise comparison, One way ANOVA, $F= 4.01$). Streams in the forest showed the highest Shannon Weiner, Margalef and Simpsons Indices. Endemic *Puntiuscumingi* was the most dominant fish contributing to more than 50 % of the composition both in tea and paddy fields yet absent in the rubber plantation and in the forest. The freshwater fish should get special attention in conservation since they are the most vulnerable taxonomic group in Sri Lanka as most of the threatened and endemic species live in habitats outside the Protected Areas. Moreover, many endemic fish show restricted distribution and found only in the wet zone with much higher abundance than in other areas. In this context, results of the present study raise several implications for watershed management. The results stress on the importance of minimizing human impacts in riparian zones and ensuring water quality for enhanced conservation of fresh water fish.

Keywords: freshwater fish, impacts, land use, Kaluganga basin

An Investigation of Mangrove Distribution Pattern and Associated Factors in Selected Localities along Matara - Galle Coastal Belt

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Mangrove ecosystems are one of the most important coastal ecosystems in Sri Lanka. Mangrove species and mangrove associates of Sri Lanka have been well documented. However, localized distribution patterns of mangroves in estuarine areas have been less studied. Further, the effect of tsunami on mangrove distribution pattern has not been documented. There are localized mangrove patches along estuarine areas of southern Sri Lanka. Hence the present study explored the mangrove distribution pattern along estuarine areas of Nilwala River, Polwathumodara River, Koggala lagoon and Thalpe Ela, Unawatuna. Study sites were visited on a monthly basis and mangrove species distribution pattern was mapped. Physicochemical parameters were also studied at the study sites. A questionnaire was administered to neighboring community to reveal the past and present status of mangroves in the study sites. Newly built constructions, landfills, garbage dumping sites and other threats were studied at each study site. The present study recognized a unique mangrove distribution pattern in each study site, indicating the specific environmental factors affecting mangrove distribution pattern. At all sites, tourism related constructions and illegal mangrove clearing and landfilling were observed. Major species recorded in this study were *Sonneratia caseolaris*, *Bruguiera gymnorrhiza*, *Avicennia marina*, *Excoecaria agallocha*, *Acanthus ilicifolius*, *Acrostic humaureum*, *Cerberamanghas*, *Dolichandrone spathacea* and *Hibiscus tiliaceus*. Excessive growth of *Nypafruiticans* was observed at Polwathumodara and Nilwala sites while thick *Rhizophora* belts were observed at Thalpe Ela and KoggalaOya sites. *Sonneratia caseolaris* were abundantly available at the study sites of Nilwala River and Polwathumodara River. No direct use of mangroves was observed during the study period at these sites. A survey conducted among the neighboring people revealed an excessive growth of *Nypafruiticans* and *Rhizophora* and loss of mangrove diversity after Tsunami. At Thalpe Ela site people revealed the excessive growth *Rhizophora* after Tsunami. Water quality parameters indicated that sites were normal in terms of depth and water quality. Further studies are required to supplement the

finding of this study, for a better understanding of mangrove species distribution at these localities.

Keywords: Southern Sri Lanka, Coastal belt, True mangroves, Mangrove associates, Tsunami

Patterns of Morphological Variation in *Zosterops* White-eyes along the Elevational Gradient in the Wet Zone of Sri Lanka

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The high-elevation mountain peaks of Sri Lanka harbour numerous endemic bird species, and elevation is believed to have played an important role in generating this endemism. Elsewhere, the elevation is a known barrier to gene flow and has greatly contributed in shaping up the montane biodiversity. The *Zosterops*(white-eye) complex in Sri Lanka consists of two species, the high elevation endemic, *Zosteropsceylonensis*(Ceylon white-eye) and the lower elevation regional relative, *Zosteropsalpebrosus*(Oriental white-eye). As part of a deep study on the role of mountain peaks in generating endemism in South Asia, here we investigated how the morphology of the species pair varied along an elevational gradient and to verify the presence of a distinct morphotype (species) at higher elevations. Adult birds were captured using call playback and mist nets along a transect line spanning across the wet zone of Sri Lanka. This represented an elevational gradient, and multiple traits were measured from each captured bird, for which basic statistical analyses were carried out. Almost all the morphometric characters indicated a significant increase along the elevational gradient (low to high). The morphotype described for *Z. ceylonensis* was restricted to the higher elevations, while those for *Z. palpebrosus* were largely restricted to the lower elevations. It was also seen that the *Z. palpebrosus* co-occur with *Z. ceylonensis* at elevations 1000-2000m. *Z. ceylonensis* is known to be distinct from *Z. palpebrosus* being darker in colour, having a larger body size (weight – $11.9 \pm 1.9 > 10.6 \pm 1.4$, tarsus – $18.0 \pm 1.4 > 15.7 \pm 1.2$) having a thicker and longer bill (total culmen – $14.8 \pm 0.8 > 11.9 \pm 1.0$) and a bigger eye ring gap ($1.4 \pm 0.4 > 0.7 \pm 0.3$). Our analyses showed an increase in all these characters and additional characters such as the size of the skull, and length of the wing, tarsus, claw and tail, proving *Z. ceylonensis* to be bigger in size. Plumage characters need to be analyzed to confirm that *Z. ceylonensis* is darker. In order to further confirm the presence of a distinct species at the higher elevation and to understand the role of elevation in generating endemism, a thorough data analysis is required in which phenotypic data coupled together with genotypic data.

Identifying Measures to Produce Tea with Minimum Impact to Climate Change by Reducing its Cradle-to-Gate Life Cycle Carbon Footprint: A Study in Sri Lankan Context

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This research study focuses on life cycle carbon footprint assessment of tea produced in Sri Lanka. Assessment of product life cycle impact to climate change and calculating the cradle-to-gate life cycle carbon footprint, identifying mitigation measures and implementation to minimize the carbon footprint are becoming new requirements of sustainable production. The objective of this research was to identify the life cycle greenhouse gas emission issues associated with the tea industry and identify mitigation measures. The overall contribution to climate change and global warming was calculated based on the measurements on soil carbon changes, biomass carbon accumulation, transport, and process related emissions covering all tea growing regions. Field samples were collected from 33 tea fields and factories covering four tea growing regions, followed by the laboratory analyses. Biomass carbon accumulation was estimated using field sampled data and allometric equations. One kilogram of made tea was considered as the functional unit of the study. The carbon footprint of tea manufactured in own leaf factories were lower than bought leaf factories due to lesser involvement of leaf transportation and purchased electricity contributed more than 50 percent of total emissions. Even though biomass was an economical and carbon neutral thermal energy source, transportation of biomass from remote locations and clearing of natural forests for sourcing biomass increased the carbon footprint of the product. Different types of mitigation measures could be implemented to reduce the carbon footprint of the product, including improving the electrical and thermal energy efficiency of the manufacturing process, converting available abundant tea lands of large plantations to energy crop plantations which would reduce long distance transportation and deforestation. Implementation of possible mitigation measures would need an in-depth analysis of individual sites or sub regions and the sector would not have appropriate expertise at plantation company level or individual factory or estate level. Implementation of tailor made mitigation measures are the most appropriate step to minimize the carbon footprint of the product. New science and technology development have to be introduced and upscaled.

