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SYMPOSIUM  
2015**



# Proceedings of the Annual Research Symposium 2015

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Wisdom Enlightens

## **OUR VISION**

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## **OUR MISSION**

To be a benchmark setter in disseminating, creating, and applying multi-disciplinary knowledge in the global presence, producing human talents of high quality, while upholding national values.

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# CONTENTS

Message from the Vice-Chancellor	6
Message from the Chairman, Symposium Committee	7
Address by the Keynote Speaker	8
Message from the Dean, Faculty of Arts	9

## FACULTY SESSIONS

<b>Faculty of Education</b>	11
Message from the Dean, Faculty of Education	12
List of Abstracts	13
<b>Faculty of Graduate Studies</b>	27
Message from the Dean, Faculty of Graduate Studies	28
List of Abstracts	29
<b>Faculty of Law</b>	37
Message from the Dean, Faculty of Law	38
List of Abstracts	39
<b>Faculty of Management and Finance</b>	57
Message from the Dean, Faculty of Management and Finance	58
List of Abstracts	59
<b>Faculty of Medicine</b>	63
Message from the Dean, Faculty of Medicine	64
List of Abstracts	66
<b>Faculty of Science</b>	103
Message from the Dean, Faculty of Science	104
List of Abstracts	105
<b>Sri Palee Campus</b>	143
Message from the Rector	144
List of Abstracts	145

## **Message from the Vice-Chancellor**



It is indeed a pleasure to issue this brief message on the occasion of the Annual Research Symposium - 2015 of the University of Colombo. Knowledge creation and dissemination of new knowledge have become key words in the present day context of University education. The word “education” can have many meanings, but it has become something which is taught or learned by

referring to available knowledge.

The role played by higher educational institutions vastly differ from the traditional mode of delivering education, since seats of higher learning are the places where new knowledge is created in various disciplines. In other words we call them research & development. There cannot be any new knowledge without empirical research derived through critical inquiry.

In spite of many developments in Research & Development, I am of the view that we Sri Lankans have not reached the heights that we are capable of scaling, up to this date. Therefore, the Universities should promote research and encourage more innovations that would leave a lasting impression in our society. Symposia of this nature make way for our teachers and students to transform their innovative ideas into scholarly work. It also helps the University to organize a gathering of similar minded scholars to meet each other and present their work, indulge in discussions and get necessary feedback. The Annual Research Symposium of the University of Colombo has now become a regular feature in the University calendar and the interest shown by our academics and students in this year's research symposium has shown us that they are keen on venturing ahead in their chosen areas of research.

I would like to extend my best wishes to the organizers of the symposium, including its chairman Dr. Sampath Senevirathne, the presenters and the participants.

I wish the Annual Research Symposium 2015 of the University of Colombo all success.

Professor Lakshman Dissanayake  
Vice Chancellor

## **Message from the Chairman, Symposium Committee**



On behalf of the Organizing Committee, I warmly welcome and embrace the research community and the invited delegates for the inauguration session and the technical sessions of the Annual Research Symposium of the University of Colombo, 2015. This is the premier and flagship gathering of one of the finest and longest traditions of academic interactions in the country, spanning across eight broad disciplines representing education, fine arts, humanities, law, management, medicine and sciences. Annual research symposium provides a platform to exchange ideas, discover novel opportunities and partnerships, reacquaint with colleagues across faculties, and broaden the knowledge. This year the symposium is held from 25<sup>th</sup> to 30<sup>th</sup> October at the University of Colombo.

In order to provide an inclusive platform for diverse research ideas, the organizing committee this year decided not to have an overall theme for the symposium. To represent the diversity within its community of freethinkers, each faculty, however came up with their own theme, which enhanced the colour and character of the symposium. About 120 abstracts represent this year's symposium. All these abstracts underwent double-blinded peer review under the careful supervision of the editorial committee.

I am pleased to have His Excellency Mr. Yashvardhan Kumar Sinha, High Commissioner of India to Sri Lanka as our Chief Guest and Professor Anthony Anghie, Professor of Law at the University of Utah, as the keynote speaker for this year's symposium. I am sure that their vast experience at both regional and global levels will enrich our understanding of global governance and networking.

I wish the very best and success to all the authors, especially the postgraduate students of this year's research symposium, who, with their tireless research work of today, will lead the society of tomorrow. The real challenge and responsibility upon us is now to bring this knowledge to where it matters – to the policymakers and general public at large.

Dr. Sampath S. Seneviratne

Conference Chair – Annual Research Symposium 2015

University of Colombo

## **Address by Keynote Speaker**

### **Sovereignty and the challenges of global governance: A sketch of three regimes**

*Tony Anghie*

*S.J. Quinney School of Law, University of Utah*

It is a commonplace to say we are living in a 'globalized world'. Our sense of identity, of who we are, has been transformed by the perception that we inhabit not only a national but global space. The Sri Lankan Ministry of Education web-site, for instance, speaks of training students to be 'competent citizens' while achieving excellence in 'global society'. The Sri Lankan Ministry of Higher Education proclaims as its goals the ambition to make Sri Lanka a regional knowledge hub. If the space of the 'global' has assumed this immense significance, the question then arises. What are the rules that govern this space-the rules of 'global governance'? Who makes these rules? What are the politics of rule making? If politics in the national sphere provides us with a model of how rule-makers can be held to be representative or accountable, what are the politics which apply in the realm of 'global governance'?

Classically, states create rules-international law-to govern the globe. The intensification of globalization however, has complicated this framework. New actors have emerged, wielding immense power in somewhat unconventional but effective ways. Further, it is not only through 'law' strictly so called, that power may be exercised. This continuously changing system, if it can be called that, raises new challenges to issues of accountability, representativeness and legitimacy.

I address these issues-and can do so only in a superficial way- by sketching out three somewhat different modes of what might be broadly termed 'global governance' 1. Indicators 2. Investment Protection and 3. Human Rights.

#### **1. Indicators and Rankings:**

We now live in a world where indicators and rankings exist for a startling number of phenomena: the various World Cricket Rankings, Credit Rating Agencies and the World University Rankings are only three of these. Indicators and Rankings rarely if ever make any claim to represent 'binding law'. Nevertheless, they exercise enormous authority and influence on policy making-whether at the levels of government or the university. Equally importantly, they affect the perceptions of a very large and potentially important audience about the quality or standing of a particular country or institute or program or even, individual. These rankings and indicators can provide valuable information in an accessible way. The issues then arise: how are these rankings compiled, what

assumptions do they make about 'quality' and 'measurability' and what do concepts of 'transparency' or 'accountability' that are usually associated with proper governance mean in the context of indicators and rankings?

## 2. Foreign Investment:

The importance of foreign investment for achieving economic development has long been emphasized by economists and development organizations. Private actors can play a vital role in promoting economic growth. The character of the legal regime that has been devised to protect the rights of investors has always been controversial because these disputes are usually adjudicated by international arbitral panels-located in Washington DC or Singapore or London-applying an 'international law' that is very different from the domestic law that would have been applied if the matter had been settled by a national court. In addition, government measures taken in the interests of public health and safety-such as the regulation of tobacco sales- have been challenged by corporate interests claiming that their property rights have been infringed and they have consequently suffered losses. Private actors wield immense power and questions arise of how they may be held accountable for their actions.

## 3. International Human Rights:

Although human rights is a relatively new part of international law, it has assumed an enormous significance in global governance, especially as many other major projects have become associated with human rights-including development, self-determination, the rule of law, environmental protection, transitional justice and the conduct of war. Human rights has traditionally suffered from the problem of a lack of enforcement. That situation is changing now as human rights norms are incorporated into national systems and regional human rights systems are constructed. Questions nevertheless persist as to the legitimacy and utility of human rights.

Sovereignty is conventionally seen as essential to the protection of the rights of a people in the international realm. Each of these three regimes presents different challenges to sovereignty. Indeed, each may usefully compel sovereignty to justify its practices and subject itself to broader scrutiny. While they differ in important respects, we might examine these regimes in terms of basic issues about how they are constructed and exercise power, the participation of developing countries in the formulation of these regimes, and the impact of their operations on people in developing countries. These questions may provide some provisional insights into the mysteries of global governance while also suggesting a useful scholarly agenda.

## **Message from the Dean, Faculty of Arts**



It gives me great pleasure to provide this message on the occasion of the University of Colombo Research Symposium 2015 that has become an important annual event in the university calendar.

In keeping with the mission of the University of Colombo, an objective of the university is to make research an essential part of the curriculum and academic work. The annual research symposium provides an important opportunity, therefore, for mainstreaming research into the university curricular and academic life, and for the academic community to showcase its research and receive expert feedback.

Following the ceremonial inauguration of this year's University of Colombo Research Symposium, the Faculty of Arts will hold its International Research Conference on 3<sup>rd</sup> and 4<sup>th</sup> December 2015 under the theme "Changing Socio-Economic Dynamics in Sri Lanka: Contexts, Cultures and Imaginations."

I am very happy to note that there are more than a hundred researchers who will present their research findings to the academic community at this year's annual research symposium of the University of Colombo. I wish all the researchers the very best. I am confident that the experience and exposure obtained from this Symposium will help you in your academic career.

I would also like to take this opportunity to congratulate the University of Colombo Research Symposium organizing committee for coordinating this annual event very successfully.

Prof. A.R Ranasinghe,  
Dean, Faculty of Arts,

## **Faculty of Education**



"Education and Social Cohesion"

## **Message from the Dean**



I write this message for the Annual Research Symposium 2015 of the University of Colombo with great pleasure.

The main role of the university is to produce and disseminate knowledge for the development of society. In that sense the Annual Research Symposium is a very important event of the University. It provides a useful and meaningful forum for academics to share their knowledge. Undoubtedly this will enhance the quality of University teaching, learning, and research.

Moreover this will contribute a lot to the development of our society.

This year the theme of the research symposium of the Faculty of Education is “Education for Social Cohesion”. Social Cohesion is understood as the social network and the norms of reciprocity and trustworthiness that arise from connections among individuals. The Faculty of Education plays an important role in Social Cohesion through educating teachers with necessary knowledge and skills to enhance the social cohesion in the School System.

The Faculty of Education is also one of the recipients of a HETC/QIG W3 grant for improving post graduate studies. The theme of the Faculty was “Social cohesion through school education” and at present there are seven ongoing PhD studies under this theme. Faculty of Education has a close collaboration with the school system in Sri Lanka. So the research findings will contribute to enhancing the school system in Sri Lanka.

I like to take this opportunity to thank the Vice Chancellor and the Organizing Committee of the Research Symposium 2015 and also the Faculty Symposium Committee and specially the Chairperson of the Faculty Symposium Professor Marie Perera.

I wish all the participants, discussants and presenters of the symposium an interesting thought provoking and productive time.

Prof. W. Chandradasa  
Dean, Faculty of Education

## **Faculty of Education**

### **List of Abstracts**

1. Teaching of a second national language (2NL) in Sri Lanka: Success and failure in achieving objectives of 2NL	14
2. Assessing soft skills of Bachelor of Education undergraduates	15
3. An inquiry into the students' readiness for self-directed learning	16
4. 'Shifters' in bilingual education: Problems and challenges of learning through a second language	17
5. Challenges of shifting to bilingual medium education in state universities: a case study	18
6. Teaching a second national language in Tamil schools: The case of Batticaloa district in Sri Lanka	19
7. A study on the nature and impact of the ICT subject on Post Graduate Diploma in Education students	20
8. An inquiry into the learning environments of bilingual mathematics classrooms in Sri Lanka	21
9. A gender-based analysis of the school library usage trends of the new entrants: a case study	22
10. Access to select social media and the preferences of communication methods with the library: a gender-based analysis of new entrants	23
11. Efficacy of "micro teaching" in teacher education: developing teaching skills of prospective teachers.	24
12. Crossing the cultural boundaries: developing intercultural competence of English language teachers	25
13. Towards quality: Critical analysis of curriculum practices of teachers at the classroom level	26

## **Teaching of a second national language (2NL) in Sri Lanka: Success and failure in achieving objectives of 2NL**

*S. Athirathan<sup>1</sup>, M. Karunanithy*

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Teaching a Second National Language (2NL) in secondary schools is one of the initiatives of the Government to bridge the communication gap between the ethnic groups. Social cohesion is one of the objectives of education and it was clearly stated by the National Education Commission in its first report. Further communication with other ethnic groups and cultural understanding is also highlighted in the grade 10 Teacher's Instructional Manual as a main objective of teaching 2NL. Textbooks have been developed for junior secondary grades by the Educational Publication Department, yet it is claimed that there are many shortcomings. The objectives of this study are to identify the status of achieving the objectives of teaching 2NL in secondary grades. This study was conducted utilizing a descriptive survey design in two educational zones in the Western province in Sri Lanka with a sample of 75 students, 16 principals and 50 teachers from 16 schools. Quantitative and qualitative data were gathered using questionnaires, focus group interviews and observation of the teaching-learning process in classrooms. Data was analyzed using descriptive methods. Findings revealed that the teachers are less qualified, the curriculum is very heavy for a 2NL learner, text books are not matching with the needs of students, the content of the text books is very heavy and difficult, activities given in the text books are not interesting and teachers do not use modern teaching-learning strategies, nor create a conducive teaching-learning environment in and outside the classroom. Achieving the objectives of teaching 2NL is a great challenge because of the above indicated issues. 72% of teachers teach 2NL (Tamil) using the lecture method, they do not use proper teaching methods, aids/materials in the classroom. Teachers do not like to enhance listening and speaking competency of the students. Only 21 % of students can speak and listen in Tamil language; 68% of students cannot write Tamil letters accurately. In addition 76% of students of grade 09 cannot communicate in Tamil Language. The majority of the students and teachers do not consider Tamil as an important subject in the curriculum.