Keywords: Tea, Life cycle assessment, Climate change, Carbon footprint

Mycoleptodiscin B, an Antimicrobial Alkaloid from *Mycoleptodiscus* sp. endophytic in *Calamus thwaitesii* (Arecaceae)

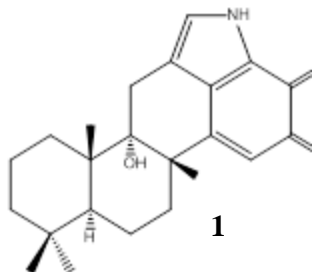
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Endophytic fungi are a proven source of biologically active secondary metabolites often with novel structural features. In a study to investigate the antibacterial producing potential of endophytic fungi from different ecological settings of Sri Lanka we have examined the endophytic fungi inhabiting the endemic plant *Calamus thwaitesii* (Ma whe wel). Specimens of *C. thwaitesii* were collected from Udugampola in the Gampaha District and 24 pure cultures of endophytic fungi were isolated from surface sterilized leaves and stem under aseptic conditions. Antimicrobial activities of the organic extracts of the pure cultures were evaluated using disc diffusion method against four bacterial species and four fungal species. The endophytic fungus *Mycoleptodiscus* sp. which exhibited the best antimicrobial activity was grown large scale on PDA for 14 days and the EtOAc extract of the culture was subjected to bioassay guided fractionations using a series of solvent/solvent fractionations, silica gel chromatography, size-exclusion chromatography and finally reversed phase High Performance Liquid Chromatography (HPLC) to isolate 2 mg of the active compound. Structure elucidation of the active compound using mass, ¹H-NMR, ¹³C-NMR and 2D NMR (COSY, HSQC, HMBC) spectral data identified the active compound as the known alkaloid, Mycoleptodiscin B (1).



Mycoleptodiscin B was first reported from *Mycoleptodiscus* sp. endophytic in *Desmotes incomparabilis* from Panama in 2013 and was reported to possess moderate cytotoxic effect against four cancer cell lines (H460, A2058, H522-T1 and PC-3).

In our study mycoleptodiscin B exhibited potent antibacterial activities against Gram positive bacteria *B. subtilis* - UBC 344 (MIC 0.5 µg/mL) *S. aureus* -ATCC 43300 (MIC- 1 µg/mL) and MRSA-ATCC 33591 (MIC- 32 µg/mL) and antifungal activity against *C. albicans* -ATCC 90028 (MIC 64 µg/mL).

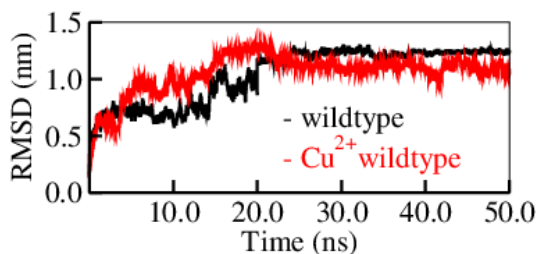
Misfolding of β Amyloid Protein due to Electrostatic Interaction of Heavy Metals and Methionine Sulphur Using Cu^{2+} as a Model

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Department of Chemistry

It is believed that the major component of amyloid plaques is formed by misfolding of β -amyloid peptides with a length from 1- 39 to 1 – 42 amino acids. Heavy metal atoms play a key role in the misfolding of amyloids. Current study has focused on the use of molecular dynamics techniques to study effect of Cu^{2+} anchorage on to the MET-35 residue of β -amyloid protein.

Wild type β -amyloid and wild type β -amyloid- Cu^{2+} complex were subjected to 50 ns long MD simulation using GROMACS software package. Both proteins were in aqueous medium with 12470 SPC/E water molecules and under neutral electrostatic conditions. Temperature and pressure of the simulation were maintained at 300 K and 1 bar, respectively and the time step for the simulation was 2 fs.



The root mean square deviation (RMSD) shown in above figure clearly suggests that an electrostatic interaction between Cu^{2+} and the S atom of MET35 of the β -amyloid 1-42 protein indicates a significant structural rearrangement as early as 5 ns simulation time. This observation is further supported by radius of gyration (Rg) values (not shown here) that indicate a more compact conformation of β -amyloid- Cu^{2+} complex compare to that of wild-type protein. Further Ramachandran plots reveal formation of β -sheet structure and this is clearly persistent in residues 27-35 throughout the simulation. These β -sheets were also observed using the matrices developed by the DSSP (Secondary Structure Prediction) software program. This Cu^{2+} -S of MET35 electrostatics interaction could be considered as a new mechanism for β amyloid misfolding.

Investigation of Heavy Metals in Roadside Dust Particles and Indoor Depositions from Selected Locations in Gampaha District

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Department of Chemistry

Presence of heavy metals in both indoor and outdoor dust samples from four sites were investigated over a period of six months from October 2013 to March 2014 from Yakkala (semi-urban), Yakkala- Gampaha road (semi-urban with different traffic condition), Battuwaththa (rural) and Sapugaskanda (industrial) in Gampaha District. Outdoor dust samples were collected from a bus halt, market, motor vehicle park and out of a residence. Three houses were selected in each sampling location for indoor samples.

The collected dust particles ($n = 28$) were acid digested to recover the heavy metals for the atomic absorption analysis. Mean concentrations of outdoor dust for Cd, Cr, Ni and Pb were 0.58 ± 0.09 , 41.78 ± 7.20 , 14.53 ± 2.47 and 28.08 ± 3.65 mg kg⁻¹ respectively, and mean concentrations of indoor dusts were, 0.72 ± 0.09 , 43.29 ± 12.94 , 17.67 ± 2.28 and 43.06 ± 7.73 mg kg⁻¹ respectively. The results showed the indoor average heavy metal concentrations are comparatively higher than outdoor heavy metals.

A statistical approach was employed to investigate the correlations between toxic heavy metals in indoor and outdoor. There is a moderate positive correlation suggesting that they could have come from the same sources. In general, indoor and outdoor concentration ratios varied widely from one metal to another and from one location to another. The distance from the main roadside appeared to have an influence on the heavy metal distribution. In general, Sapugaskanda area heavy metals in indoor dust levels (Cr = 60.32, Pb = 51.50, Cd = 0.77 and Ni = 18.48 mg kg⁻¹) and outdoor dust levels (Cr = 52.57, Pb = 28.26, Cd = 0.70 and Ni = 15.44 mg kg⁻¹) are significantly higher than other indoor (Cr = 37.18 - 45.42, Pb = 35.05 - 47.53, Cd = 0.63- 0.82 and Ni = 14.52- 19.94 mg kg⁻¹) and outdoor (Cr = 37.63 - 38.56, Pb = 23.02 - 31.75, Cd = 0.49 - 0.60 and Ni = 11.90 - 17.52 mg kg⁻¹) locations. The mean levels of Pb, Ni, and Cd reported in this study were comparable to those reported worldwide.