**Key words:** Second national language, Objectives of teaching 2NL, challenges.

## **Assessing soft skills of Bachelor of Education undergraduates**

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Soft skills have been identified as a necessary set of skills employees must possess in order to compete in the 21<sup>st</sup> century workforce. Enhancing soft skills among the undergraduates in the Higher Education institutes in Sri Lanka has become a major task for producing the future workforce. This paper is based on an ongoing research. One of the objectives of the study is to identify the most important soft skills for Bachelor of Education Graduate (B.Ed.) teachers. This study is a case study. Hundred Bachelor of Education final year undergraduates (Sinhala, English and Tamil Medium) and ten university lecturers from the Faculty of Education, University of Colombo constitute the sample. The reason for including the B.Ed undergraduates as the sample is that they will become graduate teachers in the future. Researcher developed a tool to assess soft skills of the sample. It was based on the American model for 21<sup>st</sup> century student outcomes & support system. The Soft Skill Assessment is comprised of a five-point Likert- type scale that assesses the four areas: i). The current awareness (knowledge) level of soft skills ii).Importance of soft skills to teachers iii).contribution of the B.Ed course to develop soft skills iv).factors that affect teaching learning process to develop soft skills. The major findings of the study were: i. majority of the undergraduates lack critical thinking skills, decision making, problem solving, team work, and assessing skills ii. Most of the undergraduates are not satisfied with the opportunity provided to gain soft skills in the teaching learning process during the course. However they are satisfied with the integration of soft skills during teaching practice and workshops. iii. Majority of undergraduates are willing to undergo training to develop soft skills as a teacher. iv. Majority of the lecturers were agreeable to the incorporation of soft skills in the curriculum. The results of these findings can be used to design a model to develop soft skills in the higher education sector in Sri Lanka. Applying these skills in graduates, can fulfill the expectations of the employers.

**Key words:** Soft skills, Bachelor of Education, soft skills assessment

## **An inquiry into the students' readiness for self-directed learning**

*L.M. Kapila Bandara,  
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Being a self-directed learner is considered a major requirement to be an active and productive citizen in the globalized and knowledge economy. In educational institutions at all levels, the development of skills and attitudes supportive of self-direction in learning is now often an integral part of their mission and goal statements. On the other hand, it is alleged that the graduates who graduate, especially from Humanities and Social Science courses, have relatively poor knowledge, skills and work attitudes and aspiration which the labour market demands. In such a context, it is questionable whether the current practices in these institutions are capable of achieving their mission of developing self-directed learners. The available literature suggests that this situation is common and there is a mismatch between the practices and expectations of the Humanities and Social sciences disciplines in higher education institutions in Sri Lanka. In order to bridge this gap it is necessary to identify the challenges and barriers to achieving this mission and introduce appropriate strategies to overcome the challenges. As the initial step, this study proposes to measure the readiness, willingness and skills, and to identify the barriers to develop self-directed learning skills of the undergraduates who follow the Humanities and Social Science courses. A questionnaire along with a self-directed learning readiness scale was administered to 150 respondents who were purposely selected from the 3<sup>rd</sup> year special degree courses in the Faculty of Arts, University of Colombo. Twenty interviews were conducted with undergraduates who were randomly selected from the sample, in order to represent all the above courses. 60% of the members of the sample apply the practices related to the SDL in their teaching-learning process. Despite more than 60% of the respondents being ready for self-direction in learning, it seems to be that the system does not support them. Data reveals that language difficulties (30%), examination pressure (22%) and insufficient time allocation for the subject (19%) are major barriers to develop SDL skills. The study recommends an action research with a group of undergraduates who are in Humanities or Social Sciences in order to introduce a suitable model to develop self-directed learning skills of the undergraduates in Sri Lanka.

**Key Words:** Self-directed learning, Students' readiness

## **‘Shifters’ in bilingual education: Problems and challenges of learning through a second language**

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Bilingual Education (BE) has been in existence in the Sri Lankan secondary grades since 2001. In the present context BE at secondary grades means teaching of some subjects in English which is the students’ second language while the other subjects are taught in the first language. The main objective of introducing this programme was “to ensure that all students, irrespective of socio-economic and / or regional disparities, have the opportunity to acquire a level of English proficiency adequate for higher education and career advancement” (NEC, 2003, p, 178). However, BE has not been spread to all schools and hence this objective has not been achieved. There is also evidence to prove that students who study in the second language medium improve their language competency. However, there are also claims that some students who study in BE shift to monolingual education, especially in grades 7-9 and after the GCE (O/L). Based on data collected through two ongoing studies this paper examines the reasons for this shift. Utilizing quantitative data gathered through a survey of 60 schools it was revealed that 60 -100% of students shift to the monolingual medium after the G.C.E. (O/L). Teachers and principals of the sample attribute this shift to lack of confidence of the students regarding their second language competency, parental pressure and competition at the G.C.E.(A/L) examination. This data is supplemented by the case studies of four ‘shifters’ whose stories corroborated the survey findings. Based on the findings of the two studies it can be concluded that there are ‘shifters’ from BE to monolingual education especially after G.C.E (O/L). It is recommended that a comprehensive Content and Language Integrated Learning programme be developed with the help of the content teachers and second language teachers to help the learners to study in the second language medium.

### References

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### Acknowledgement

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## **Challenges of shifting to bilingual medium education in state universities: a case study**

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This paper is focused on a case study carried out on a sample of Bachelor of Education (B.Ed) part 1 undergraduates to examine the challenges they were faced with, in shifting to bilingual medium education in the university. The main objectives of the study was to identify the perception of the undergraduates on challenges they were faced with, and to compare them with the authentic challenges they were faced with in learning the content in English. Initially, a test based on standard criteria was administered to identify the level of the academic language proficiency of the students, which was followed by a questionnaire as well as interviews to identify their perceptions on the challenges they were faced with in studying in the bilingual medium. Simultaneously classroom observations were carried out to verify their perceptions. Findings revealed that all the students in the sample have had very few opportunities to develop English language proficiency before entering the university. Although they claimed that they were able to listen and understand a lecture as well as to read and understand an article, none of them took down their own notes or answered the questions of the lecturer. 70% could not read and understand the key points of an academic article on their own and all of them made many errors in speaking and writing. On the other hand, lecturers who taught the subjects had neither adequate time nor training to develop language and content knowledge simultaneously; hence the focus was only on giving the content. However, the B.Ed. students in the sample would be employed as bilingual medium teachers in schools after graduation with the aim of developing English language proficiency of students in schools while teaching the content in English. The teachers should be equipped with necessary language skills as well as bilingual techniques in order to achieve this aim. Therefore, it is important to develop both language and bilingual skills simultaneously with the content knowledge. One effective way of achieving this could be the collaboration between the content and language lecturers.

**Key words:** Bilingual medium, B.Ed., challenges in shifting to a bilingual medium.

## **Teaching a second national language in Tamil schools: The case of Batticaloa district in Sri Lanka**

*Virajith Gamage<sup>1</sup> and A.M. Hettige<sup>2</sup>*

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The acquisition of a Second National Language (2NL) plays a significant role in establishing sustainable peace in a multilingual society like Sri Lanka, a country that has experienced thirty years of civil war. One of the main reasons for this ethnic conflict has been the language barrier, which prevents mutual understanding between the two main ethnic groups: the Sinhalese and the Tamils. As part of a solution to the problem, Sri Lankan educational authorities introduced the teaching of Second National Languages: Sinhala and Tamil for grades 6 – 9 students since 1997. However there is hardly any empirical research exploring the process of teaching and learning of a Second National Language in Tamil medium schools. It is against this background that the present study was undertaken with a view to understanding the process of teaching of the Second National Language in the Batticaloa district of Sri Lanka.

A mixed method research design was adopted for the study. Firstly, a qualitative content analysis was done in respect of the existing literature including research articles, 2NL curricular materials, policy documents, and other relevant material. Secondly, observations were conducted to understand the actual classroom practices and finally, questionnaires were administered among principals, 2NL teachers, students and parents to gather additional information. The key findings of this research are: (a) the lack of an adequate number of qualified teachers for 2NL teaching, (b) the curriculum is too advanced for the teachers whose knowledge of this language is too low for the purpose, and (c) a considerable gap between the existing 2NL curriculum and actual teaching. In view of the above, the following recommendations can be made: recruitment of qualified 2NL teachers in sufficient numbers, provision of further training to teachers, preparation of a more suitable curriculum for teachers and students, and the conduct of further research to explore other issues and monitor further developments.

**Key Words:** Second National Language, Teaching learning process

## **A study on the nature and impact of the ICT subject on Post Graduate Diploma in Education students**

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The Postgraduate Diploma in Education (PGDE) is a professional certification for the Graduate teachers who presently work in government or private schools in Sri Lanka. Information Communication Technology (ICT) is one of the compulsory subjects included in their present curriculum and is not a credit bearing subject. This study was done to assess the usefulness of the ICT subject offered in the PGDE curriculum to them and its usefulness for their teaching-learning process at the classroom. Data were collected by using interviews and questionnaires. The sample consists of 30 government school teachers who have completed PGDE full time course at the Faculty of Education. In depth interviews were carried out with five (5) teachers. Interview and questionnaire responses revealed that ICT course content and its uses do not directly influence their day-to-day teaching and learning practices at the classroom. A majority of the teachers revealed that they do not use ICT in their day-to-day teaching due to various constraints. They listed the unavailability of a sufficient number of computers, unavailability of electricity in their classrooms, inflexibility of curriculum to incorporate ICT, less support from the school administration to implement ICT-integrated lessons in the classroom, and technical difficulties, as constraints to incorporate ICT in classroom teaching. Most of the teachers in the sample did not wish to reveal their personal interests or attitudes regarding ICT incorporation at the classroom. A higher number of teachers interviewed, and who answered the questionnaire, revealed that ICT incorporation in the classroom teaching learning is not feasible without having proper ICT resources and administrative support at the schools. A majority of the teachers agreed that ICT should be a compulsory subject in their PGDE curriculum. However they suggested that the content of the curriculum be changed to suite their day to day teaching in the classroom.

**Key words ;** PGDE, ICT Curriculum, use of ICT for teachers

## **An inquiry into the learning environments of bilingual mathematics classrooms in Sri Lanka**

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Bilingual Education (BE) was started in the Sri Lankan school system in 2002 with the objective of promoting it to a wider segment of the student population to benefit from the added advantages of BE. However, BE shows slow progress in terms of enrolments and students' continuation of studies in the BE stream. There may be many reasons for this effect and one important reason could be the nature of students' Classroom Learning Environment (CLE). According to literature there are many definitions for CLE, but in this research CLE is defined in terms of three dimensions: the physical, psychological and instructional learning atmosphere that students experience during the bilingual teaching-learning process. It is argued that students thrive well in a physically equipped, spacious, psychologically supportive and stress free, and instructionally rich CLEs. Therefore, it is important to study the nature of the classroom learning environment available for BE students in Sri Lanka. The present study attempts to inquire into the perceptions of students regarding the nature of the classroom environment in which they learn. A randomly selected sample of 112 students representing the Southern Province in Sri Lanka was surveyed using a researcher prepared instrument. The items for the instrument were derived from literature and arranged in a 5 point Likert scale. In addition, a complementary set of qualitative data was gathered through interviews with 12 students and 12 classroom observations. The qualitative data gathered were analyzed using a qualitative data analysis method (Corbin, and Strauss, 2008). Quantitative data were analyzed using descriptive statistics and one-way ANOVA. Overall, the findings suggest that the students' perceptions regarding the psychological and instructional components of learning environments are moderately favourable for them. However, the physical learning environment is not satisfactory. This finding was further strengthened during the classroom observations and students' interviews. There were no significant differences of students' perceptions with regard to gender, school type, and the situation of the school, at the alpha level of 0.05. It is recommended that students should be provided with physically rich spacious classroom learning environments. In addition, teachers should be trained to organize rich learning environments for students.

**Key words:** Bilingual Education, Classroom Learning Environment

**A gender-based analysis of the school library usage trends of the new entrants:  
a case study**

*Pradeepa Wijetunge and Kalpana Manatunge*

*Main Library, University of Colombo.*

The prior experiences in using the library resources, services and tools by the new entrants are not considered in planning the orientation programmes. A knowledge of the extent to which they have used the school library will be advantageous in providing a more context specific training in the university library. To fill this gap in knowledge the principal researcher undertook a research in several social science faculties in two Sri Lankan universities and this paper is related to the findings of the Faculty of Law, University of Colombo. Three objectives were formulated for the study; 1) to identify the gender distribution of the new entrants to the Faculty, 2) to investigate the gender-based frequency of using the school library for their GCE/AL studies, and 3) to examine the gender-based trends of using the school library. Two hundred and fifty who entered the Faculty of Law in the academic year 2015/2016, were given a structured two-page questionnaire and the results were analysed and interpreted using SPSS (Ver. 22). Findings established that 83% are female and in the 21-22 year age group and that there is no statistically significant correlation between the gender and the frequency or trends of using the school library. However, the majority (87%) of the respondents have only borrowed books and studied in the library (72.3%) while less than half (40.7%) used magazines, used the library catalogue (48.5%) and only one fourth (25.1%) have used computers in the library. The university education places significance on scholarly journal articles in addition to books, and the university library provides a computerized catalogue to locate information; besides, the students are expected to refer a range of scholarly material to underpin their classroom learning. It is strongly recommended to provide more guidance and training for the new entrants, in using the journals and the library catalogue, especially the electronic resources and tools, so that they can excel in their studies. It is also recommended to allocate more time beyond the library tour to enhance their information seeking skills.