Development of a Method to Use Gunshot Residue as a Forensic Evidence to Establish the Shooter

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In Sri Lanka, many civilians have been victims of illicit practice of firearms especially the homemade firearms including 'galkatas' as well as imported small firearms. In the circumstances concerning actual or suspected mishandling of firearms, detection and identification of residual materials from firearms discharge may afford valuable exploratory data to differentiate between innocence and the shooter.

In the present study, it particularizes the use of gunshot residue analysis by identifying the gunshot residues through elemental characteristics. Residual barium (Ba), antimony (Sb) and lead (Pb) were collected by using cotton swabs or filter papers moisten with a chelating agent of ethylenediaminetetraacetic acid (EDTA) before and firing. The quantitative detection of the metal residues were done by using Inductively Couple Plasma Optical Emission Spectroscopy (ICP-OES).

No detectable amounts of Ba, Sb and Pb on shooter's hands were found before firing whereas significant amounts of these elements were present on both hands after firing. Comparatively, higher element concentration was detected on the right hand to left hand for right-handed shooters. It was also observed that swab sampling is more sensitive than that of filter-paper sampling method. It was problematic that a significant lead concentration was distinguished in some occasions before firing the firearms compared to Ba and Sb. The average Ba, Sb and Pb concentrations in mg dm^{-3} (0.51 ± 0.34 , 0.22 ± 0.18 and 0.77 ± 0.47) of ten firearms tested, exceeded the detection limits 0.05 mg dm^{-3} , 0.05 mg dm^{-3} and 0.04 mg dm^{-3} respectively. The maximum metal concentration (mg dm^{-3}) obtained for Ba, Sb and Pb were 0.91, 0.60 and 1.34 respectively. The presence of considerable level of all three metal ions namely Ba, Sb and Pb in the hands of the suspect all together legalizes that the related suspect may be the real shooter giving the scientific clearance.

Fabrication and Development of Novel and Simple Paper-based Electrochemical Devices

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This paper describes the fabrication and the characterization of a simple electrode system that can be used in paper based electrochemical devices. Paper based electrochemical devices have emerged as a simple and powerful platform for the development of low cost analytical devices. Commercially available varnish paint was used as an alternative for the previously reported wax based fabrication methods. The channels and detection/reaction zones were developed using hydrophobic varnish patterns on filter papers. A three electrode system was constructed on the detection/reaction zone by drawing working and counter electrodes using commercially available graphite pencils. The reference electrode was drawn using conductive silver paint which is different from silver/ silver chloride paint previously reported in literature. The electrochemical behavior was characterized using cyclic voltammetry with the electro active potassium hexacyanoferrate(II). The voltammograms exhibit sharp peaks at 0.1 V and 4.0 V potentials which are the typical values for potassium hexacyanoferrate(II). Prepared paper-based electrochemical device was tested with a range of potassium hexacyanoferrate(II) concentrations (1, 2, 4, 5 mM). Resultant anodic and cathodic peak currents showed a linear relationship ($y = 1 \times 10^{-06}x + 3 \times 10^{-06}$, $R^2 = 0.9646$ and $y = 2 \times 10^{-06}x + 6 \times 10^{-06}$, $R^2 = 0.9584$) of with the concentrations of potassium hexacyanoferrate(II). Based on these results, it can be concluded that these simple and novel fabrication and electrode development methods are suitable for the fabrication of paper-based electrochemical devices.

Keywords: paper-based devices, fabrication, electrode systems, cyclic voltammetry.

Determination of Cr(VI) and Other Heavy Metals in Leather Products of Sri Lanka

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It is a well-known fact that various chemical treatments are applied to the animal skins during leather production. Chromium acts as an excellent tanning agent exerting stability and flexibility to leather. Chromium, especially hexavalent chromium Cr(VI), along with lead, cadmium, arsenic, antimony, barium and selenium could be added into the leather products during the post tannery operations. These metals can also cause serious and prolonged injuries to human health.

In this study, 33 leather samples were subjected to analysis for Cr(VI), lead, cadmium, arsenic, antimony, barium and selenium. Determination of Cr(VI) was carried out according to the method specified in the International Standard (ISO) 17075 – IULTCS/IUC 18. The limit of detection was 0.05 mg/L whereas the limit of quantification was 0.14 mg/L. The soluble and total metal analysis was conducted using methods under the consumer Product Safety Act (CPSA), as amended by the Consumer Product Safety Improvement Act (CPISA). For As, Ba, Cd, Cr, Pb, Sb and Se analysis, the limits of detections and limits of quantification were 0.028, 0.026, 0.003, 0.003, 0.006, 0.023, 0.030 mg dm⁻³ and 0.099, 0.092, 0.009, 0.009, 0.021, 0.082, 0.106 mg dm⁻³ respectively.

Two samples having Cr(VI) levels of 3.15 and 51.22 mg kg⁻¹ respectively exceeded the permitted level of 3 mg kg⁻¹ whereas five samples had closer levels (2.40 – 2.84 mg kg⁻¹) to the permitted limit. Except for five samples soluble levels of Cr was found to be greater than the limit of 60 mg kg⁻¹ (63 - 1324 mg kg⁻¹). None of the samples contained soluble forms of As or Cd. All the samples were well below the limits assigned for Ba, Pb, Sb and Se. Comparatively the total levels of the metals were very high in most of the samples. With the results, it is very clear that Cr is the core metal that has become a nuisance in tanneries.

Quantification of Pesticide Residues in Black Tea by GC-MS

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Sri Lanka is one of the leading tea producing countries in the world and tea is one of the major export products in Sri Lanka with a great impact on the economy. In this regard, pesticide residues in tea play a major role. Pesticides are used as a pest control measure to get the maximum production and residues of pesticides could be remaining in made tea if proper control measures have not been adopted.

Tea consumer countries have imposed stringent quality control measures and regulations to control pesticide residue in made tea. Therefore, made tea should be screened for pesticide residues before exporting to international market. Tea buying countries have their own maximum residue limit (MRL) for each pesticide and maximum residue level shows the highest level of a pesticide residue that is legally tolerated in or on food. Therefore, Tea Research Institute (TRI) has been developing methods to analyze pesticide levels in tea.

GC-MS has excellent separation and quantitative determination of pesticide residues in tea and used for method development. Hexaconazole, propiconazole, tebuconazole, bitertanol, diazinon and methylated 2-methyl-4-chlorophenoxyacetic acid (MCPA) were analyzed using GC-MS.

Method development consists of few analytical steps including extraction, cleanup, separation and detection of pesticides. Accelerated solvent extractor (ASE) is used for pesticide extraction from tea samples with organic solvents. Extracted mixture was cleaned up using gel permeation chromatography for removal of unwanted materials and interferences from sample. Finally GC-MS technique is used for separation and quantitative determination of pesticide residues.

As per the recovery analysis data for diazinon, hexconazole, propiconazole, bitertanol and tebuconazole, average recovery percentage of all pesticides was observed between 98 - 103% and that of MCPA, recovery percentage varied between 86 - 109 %. Finally multi residue method was developed for the analysis of diazinon, hexconazole, propiconazole, bitertanol and tebuconazole while single residue method was developed for the analysis of MCPA.

Preliminary Investigation of Heavy Metals Exposure to Different Occupations

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Heavy metal pollution has become a serious health concern in recent years. Continuous exposure of heavy metals may result in bioaccumulation and health deterioration in humans. During recent years human scalp hair, one of the metabolic end products of the body has emerged as an ideal indicator of environmental exposure to various toxic elements.

Eight metals (Cd, Co, Cr, Cu, Fe, Mn, Ni and Pb) were estimated in scalp hair samples of traffic control police officers, three-wheeler drivers, painters, mechanics, welders and a control group with the same socioeconomic background. The collected scalp hair samples were washed, and digested using nitric acid (69%). The selected metals were analyzed by the inductively coupled plasma optical emission spectroscopy (ICP-OES) and the results are summarized in the table below.

Levels of heavy metals in scalp hair sample in $\mu\text{g/g}$.

Occupation	Levels of heavy metal in scalp hair in $\mu\text{g/g}$							
	Cd	Co	Cr	Cu	Fe	Mn	Ni	Pb
Traffic control officers	0.005	0.002	0.001	1.269	1.380	0.017	0.058	1.114
Three-wheeler drivers	0.002	0.001	0.002	1.114	1.294	0.004	0.006	0.883
Painters	0.059	0.002	0.061	1.125	0.645	0.064	0.044	1.531
Mechanics	0.003	0.001	0.367	1.660	1.664	0.008	0.522	1.653
Welders	0.046	0.001	0.026	2.475	2.754	0.370	0.615	2.424
Controls	0.001	0.002	0.001	0.829	0.666	0.001	0.003	0.735

When comparing hair mean metal concentrations with the control group a statistically significant difference (at 5% level of significance) is shown for traffic control officers for the metals, Cu ($p < 0.001$) and Cd ($p = 0.03$), for three-wheeler drivers for the metals Cu ($p < 0.02$), and Fe ($p < 0.004$), for

mechanics for the metals Cr ($p < 0.001$), Cu ($p < 0.001$), Fe ($p < 0.001$), Ni ($p < 0.001$), and Pb ($p < 0.001$) for painters for the metals Cd ($p = 0.001$), Cr ($p < 0.001$), Cu ($p = 0.004$), Ni ($p < 0.001$), and Pb ($p < 0.001$), and for welders for metals Cd ($p < 0.001$), Cr ($p < 0.001$), Cu ($p < 0.001$), Fe ($p < 0.001$), Mn ($p < 0.001$), Ni ($p < 0.001$), and Pb ($p < 0.001$).

It can be concluded that heavy metals associated with an occupation accumulate in the occupant's body due to long-term endogenous exposure.

A Novel Electrochemical Method for the Determination of Caffeine Using Phenol Formaldehyde Polymer Modified Carbon Paste Electrode

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Department of Chemistry

Caffeine (1-3-7-trimethylxanthine) is a natural alkaloid found in coffee, tea, cola nuts and various energy drinks. Caffeine ingestion causes physiological effects such as gastric acid secretion, diuresis and stimulation of the central nervous and cardiovascular systems. Further, when consumed at higher doses, caffeine may act as a risk factor for cardiovascular diseases, depression and hyperactivity. At present, electrochemical methods are popular for the determination of caffeine due to their simplicity, higher sensitivity, excellent stability and low cost.

Carbon paste electrodes are widely used for analysis due to the ease of preparation, speed of regenerating a fresh surface, low residual current, wide anodic potential range, porous surface and low cost. In this research we have developed a phenol formaldehyde polymer modified carbon paste electrode as the working electrode. Caffeine oxidizes at a higher potential on the carbon surface and due to this the oxidation peak can overlap with other background peaks. Use of H₂SO₄ as the supporting electrolyte is proposed with a novel, simple phenol formaldehyde modified carbon paste electrode to eliminate these background peaks.

Use of HClO₄ as the supporting electrolyte in caffeine determination is reported by many research groups. However, HClO₄ medium produces a background peak current at +1.54 V which is the main disadvantage. In this study, H₂SO₄ is tested as an alternative supporting electrolyte medium for the electrochemical determination of caffeine. Differential pulse voltammograms (DPV) for caffeine (0.01 M) with 0.1 M HClO₄ produced symmetric anodic peaks at +1.41 V and a background current peak at +1.54 V. However, DPV for caffeine (0.01 M) with 0.1 M H₂SO₄ produced only the analyte anodic peak at +1.41 V clearly indicating that it is a better supporting electrolyte. The highest anodic peak current was observed for caffeine (0.01 M) with H₂SO₄ at pH = 0.5. In DVP for caffeine, anodic peak

current (i_p) is obtained at +1.34V and the i_p increased with the increase of caffeine concentration. Based on these observations, H_2SO_4 can be used as a better supporting medium with simple carbon paste electrodes for the determination of caffeine.

Keywords: cyclic voltammetry, differential pulse voltammetry, caffeine, carbon paste electrode, supporting electrolyte

Nutrition Labelling of Kithul (*Caryota urens*) Sap, Treacle and Jaggery

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In Sri Lanka, Kithul palm (*Caryota urens*) is tapped for its sap, which is subsequently processed into treacle or jaggery. Although the industry dates back to about 2000 years, the complete nutrition information on these products are not available.

The objective of the present study was to determine the nutrition composition of kithul sap, treacle and jaggery and to furnish the standard nutrition label of each of these products. Basic nutrition information such as moisture, fat, protein, total ash, fibre, carbohydrate and energy were determined with standard test methods (AOAC 2000). Micro nutrient of the products were also determined (AOAC 2000). Vitamin C content of the three products was determined spectrophotometrically (US Department of Health & Human Services, 1979). Other water soluble vitamins were determined with HPLC methods.

Results indicated that the main nutrient component of the sap, treacle and jaggery is sugars and were 15.0 ± 0.4 , 68.2 ± 1.8 and 82.3 ± 0.9 g/100g respectively. Vitamin C content of the products were fairly high and were 8.2 ± 1.0 , 37.9 ± 2.9 and 35.4 ± 4.4 mg/100g respectively for sap, treacle and jaggery. Considerable amounts of other water soluble vitamins were absent in all products. All products are good sources of potassium and phosphorous, having 42 ± 2.5 , 230 ± 46 and 235 ± 49 mg/100g potassium and 8.1 ± 0.8 , 48.3 ± 5.9 and 51.2 ± 6.5 mg/100g phosphorous respectively for sap, treacle and jaggery.