**Key words:** Undergraduates, usage of school library, new entrants

## **Access to select social media and the preferences of communication methods with the library: a gender-based analysis of new entrants**

*Pradeepa Wijetunge and Kalpana Manatunge*

*Main Library, University of Colombo.*

Offering Information Literacy (IL)\* programs, in addition to the traditional library tour, to the new entrants to the university is becoming vital, to prepare the students for the increasingly complex information environment in the university library. However, the IL program planners do not have a sufficient knowledge of the new entrants' information seeking behaviour, to plan more context-specific programs. To fill this knowledge gap, the principal researcher undertook a study in the Faculty of Law, at University of Colombo. Two objectives were formulated: 1) to study the pattern of the gender basis of access to select social media and e-mail, and 2) to investigate the gender-based preferences in communicating with the library through social media, e-mail and Short Message Service (SMS). The total population (250) enrolled in the Faculty for 2014/2015 academic year was surveyed using a structured questionnaire and SPSS (Ver. 22) was used to analyze and interpret data. The study established that there is an observed gender-based difference in the access to FaceBook (FB), Twitter and e-mail and in the preferences of communicating with the library through SMSs, but Cramer's V test proved that this correlation is not statistically significant. The study proved that, 78.4% have an e-mail account, 52.4% have an FB account but only 14.2 % have a Twitter account. Of the respondents, 91.8% are willing to communicate with the library using FB, Twitter and e-mail and 88.7% are willing to receive SMSs from the library. In planning the IL programs and information services for these respondents, it is recommended for the library staff to consider their preferences so that the information is delivered to the net-generation students in their preferred methods.

**Key words:** Undergraduates, Face Book, Twitter, e-mail, communication.

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\* Information literacy is the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is produced and valued, and the use of information in creating new knowledge and participating ethically in communities of learning (ACRL 2015).

**Efficacy of “micro teaching” in teacher education: developing teaching skills of prospective teachers.**

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This paper is based on the first phase of a study, which attempted to develop the teaching skills of prospective teachers of English. The objective of the study was to develop the questioning techniques of prospective teachers using ‘Micro Teaching’. Review of research shows positive results in using ‘Micro Teaching’ to develop teaching skills in an international setting. Though ‘Micro Teaching’ has been mentioned in the syllabi of National Colleges of Education, it has been treated as theoretical knowledge rather than a tool to be used in developing teaching skills. A checklist was used to analyze the state of questioning techniques employed by the 30 prospective teachers that formed the sample. Intervention to develop questioning techniques was carried out following the ‘Micro Teaching’ cycle. Several adaptations to the ‘Micro teaching’ cycle were made to suit the local setting. A ‘Skill Plan’ was introduced for the planning stage of the ‘Micro Teaching’ cycle to pre-plan the questions of the lessons. Observation schedules, video/audio taping and field notes were used to record and analyze the efficacy of ‘Micro Teaching’. The data gathered through the above mentioned instruments showed that ‘Micro Teaching’ has been successful in developing the questioning techniques of prospective teachers. When the peer group acts as the students the responses became artificial. Therefore, using school children as students is suggested to have more authentic responses. It is suggested to have an additional critique session after the model lessons, at the beginning, as a further adaptation. ‘Micro Teaching’ can be introduced as a successful technique to develop teaching skills. ‘Micro Teaching’ is suggested to be used to develop several other teaching skills too, to verify its effectiveness in future research.

**Key words:** Micro Teaching, Teacher Education, Questioning Techniques, Prospective Teachers.

## **Crossing the cultural boundaries: developing intercultural competence of English language teachers**

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Sri Lanka is a pluralist society, which shelter diverse cultural groups. Nevertheless, our schools are segregated based on the medium of instruction reinforcing the cultural conflicts which took place over many centuries. However, teachers of English have a key role to play in this divided society as they are often 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 (CALD) to their own. Accordingly, the competence of communicating across cultural boundaries has become a prerequisite of professional competence of English language teachers. This study explores the possibilities of developing Intercultural Competence of prospective teachers of English undergoing their training at a pre-service teacher education institute in Sri Lanka, through a curriculum intervention which provides them with extensive opportunities to engage in intercultural interactions while learning English in the classroom together with their counterparts from other major ethnic groups. During a classroom-based study over an academic term of three months, a specially designed intercultural syllabus was implemented to teach English Language skills, *i.e.*, reading, writing, listening, and speaking, which aimed to facilitate new understandings and insights around cultural diversity and contribute to learners' development of intercultural competence. Findings reveal that most of the trainee teachers possess ethnocentric attitudes towards other cultures. However, after the intervention they developed more positive ways of accepting and tolerating other cultures. The main purpose of the investigation is to develop intercultural competence in the participants to enable them to play their role effectively with the students coming from linguistically and culturally diverse backgrounds. Consequently they also pass on to the students the knowledge, skills and attitudes necessary for survival in a multicultural society.

**Key words:** cultural perceptions, intercultural competence, pre-service teacher training, CALD students

**Towards quality: Critical analysis of curriculum practices of teachers at the  
classroom level**

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The quality of education that teachers provide students is highly dependent upon how teachers organize the curriculum in the classroom. Nevertheless, they should also be accountable for their performance and progress in their careers on the basis of demonstrated effective curriculum practices. However, it is claimed that most teachers in Sri Lanka do not possess proper understanding of curriculum practices (Seneviratne, 2009). Without this understanding teachers will not be able to be objective in evaluating how good they are in curriculum planning at the classroom level. This study critically analyzes curricular practices of teachers in relation to five domains

## **Faculty of Graduate Studies**



"The Role of Post-graduate Research in an  
Efficiency-driven Economy"

## **Message from the Dean**



The Faculty of Graduate Studies (FGS) is home to more than 2000 postgraduate Students including foreign students. Their research work cuts across a range of subject areas such as human rights, conflict and peace studies, public administration and public management, business management, regional development and planning, clinical psychology, counselling and psychosocial support, labour relations and human resource management, manufacturing management, business studies and development studies. This diversity of background

and discipline results in a vibrant research culture. The theme for Annual Research Symposium 2015, **“Role of postgraduate studies in an efficiency driven economy,”** focuses on the role of human capital in transiting the small, open economy of Sri Lanka from factor driven to efficiency driven stage. Postgraduate research provides impetus for high efficiency through human capital development. FGS Annual Research Symposium takes pride in providing a suitable platform to showcase these valuable research findings to a wider audience.