In conclusion, kithul products are good sources of vitamin C, potassium and phosphorous whilst the major nutrient component is carbohydrates. Standard nutrition labels of the three products were completed based on the findings.

Development of a Novel Carbon Paste Electrode for the Simultaneous Determination of Lead and Cadmium in Water

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The environmental pollution due to cadmium and lead is one of the most serious problems. These metal ions enter natural water sources through various industrial operations and improper waste management methods. Higher concentrations of these metal ions can harm human health. Hence, the identification of levels of lead and cadmium in polluted sites and water sources is needed by society. There are different analytical methods for the determination of heavy metal ions. Among them stripping voltametric determination using mercury-based electrodes is one of the most sensitive analytical methods. However, due to various harmful effects it is recommended to replace mercury electrode with another electrode. Modified carbon electrodes can be used as a substitute for the mercury-based electrodes.

An effective phenol formaldehyde modified carbon paste electrode (PFMCPE) is developed in this work for the simultaneous determination of Pb^{2+} and Cd^{2+} by using differential pulse anodic stripping voltammetry (DPASV). PFMCPE can be used to preconcentrate Pb^{2+} and Cd^{2+} from aqueous solution effectively using DPASV. This PFMCPE showed higher sensitivity towards both Pb^{2+} and Cd^{2+} displaying peak currents of 1.46 μA and 2.06 μA respectively compared to the previously reported modified carbon paste electrodes exhibiting peak currents of 0.91 μA and 1.14 μA for Pb^{2+} and Cd^{2+} respectively. In addition to the sensitivity, this new PFMCPE has reduced the overlap between the two Pb^{2+} and Cd^{2+} stripping voltametric peaks.

Based on the observations, it can be concluded that PFMCPE enhances the preconcentration step for Pb^{2+} and Cd^{2+} compared to previously reported electrodes. The large voltage separation between the Cd and Pb stripping peak potentials (250 mV) suggests the higher possibility of simultaneous determination of Pb^{2+} and Cd^{2+} in water using proposed phenol formaldehyde modified carbon paste electrode.

Keywords: phenol formaldehyde. cadmium (II), lead (II), differential pulse anodic stripping voltammetry, modified carbon paste electrode.

Fuzzy Based Model on Analysis of Invasiveness Due to Dispersal Related Traits of Plants

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Invasive Alien Species (IAS) can be considered as a serious threat to the environment as they alter physical, chemical and biological components of the environment. The invasive potential of species can be recognized by their biological traits. A model to predict the invasion risk prior to the introduction of species into a new environment would therefore be invaluable. This work aims to incorporate seed dispersal related biological traits into a mathematical model to evaluate the invasion risk of plant species. For this purpose, four traits/factors related to dispersal were selected. Biological data of known invasive and non invasive species for the four factors were collected from literature. The invasive species were categorized into three groups (high, moderate, low) based on their contribution to invasiveness due to efficacy of dispersal following the National Risk Assessment criteria adopted to prioritize invasive species in the country. Fuzzy membership functions for each factor were developed and fuzzified parameters were aggregated using the Hamacher operator. Risk scores for selected plant species were obtained through this model. These scores were compared with those of the National Risk Assessment.

The results show that species with high efficiency in dispersal of seeds show comparatively higher scores than the species that contribute poorly to seed dispersal. Our categorization of species using the model was compatible with that of the National Risk Assessment. The non invasive species selected for assessment exhibited low risk scores compared to the invasive species. It can be concluded that the invasiveness of species due to dispersal related traits can be measured by a mathematical model incorporating related biological traits. However this model has to be further developed to incorporate other biological traits that contribute to invasiveness in order to get an overall value for invasion risk of plant species.

Keywords: Fuzzy set theory, Fuzzy membership functions, Invasive alien species (IAS)

Optimal Control Model of Transmission of Dengue: Theoretical Model

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Dengue disease, which is a vector borne disease, has been a major health issue in tropical and sub-tropical regions in the world. Since there are no specific dengue therapeutics or standard treatment techniques, controlling the spread of dengue disease is the only mitigating tool for dengue. Hence, the study of the dynamics of controllability of dengue transmission helps to execute a proper plan to curtail the spread of dengue disease before it becomes an epidemic.

In this study, an optimal control problem for a mathematical model of dengue transmission is solved by considering two control variables, u_1 : the use of alternative preventive measures to minimize or eliminate mosquito-human contacts, and u_2 : the level of larvacide used for mosquito control administered at mosquito breeding sites to eliminate specific breeding areas. The classical SIR model is used to describe the dynamics of dengue transmission. A cost functional is defined with the aim of controlling the infected host population as well as infected vector population. A constrained optimization problem is derived and the first order optimality system is set up by considering the Lagrangian formulation. The state system and the adjoint system are solved simultaneously by using MATLAB[®]. The control system is obtained via a steepest decent numerical algorithm.

It is observed that the number of infected host and vector populations is minimized by using two control variables. It is noted that the proposed model needs to be modified according to external factors.

Keywords: SIR model, adjoint system, state system, Lagrangian formulation, optimality system

A Local Sensitivity Analysis of the Dynamic Model for Dengue Disease Transmission

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Dengue is a vector-transmitted disease and it has been endemic mainly in the tropical and subtropical regions in the world. The transmission process of dengue is not simple since various external factors influence its dynamic behavior. This complexity in disease transmission makes it difficult for public health officials to implement control measures. Mathematical models of dengue transmission provide a better insight to understanding the dynamics, but this type of nonlinear system deals with a large parameter space. A sensitivity analysis of the dynamic dengue transmission model is performed in order to determine the relative importance of the model parameters to disease transmission. In this particular study, we used local sensitivity analysis based on the basic reproduction number R_0 of dengue transmission. The relative change in the value of R_0 was assessed using the *normalized sensitivity index* as the biologically controllable parameters in this model namely; transmission probabilities of the virus from human to mosquito and from mosquito to human and the mosquito recruitment rate take various values. The *normalized sensitivity index* is computed as the ratio of the relative change in R_0 to the relative change in the parameter of concern. Then our dynamic model of dengue transmission was simulated for the varying values of the model parameters considered using MATLAB[®]. We identified that R_0 shows an identical behavior with the model parameters, constant recruitment rate of mosquitoes and transmission probabilities. Therefore, both mosquito density and transmission probabilities should be controlled to minimize the risk of dengue transmission which is describe by the basic reproductive number. A sensitivity analysis of this type can be used to define threshold values for the most sensitive and biologically controllable parameters in the model so that early warning systems can be established to minimize the dengue disease burden.