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.

Professor Sunil Chandrasiri,  
Dean, Faculty of Graduate Studies

## **Faculty of Graduate Studies**

### **List of Abstracts**

1. A performance based multi-skilled labour allocation model for cellular manufacturing	30
2. Adaptation and validation of the Obsessive Compulsive Inventory – revised version (OCI-R) among Sri Lankan university students	31
3. Service quality gaps in private higher education	32
4. Future of information & communication technology (ICT) industry in Sri Lanka	33
5. Poaching by Indian fishermen: Emerging challenges to Sri Lankan peace and stability	34
6. Clinical assessment of the efficacy of an <i>Ardraka kanda</i> (AKI) drug for food hypersensitivity	35
7. Impact of language anxiety on learner performance among undergraduates	36

## **A performance based multi-skilled labour allocation model for cellular manufacturing**

*V. A. A. U. de Silva*

*Faculty of Graduate Studies, University of Colombo.*

Labour allocation is a major function of manufacturing shop floor control. This becomes a very crucial decision process specially when the concerned manufacturing organization operates on highly labour intensive processes such as garment manufacturing, electronic and electrical assembling, automobile assembling. On the other hand, while the developed countries are moving into more and more automated processes the developing countries such as Sri Lanka are still depending heavily on labour mainly due to its availability and low cost. By nature, labour is a highly variable resource and not a very dependable factor due to skill variations, learning curve, absenteeism, motivation and also the changes and disturbances from the surrounding environments: social, organizational and technological. Manufacturing literature has suggested that the readiness of a labour allocation system to cope with such issues is the capability to react to the situation with the minimum human intervention, which in fact is the main purpose of this research.

The research has been conducted as a case study in a local factory where the final assembly process has a cellular formation to produce several products in parallel. The assembly work force is multi-skilled and possesses different skill levels at each task. Currently the manufacturing process is struggling to cater to varying and increasing demand levels with varying staffing levels. One of the main causes for this struggle is the instinct-based manual manpower assignment method, which does not produce the required departmental throughput.

This work has proposed a simple mathematical model integrated with the fast and convenient calculation power of personal computers, which would enable production control personnel to assign operators more effectively in terms of overall throughput. The mathematical model was expressed through a Microsoft Excel spread sheet and solved using Excel Solver for a collection of historical data. The model generated superior theoretical throughput rates compared to the manual assignment results. And finally, the negative impacts of such a method and possible areas of improvements have been discussed briefly.

**Adaptation and validation of the Obsessive Compulsive Inventory – revised version (OCI-R) among Sri Lankan university students**

*B. G. R. de Silva*

*Faculty of Graduate Studies, University of Colombo*

Clinical Psychology is a relatively new field in Sri Lanka. Therefore, there is a dearth of valid and reliable clinical measures that assess for psychological illnesses such as Obsessive Compulsive Disorder. Out of the general population, University students have been found to be a vulnerable population to develop mental health problems and have been found to suffer from high levels of psychological distress. Therefore, the main objective of the study was to adapt and validate the Obsessive Compulsive Inventory – Revised (OCI-R) among Sinhala speaking university students between the ages of 18 to 35 years. The OCI-R was adapted to the Sinhala language via two phases. The first phase included translating the OCI-R to Sinhala language and then obtaining content and consensual validity from a panel of mental health experts in Sri Lanka. Phase two contained the cross sectional, correlational and factor analytical study, which assessed for internal consistency reliability, test-retest reliability, convergent validity, and divergent validity, using DASS-21 Sinhala version and factor structure of the OCI-R Sinhala version. The OCI-R Sinhala version was translated successfully to Sinhala language with a few minor issues and re-adjusted with the aid of the mental health expert panel and the pre-testing process to retain the original conceptual meaning. Within phase two, the OCI-R Sinhala version demonstrated good internal consistency reliability (Cronbach  $\alpha = 0.86$ ) and test-retest reliability (0.75). The measure also obtained good divergent validity (0.35) and acceptable convergent validity (0.41) when measured against the depression and anxiety subscales of the Depression, Anxiety and Stress Scale - 21 Sinhala Version. It also obtained an adequate confirmatory factor analysis, and thereby, satisfactory construct validity. In conclusion, the OCI-R Sinhala version appears to retain the sound psychometric properties of its' original version, providing an instrument to assess for obsessive-compulsive symptoms within the non-clinical population between the said ages in Sri Lanka.

## **Service quality gaps in private higher education**

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Sri Lankan tertiary education system is limited as only 15 to 20 percent of students get enrolled to the state university system annually. Consequently, there is a growing demand for private degree awarding institutes in Sri Lanka. With this increasing demand, the quality of the education service provided by these private degree awarding institutes is always questionable. This study explores the quality gaps in the education service provided by a leading private higher education institute in Sri Lanka. The examination of this issue is significant to improve the service delivery of the institute to meet the quality requirements of the undergraduates. The primary objective of this study is to investigate service quality gaps in the institute while identifying the determinants of the service quality gaps.

To achieve these objectives, a comparison of students' expected service with their perceived service was conducted in relation to five generic quality dimensions. The deductive reasoning has been applied for this research with the application of Parsu Parasuraman's SERVQUAL Model. The primary data was gathered through structured questionnaires from a sample of 450 students. The findings indicated that, there is a discrepancy between students' expectations and their perceptions of the service delivered, regarding four quality dimensions, *viz.*, 'Responsiveness', 'Assurance', 'Empathy' and 'Tangibles' under the level of significance 0.05. The findings also discovered that demographic and educational factors such as 'Gender', 'Faculty', 'Age of the Faculty', 'Academic Year' and 'Income Level' were determinants of the service quality gaps. The researcher recommends that the institute obtains students' feedback to identify the areas of improvement, conducts peer reviews, and implements effective staff training programs to improve the quality of the service delivery.

## **Future of information & communication technology (ICT) industry in Sri Lanka**

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The exporting sector plays a dominant role in many developing countries in recent years, in terms of sustaining and ensuring economic growth, profitability and survival. Under this ground, the ICT industry in Sri Lanka has been recognized as a promising services export sector, having a greater potential growth and a greater possibility of expanding market share. But this industry is not performing as well as expected, and far below the expected growth rates since 2011. Thus, the main objective of this study is to investigate the future challenges and issues pertaining to the ICT export entrepreneurs in Sri Lanka.