Keywords: dynamic model, basic reproduction number, sensitivity index, local sensitivity, early warning systems

Effect of Sulfidation on *n*-type Cuprous Oxide Thin Films for Gas Sensing Properties of Liquefied petroleum

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Monitoring of accidental leakages of liquefied petroleum (LP) gas is important owing to the concern for safety requirements in industries and household applications. Performance parameters such as sensitivity, selectivity, response time of sensors are known to be significantly influenced by the morphology and structure of the sensing material. A simple and economical method for the fabrication of highly sensitive cuprous oxide (Cu₂O) based gas sensors for detecting low concentrations of LP gas was studied. Surface of *n*-type Cu₂O thin films were modified through sulfidation and corresponding effects on LP gas sensitivity and gas response time was quantified. Electrochemical deposition was used to deposit *n*-type Cu₂O thin films on titanium (Ti) substrates in an acetate bath. Sulfidation of the thin films was made by placing aqueous sodium sulfide (Na₂S) solution and drying at 200 °C followed by the exposure of the thin films to ammonium sulfide (NH₄)₂S vapor for a duration of 2 s. The structural and morphological properties of the fabricated films were monitored using x-ray diffraction (XRD) and scanning electron microscopy (SEM). An impedometric type gas sensor was fabricated using the sulfided Cu₂O thin films with gold contacts. To evaluate gas sensing properties, fabricated gas sensors were placed inside a homemade gas perfusion chamber under ambient atmospheric conditions with the LP gas flow to the chamber controlled by an on/off valve. Resistance measurements were taken as a function of time at different sensor surface temperatures with and without LP (100%) gas flow over the sensor. The LP gas flow rate was maintained at 2.5 ml/min during the measurements. In comparison to the unsulfided *n*-type Cu₂O thin films sensors maintained at 85°C which recorded a highest sensitivity (fractional change in resistance) of only 4%, the sulfided films recorded a highest sensitivity of approximately 25% with sensor maintained at 75 °C. Sensors also showed quick response and fast recovery (< 90s) for LP gas exposures. The results show that sulfidation further improves the gas sensing properties of polycrystalline *n*-type Cu₂O thin films.

A Preliminary Study on the Distribution of Earth Resistance Around Communication Towers in Lightning Prone Areas

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Lightning is a complicated way of transferring electric charges between clouds and earth. Where lightning direct strikes are concerned, the structures of communication antennas of the same height differ from tall buildings by the fact that currents associated with lightning that strike antenna structures flow to ground within a small area. Therefore, the earth resistance between tower and the earth should be maintained at minimum levels to reduce the hazards associated with lightning. According to the communication tower standard policy in Sri Lanka earth resistance should be maintained less than 10 Ω .

The earth resistance of 20 communication towers located in seven districts in Sri Lanka with high lightning activity were measured during the period May, 2013 - April, 2014. All the selected towers have the history of lightning damages. The 20 towers inspected in this study are made of metal re-bars making a steel lattice that stands on concrete platforms and self-supported structures in the height range of 50 m to 70 m. All towers are either square or triangular cross-sectioned, having four legs or three legs. In all towers the vertical re-bars have been grounded using copper tapes at the footings. In this study the fall of potential method was used to measure the earth resistance. Measurements were made using 4105A digital earth tester with extended 50 m voltage and current probes.

Among the 20 sites, minimum ground resistance was found in Keselhenawa, Kaluthara district (0.62 Ω) and the maximum was found in Wahakotte, Matale district (116 Ω). Only 35% of the sites inspected are in conformity with the TRC guidelines with earth resistance less than 10 Ω . Most of the public complaints related to lightning threats in the tower neighborhood are from the remaining 65% of the sites with earth resistance greater than 10 Ω . When investigating the distribution of earth resistance around a tower in eight directions, it was found that the measured earth resistance value varies from 5.75 Ω to 20.35 Ω (Panadura site). This indicates that the common practice of measuring earth resistance to a randomly selected single direction may not represent the true value required by guidelines on lightning tower safety. Further studies on this aspect is recommended to understand the risk involved with non uniform radial distribution of lightning currents around a tower base.

Trends of Daily Maximum and Minimum Air Temperature at Nuwara Eliya

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Department of Physics

A long term change in extreme air temperature at Nuwara Eliya, which is situated at an altitude of 1,895 m in the western slopes of the central highlands of Sri Lanka is presented. Daily maximum and minimum air temperature records during the period 1951 – 2000 were analyzed. The trend is calculated by a least squares regression analysis and the significance of the observed trend is estimated using the Mann Kendall statistic. The mean annual air temperature shows a uniform increasing trend of 0.010 °C/year. The data clearly show that there is a statistically significant reduction in the diurnal temperature range in Nuwara Eliya. The magnitude of the reduction in diurnal temperature range is 0.25 °C per decade. The reduction is due to the increase in the daily minimum air temperature. The highest increasing trend in temperature per decade, 0.47 °C and highest reduction in diurnal temperature range per decade, 0.42 °C were observed in the 1st inter-monsoon season. No significant increase or decrease in daily maximum air temperature was evident from the data. There is a strong correlation between the standard deviation and the mean temperature for daily minimum air temperature. The increase in the minimum temperature is not uniform throughout the year. The minimum temperature has increased during the cold season while it has remained the same during the warm season there by reducing the diurnal temperature range.

Changes in Extreme Rainfall Events: Results from the CCAM Simulations over Sri Lanka

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Increasing trends in greenhouse gases and aerosol emissions have profound effects on global temperature and hence circulation and rainfall patterns. This study presents an analysis of extreme rainfall events for the present-day climate, along with their projected changes by 2050 for two emission scenarios, RCP4.5 and RCP8.5. Extreme rainfall events were analyzed using daily rainfall time series simulated by Conformal Cubic Atmospheric Model (CCAM). These CCAM high resolution experiments are the downscaled results from three GCMs among CMIP5 simulations which were forced by sea surface temperatures and sea ice concentration. The extreme rainfall indices, such as, annual highest one-day rainfall, annual highest five-day consecutive rainfall, annual maximum length of wet spells and annual maximum length of dry spells were analyzed. The projected ensemble mean changes, simulated by CCAM for 2050 under RCP4.5 and RCP8.5 suggest that the one-day rainfall and five-day rainfall are likely to increase along the southwestern and southeastern parts of the country and a decrease over the northwestern region. The changes are more prominent for higher emission scenario. The length of wet spells is projected to decrease between 0% and -45% for RCP8.5 and -5 to -43% for RCP4.5. A moderate decrease in wet spells over the northwestern region and a large decrease over the southeastern part of the country have been simulated. For the northeastern region, the model suggests that all four extreme indices will decrease in the future.

A Survey on Relevance of Physics Education in Sri Lanka

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Department of Physics

This study investigates how core areas of Physics namely, mechanics, waves, fields, optics, heat, thermodynamics, electricity and electronics taught at the level of G.C.E. A/L, in Sri Lanka, provide the necessary background and relevance for people who would utilize the knowledge of Physics in various fields and industrial sectors. For this study, a sample population of 600 persons have been selected randomly from Western, Sabaragamuwa, Central and Southern provinces belonging to five categories namely, physics teachers, undergraduates and technical students those who have studied physics, professionals in physics related fields having bachelors or postgraduate degrees and ordinary people where a majority having the maximum qualification of G.C.E. (A/L) or in addition a diploma. The study population of this survey include 150 people from each province and 120 people in each category. The study has shown that, core areas of physics are related to the above categories of people and it depends on their personal interest, as well as applicability of physics principles in their respective areas of work. Physics core areas of mechanics, waves, fields and optics taken together are preferred mostly by teachers (76%), followed by technical students (65%) and undergraduates (56%) respectively, whereas heat, thermodynamics, electricity and electronics taken together are preferred mostly by professionals (60%). Results also indicate that A/L physics curriculum has helped students engaged in technical fields to develop their technical skills (45%), whereas undergraduates find that mainly their analytical skills (33%) and logical thinking skills (30%) have been developed. The results further indicate that physics play an important role in the energy sector (42%) compared to other industrial sectors and physics has its high/moderate relevance in engineering (75%), followed by medicine (60%), chemistry (60%) and biological science (50%). These statistics may be useful in further development and dissemination of knowledge in the field of physics education in Sri Lanka.

A Comprehensive Study of Deposit Interest Rates in Sri Lanka

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Interest rates of deposits in Sri Lanka are affected by many factors. Moreover understanding the key factors such as money supply, inflation rates, loans, and Central Bank Sri Lanka (CBSL) interest rates window may provide clues to the future direction of interest rates. Many studies were focused on the retail interest rates while forecasting interest rates has received considerable less attention. In this research, Average Weighted Deposit Rate (AWDR), minimum savings and maximum savings deposit rates were considered. The AWDR is enabling to evaluate the weight adjusted deposit rate in the overall banking industry. It provides a measurement of the deposit volume weighted by the interest rates. Forecasting minimum and maximum savings deposit rates enables to understand the minimum and maximum market deposit rates.

The main objective of this research is to fit suitable models to forecast future deposit interest rates. These models may be useful for investors to making decisions about their investments. Apart from that factors associated with deposit interest rates were assess and deposit interest rates offered at selected public and private banks were compared.

With the graphs and numerical summary measures the patterns of deposit rates were studied. Auto Regressive Integrated Moving Average (ARIMA) and exponential smoothing models were used to model the response variables of deposit rates. AWDR was modeled using an ARIMA (2,2,0) model. Brown's linear trend exponential smoothing method was used to modeled the square root of minimum savings deposit rate. Maximum savings deposit rate was modeled using Holt's linear trend exponential smoothing model. The models for minimum and maximum savings deposit rates gave accurate forecasts in the short term. Furthermore it was found that macroeconomic and financial factors are affected with interest rates over time. The macroeconomic variables affect the economy as a whole. Financial factors such as private sector credit, total assets and liabilities of the banks and total deposits were found to be affected to deposit rates. It was observed that in the months of April and May almost all public and private banks have reduced their interest rates and the short term rates have stabilized thereafter.

A Simulation Study of the Properties of the F-test for Type III Fixed Effects in Binary Generalized Linear Mixed Models (GLMMs)

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Department of Statistics

The presence of clusters within data is often encountered in medicine, biology and social sciences. With such data, the observations in the data cannot be regarded as independent since the observations within a cluster might have similar patterns than observations across clusters. The method of sandwich variance estimation (SVE) is commonly used with correlated data to adjust the standard errors for correlation. This study evaluates the usefulness of SVE in generalized linear mixed models (GLMMs) which are specialized to model correlated data. The properties of the test for examining a repeated measures scenario with three periods is evaluated using a simulation study for the case of binary responses. A known method for simulating correlated binary data was modified and the correlation of first and second periods was set to 0.4 and 0.35, for first and third periods to 0.22 and 0.19 and for the second and third periods to 0.34 and 0.33 under the null and alternative hypotheses respectively to approximately represent an autoregressive pattern which is often observed in this type of repeated measurements. As properties of comparison, Type I error and the power were compared among the two GLMMs with and without SVE. The simulation consisted of 1000 replicates of sample sizes 20, 50, 100, 250 and 500. While the Type I errors of the GLMMs without SVE were conventional, the type I errors of the GLMMs with SVE were within the 95% probability interval for a 5% error rate for all the sample sizes except 20. For sample size 20, the error rate given by SVE is inflated. This indicates that except for very small sample size (20), the use of SVE in GLMMs gives superior results than not using SVE. In par with the power of the test, both the GLMMs with and without SVE reached 100% power in large sample sizes ($n=250,500$). But, the GLMM with SVE had a higher power than that of the GLMM without SVE for small sizes ($n=20, 50, 100$). Therefore, the results of this research suggested that the performance of GLMMs for binary correlated data can be enhanced further by using SVE.

A Software Tool for Analyzing Non-replicated Two-way and Three-way data

E. R. A. D. Bandara and W. N. Wickremasinghe

Department of Statistics

An experiment consisting of three factors each at several possible levels is called a three way experiment. Due to practical reasons, experimenters are sometimes compelled to have a single replication in these three-way experiments. When there is no replication, usual methods of analysis fail and one has to use special statistical techniques. A likelihood ratio test with its approximate critical values is available in literature that tests for three-way interaction in sub-areas of three-way data. This work mainly focuses on using exact critical values developed by the authors for the above test and discusses a stand-alone software developed by them for the purpose. This software is designed to identify sub-areas free of three-way interaction in nonreplicated three-way data by testing rank one sub hypothesis of three-way interactions. The software also has the facility to analyze nonreplicated two-way data.

The developed system is based on the Modified Waterfall method. The frontend design is based on the constructed Use Case Diagram and the data structure is designed based on the constructed Class Diagrams. MATLAB[®] Graphical User Interface (GUI) is used to implement the system. Several MATLAB[®] programs are written to recall as functions within the main GUI for the analysis. The final system is compressed as an executable setup file for installing and running as a stand-alone system. One advantage of the system is that the required MATLAB[®] Compiler to run the software is also installed within the system.

The developed software tool accommodates data handling under Data Section and analyzing under Results Section for both two-way and three-way cases. It performs nonreplicated two-way or three-way analysis depending on the case, to identify sub-areas free of two-way or three-way interaction by testing pair-wise rank one sub hypotheses using likelihood ratio tests available with 10%, 5%, and 1% exact critical points. The system handles three-way data for the limited cases: $3 \times 3 \times 3$, $3 \times 3 \times 4$, $3 \times 3 \times 5$, $3 \times 3 \times 6$, and $3 \times 4 \times 4$ because of the unavailability of the exact critical points of the other cases. Apart from these, the software tool facilitates data storage in a unique file format, save results and retrieve saved data.

SRI PALEE CAMPUS



Message from the Rector



I am pleased and privileged to issue this message to congratulate the community of scholars who take part in this annual research symposium 2014 as paper presenters and participants.