As per the nature of the study, data analysis was based on the descriptive approach. Primary data were gathered through face-to-face interviews of 25 owner managers of ICT exporting firms, registered at EDB, and selected using the convenient sampling method. In addition, the study has conducted a survey on all the websites of the ICT firms, registered at the EDB.

The main critical issues pertaining to the ICT industry in Sri Lanka are (a) its structural composition, (b) lack of skills / experience of human resources and (c) heavy dependency of

## **Poaching by Indian fishermen: Emerging challenges to Sri Lankan peace and stability**

*R. Joseph*

*Faculty of Graduate Studies, University of Colombo*

The poaching issue between India and Sri Lanka is a long-standing one. The peaceful environment has encouraged fishermen from both countries to engage in fishing on a large scale. The competition for limited resources has emerged as a conflict between the fishermen and evolved into a very sensitive issue between the two countries. Impacts on the economy, marine environment, Indo-Lanka relations, social, political and security stands prominent. The research problem focuses on what challenges poaching by Indian fishermen in Sri Lankan waters would pose to the 'peace' and 'stability' of Sri Lanka.

The primary objective of the study was to examine how the impacts of poaching by Indian fishermen in Sri Lankan waters could emerge as a challenge to peace and stability. Data pertaining to the research was collected through primary sources and analysis of RADAR images showing the poaching patterns were also taken into consideration. Responses given to questionnaires by officers in the Navy and fishermen in the northern community were also analyzed in arriving at findings.

The analysis of responses has clearly identified that the continuation of poaching by the Indian fishermen in Sri Lankan waters will emerge as a challenge to Sri Lankan peace and stability.

There are quite a few mechanisms that are place to solve this conflict. The Sri Lanka Navy and the Coast Guard has been deployed for anti-poaching patrols and formation of a Joint Working Group is yet another initiative. While they all seem addressing the issue in the surface level, there is a strong requirement to establish a sound framework in order to find lasting solutions to this conflict. It is quite clear that Sri Lanka could not allow this daylight robbery to continue in a large scale violating all internationally accepted rules and regulations.

## **Clinical assessment of the efficacy of an *Ardraka kanda* (AKI) drug for food hypersensitivity**

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Food hypersensitivity is a common non communicable disease in the world which can be either caused by food allergy or non-allergic food intolerance. It has a wide range of symptoms from eczema to severe life-threatening anaphylaxis and has a clear impact on quality of life of an individual and the society. The objective of this study was to assess the efficacy of *Ardraka kanda* (AK1) formula as a suitable treatment on food related complications, allergy or intolerance for the sensitized individuals. AK1 was assessed in a clinical trial, testing total IgE, specific IgE, total leucocytes with its differential count and urine analysis as biochemical parameters and clinical symptoms evaluation using a scoring system through patient interview, consisting of four phases – pre treatment, post treatment, allergen/food induced stage 1 and 2. Volunteer patients with a convincing history, age 18 -75 years and mild to moderate symptoms were selected for the study conducted at the Ayurveda Teaching Hospital, Borella during the period from February 2014 to April 2015. Thirty four patients were tested with the AK 1 drug dose (6 g freshly prepared tablets before the breakfast for 14 days) during the trial with follow up for six months with patient maintained diaries. There were eleven recorded positive patients for food specific IgE levels; for beef, milk, wheat, grapes, prawn, pineapple or tomato. Thirty patients completed the study and 21 (70%) patients showed positive improvement after 6 weeks of the intervention study. There was a gradual significant IgE reduction in all participants after the treatment initiation with the test drug [p value 0.029], and 21 patients showed overall improvement [p value 0.026] from the disease. The p value for the difference in the Neutrophil count in initial stage and after the treatment of this group of 21 patients was a significant difference [p = 0.049]. In conclusion, the study reveals that the test drug *Ardraka kanda* (AK1) has a significant impact on reducing total blood IgE level with significant reduction of neutrophils observed among the improved food sensitized patients. There was no significant impact on urine and no observable adverse or side effects caused by the drug on individuals participated the study.

## **Impact of language anxiety on learner performance among undergraduates**

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‘Language anxiety’ (LA) is a psychological construct, defined as ‘a distinct complex construct of self-perceptions, beliefs, feelings, and behaviours related to classroom language learning arising from the uniqueness of language learning process.’ It is also an emotion, and described as one of the ‘affective’ factors under the affective domain of SLA (Second Language Acquisition). Brown (2007) points out that ‘purely cognitive theories of learning will be rejected unless a role is assigned to affectivity’ Therefore, given the high failure rates and low competency levels of learners at national examinations and at tertiary level, the primary objective of this study was to examine the impact of LA on learner performance. Both the reasons that trigger LA and strategies for fighting LA were examined.

The participants of the study were 100 undergraduates studying in their second year at the University of Sri Jayewardenepura. Data collected through a questionnaire and interviews were analyzed quantitatively and qualitatively. Multiple Corresponding Analysis, (MCA) was used for creating an index of LA and summary statistics. Pearson correlations coefficient test and Chi-square tests were used for statistical analysis to test the relationship of LA with other variables. LA was measured through the FLCAS (Foreign Language Classroom Anxiety Scale: which has been validated as reliable in many studies. Anxiety measures were correlated with the marks of Compulsory English. Findings suggest that language anxiety has a significant negative correlation with performance (Pearson Chi-Square = 34.139, DF = 6, P-Value = 0.000, Likelihood Ratio Chi-Square = 33.621, DF = 6, P-Value = 0.000). Gender, field of study, speaking, and comprehension activities and having to conform to cultural and gender stereotypes and urban background all provoke comparatively more anxiety. Crossing, code-switching, group work and allocating more preparation time for learners are some of the strategies for fighting LA. Based on the findings, the study also carries pedagogical implications for improving English language education in Sri Lanka.

## **Faculty of Law**



"University as a Catalyst for Change"

## **Message from the Dean**



The role of universities as centres of research and innovation has been accepted over centuries, and universities in the modern era continue to be at the forefront of the march towards development. This has remained true in the face of globalization, which has commercialized knowledge to a level hitherto unimagined. The Annual Research Symposium of the University of Colombo provides a meaningful forum for academics to share their thoughts on the role of the university as a catalyst for meaningful change, which is a necessary development in the progress of humankind.

In today's complex world, academics can no longer take a back seat or regard research as something to be done to while away their spare time. Innovation in every field is important to ensure that resources, both tangible and intangible, are utilized at their optimum level, and are targeted toward human benefit. At the same time, we must work towards optimising the human relationships around which society revolves.

This annual event provides academics from the Faculty of Law the opportunity to present their latest research and have it critiqued by the most astute commentators. It is hoped that this exercise will refine and elevate the standard of legal research done by the Faculty.

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.