Today in my message I wish to mention that contemporary mankind is living in the very special stage of its social evolution, which are currently facing global crises. Hardships are faced by the human-kind not only due to natural disaster but also social economic, political and cultural catastrophes which are increasing day by day, as a direct result of the western neo-liberal forms of the global social evolution. We are living in a changing and challenging world. In that context engaging in scientific, social research is a prime responsibility of the academia. A quest for new knowledge and wisdom helps us to discover social laws and it is used for human development.

Sri Palee Campus, University of Colombo is one of the renowned higher educational institutions in Sri Lanka which in fact imparts knowledge in multidisciplinary forms including mass media and performing arts and has produced a number of graduates capable of serving in contemporary industry of mass media and performing arts.

I hope this annual research symposium will uncover new ideas, concepts and new patterns of thinking. Finally I wish that all participants would gain productive and intellectual achievements.

Dr. Tudor Weerasinghe
Rector, Sri Palee Campus

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A Sociological Analysis of the Influence of Visual Semiotics of Media on the Masses

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The concepts of semiotics and visual communication in the media landscape have been very popular themes in the 21st century. These have formed a new conceptual and theoretical frame as a new carrier in the field of social sciences. Semiotics is a deep concept and a paradoxical discipline described later by sociology, anthropology, psychology, mythology and in a broader sense of philosophy, cognitive sciences and especially linguistics, epistemology, and the other sciences of communication. The masses are experiencing the world predominantly through their eyes. Unique power of the vision of the man constructs the visual perception through worldly matters and discerns the meaning and notices the differences among them. Signs and symbols are very influential in visual communication and can be described denotatively and connotatively. Syntactic, semantic and pragmatic are the main theoretical aspects of the semiotics. The analysis that was conducted as an empirical research in order to seek the influence of visual communication of media on the rural masses in Sri Lanka has painted a descriptive picture of the changing aspect of them. In order to construct the overall measures of the social change of the rural masses I compute and employ the ethnographic method and its rating system. The traditional masses had to engage in a contradictory mission since the inception of modern visual communication of media in the rural territoriality. This traditional ideology and the culture have been changed to a greater extent by the visual methods of many channels of media. Audience segmentation is the specific process of this social construction. Early segmentation was based on gender, race or ethnicity, caste etc. But, it has been quickly developed into a complex of factors that push and pull individuals towards diffusion and assimilation, or the maintenance of socio-cultural distinctiveness of the dominant society constructed by the visual aspect of the media communication.

Keywords: Visual Communication, Ideology, Rural Masses, Socio-cultural Changes.

A Study on the Effect of Communication in Managing Organizational Conflict

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Organizational communication is the process by which individuals stimulate meaning in the minds of other individuals by means of verbal or nonverbal messages. The breakdown or mismanagement of effective communication among employers in an organization seemed to ignite organizational conflicts which are assumed to influence heavily on the smooth functioning of the organization. The problem of detecting communication break downs among employees is receiving considerable attention globally with the introduction of conflict communication now. This research attempted to investigate the factors involved in communication breakdowns and how communication strategies used in organizational setting lead to reduce conflict environment in organization structures. The paper seeks to answer the question: How organizational conflicts are related with different personality factors and how they can be managed through well structured communication patterns? A standard questionnaire was used to collect data and the questionnaire was distributed among 65 participants who work in different organizations. The Regression Analysis was computed to analyze the data. It was found that there was a relationship between conflict styles selection; aggressive, avoidant, collaborative, accommodative and compromise, and demographic factors. Also, there seemed to appear a relation between position of the employers and the conflict strategy selection. Also, it was found that there is a relation between education level of employers and conflict management strategy. It is recommended that the employers should be made aware of all these conflicts related characteristic variables on occasions of their promotional trainings.

Keywords: Organizational Communication, Organizational Conflict, Conflict Management, Conflict Styles

An Overview of Mobile for Development Intelligence (MDI) in Sri Lanka

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A rapid growth in mobile Internet usage has occurred in Sri Lanka. It is a significant trend observed during the last couple of months. 57% of the users in Sri Lanka have access to the Internet through a mobile device. Sri Lankan leading websites are getting more traffic through mobile device rather than through desktop computers. The number of Internet users in Sri Lanka by March 2014 can be estimated as at least 4.75 million which is a 21% penetration. Ikman.lk is a significant example where they get more visitors to their mobile version than to their desktop version. (Mobile for Development Intelligence) MDI services are led by mobile operators and operate in health and education sectors while (Mobile for Development) M4D services are rooted in social impact. Mobile developers have become interested in developing applications in the local context. In the earlier days there was no local language support for android mobiles. But Sri Lankan developers have overcome the problem, and now there are more mobile apps in native languages. This is a good foundation for the mobile platforms for intelligent concepts. Data were collected both qualitatively and quantitatively media observation, audience research, critical method and deconstructive method were used as qualitative methods for the qualitative analysis. 1000 respondents participated in an online questionnaire representing five districts in the country. Quantitative data were analyzed using fact analysis. According to the result of this study it was revealed that they were five kinds of gaps in the mobile device usage in Sri Lanka.

- 1) Off telecommunication connectivity
- 2) Lack of Internet access
- 3) Lack of usage E- commerce for business
- 4) Lack of knowledge about mobile technology and language
- 5) ICT strategies and policy frameworks needed for the mobile phone users.

Furthermore this paper suggests implications for overcoming these gaps in details.

Keywords: Mobile Penetration, Rural Masses, Development Intelligence, Mobile Development

The Role Played by the Economic Magazines and the Constructions of Mass Consciousness in Sri Lanka

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This study investigates the Sri Lankan and global magazine history with particular attention to the economic and political texts in the introductory period of open economy and the post-open economy period and the strengths and weaknesses of magazine media. *ArthikaVimasuma (Economic Review)* which was one of the economic magazines published monthly by the Research Unit of the Peoples' Bank and circulated widely in Sri Lanka from 1975 to 1985 was chosen for this research. This magazine contained articles on economy, industry, agriculture, management, bank and finance, consumer production, and foreign news with political and economic based analyses. These articles grouped under three themes: 1) Sri Lankan economy. 2) Political economy. 3) Current Issues in global economy and political context were analyzed using the content analysis. In addition, the contemporary Sri Lankan cinema, stage plays, novels available from 1975-1985, political issues in Sri Lanka including Srimawo Bandaranayake era in 1972, and the 1978 constitution of Sri Lanka, the open-economy introduced in 1977, and 1983 Black July were also used as secondary sources for the analysis. Results showed that the articles published in the *Economic Review* magazine published from 1975 to 1977 helped to construct mass consciousness related to rural development, agriculture, and micro-finance. This finding was based on Mahaweli and Galoya development projects, nationalization of private institutions which reinforced rural development. The findings also showed that the content of the articles promoted socialist economy prior to 1977 and industrial based economic consciousness after 1977. Similarly, after the introduction of the open economy in 1977, the content of the articles was mainly associated with those of the foreign articles.

Keywords: Mass Consciousness, Open Economy, Political Economy.