Indira Nanayakkara  
Dean/Law

## **Faculty of Law**

### **List of Abstracts**

1. Safety and health at workplace: reflection on legal responses available in Sri Lanka	40
2. Micronations: Statehood, sovereign equality and subjects of international law	41
3. Reconciliation of freedom of expression and right to reputation in cyberspace: A critique of the legal framework governing internet defamation in Sri Lanka	42
4. Rethinking the Trusts Ordinance of Sri Lanka: A comparative study	43
5. A daughter's succession right to her parents' intestate property under the Thesawalamai and Kandyan law	44
6. Viability of a registration system to protect geographical indications in Sri Lanka	45
7. Transplanting requires tending the roots: Developing criteria for creating 'Law and Literature' syllabi for Sri Lankan universities	46
8. Representation and democracy: A critical study of electoral systems for local authorities in Sri Lanka	47
9. Towards a level playing field: Reintroducing family court to ensure justice and fair play in family disputes	48
10. Environmental integrity in international investment law: Challenges and opportunities – a theoretical perspective	49
11. An appraisal of the law governing the protection of the environment in the context of armed conflict	50
12. Preservation of confidentiality of trade secrets in the course of legal proceedings: a Sri Lankan perspective	51
13. Getting back to <i>Caveat Emptor</i> ? A study relating to misleading advertisements	52
14. Moving towards no-fault compensation for medical malpractices in Sri Lanka	53
15. Child transgressors in delict in Sri Lanka	54
16. Prospects and challenges of the concept of 'Responsibility to Protect': an appraisal of its application in the contemporary world	55
17. An analysis of the child's right to education with reference to the legal framework governing child labour in Sri Lanka	56

## **Safety and health at workplace: reflection on legal responses available in Sri Lanka**

*A. Sarveswaran*

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In Sri Lanka, many physical, biological, ergonomic and psychological hazards, hitherto not much experienced, emerge at workplaces. The objective of this paper is to assess the extent to which the Sri Lankan legal system responds to promote safety and health at workplaces. In Sri Lanka, only the Factories Ordinance has detailed provisions relating to safety and health at workplaces. It is a misconception to consider that the workers have risks relating to safety and health only in the Factories. According to the Shop and Office Employees' Act and the Maternity Benefits Ordinance, an employer should not provide work that may be injurious to a woman worker during the period of three months before and after her confinement. The Workmen Compensation Ordinance provides for payment of compensation for industrial accidents and occupational diseases. The lists in the Ordinance do not include all types of diseases for payment of compensation. However, the statutes that have been enacted with different objectives could be creatively used to deal with safety and health issues at workplaces. The Employees' Councils established by the Employees' Councils Act could advise employers to take adequate steps to prevent accidents and eliminate health hazards. The mechanisms for settlement of industrial disputes in the Industrial Disputes Act could be used to promote safety and health at workplaces. Trade Unions can bargain with employers, and include clauses relating to safety and health in collective agreements which legally bind the two parties. But, these are not effective responses to protect workers from workplace risks and hazards. An attempt has been made in 2009 to enact an Occupational Safety, Health and Welfare Act to provide a holistic approach to safety, health and welfare issues at all types of workplaces. However, the Act has not yet been enacted. Therefore, there is an urgent need for legislative intervention to enact legislation that will take a holistic approach to provide for safety and health at workplaces.

## **Micronations: Statehood, sovereign equality and subjects of international law**

*D. S. Medawatte*

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Micronations are a subject of interest to many as it compels the reconsideration of concepts such as the legal requirement of a territory for establishing a State, sovereign equality and the rights of States to determine their national laws. Tushnet's opposition to the 'rights thesis' remains valid even in the context of international law, where the conception of equality has been used as a tool to create a mockery of certain micronations, despite the International Court of Justice's acceptance in the *Nottebohm Case (Second Phase)* in 1955 that micronations (in this case, Liechtenstein – which was then a principality) possess the right to determine rules pertaining to the acquisition of nationality similar to other sovereign States.

Since the early 2000s, a notable increase of academic interest in micronations is observable through the publications appearing in international law journals. These highlight the need for reconsideration of accepted criteria of international law applicable to creation, recognition and 'naturalization' of States. In the light of these developments, as Alfred Verdross stated in the late 1900s, the distinction between States and other subjects of international law continues to be of paramount importance.

This paper utilises a critical approach to the existing rules of international law. The responses the author received in a survey conducted in June 2015, where the respondents were several rulers of Micronations, have been used in the paper along with accepted principles and concepts of international law to provide an insight to the challenges faced both by 'macro' and 'micro' nations due to the attempts of the latter category to establish independence and sovereignty. In the main, the paper seeks responses for the following three questions: (i) Is a territory an absolute requirement for the establishment of a State? (ii) How has sovereign equality been used as a tool to undermine the sovereignty of micro entities? (iii) How could we distinguish sovereign States from other subjects of international law?

**Reconciliation of freedom of expression and right to reputation in cyberspace:  
A critique of the legal framework governing internet defamation in Sri Lanka.**

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The right to freedom of speech and expression as one of the “highest aspirations of the common people,” is regarded as an indispensable element of liberal democratization. Nevertheless, as declared by Article 15 (2) of the Constitution of Sri Lanka, this fundamental right has been restricted in order to prevent the impairment of a person's reputation from injurious defamatory statements. In this cyber age, the inherent ability of the Internet to perpetrate unprecedented massive infringement on a person's reputation has necessitated a reshaping of the existing defamation laws. Against this backdrop, the research considers whether the existing framework on Internet defamation in Sri Lanka is sufficient to reconcile the right to reputation and the right to freedom of expression in cyberspace. Therefore, the focal objective of the research is to examine the adequacy of the existing legal framework of Sri Lanka, in order to reconcile these conflicting rights, in light of recent developments in selected jurisdictions such as the UK, South Africa and India. It is revealed that in the contemporary context of Sri Lanka, since criminal liability for defamation has been repealed by the Penal Code (amendment) Act No.12 of 2002, the civil law relating to defamation needs to be developed to provide a remedy where infringements of the right to reputation takes place in cyberspace. Therefore the study recommends that legal reform be implemented in this fast-growing area to clearly address the issues relating to actions against anonymous defamatory posts, conflict of laws and the notice and takedown process, which would protect the rights of victims of defamation. At the same time, the study proposes that the prominent role of the Internet in re-shaping public ideology should be ensured through necessary defences that would enable the exercise of rights such as freedom of expression, the right to information, and the protection of journalists and ISPs.

## **Rethinking the Trusts Ordinance of Sri Lanka: A comparative study**

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‘Trust’ is a significant development of English jurisprudence and is a consequence of the judicial interpretation of principles of equity. Trusts law was introduced to Sri Lanka by an ordinance named ‘Trusts Ordinance’ of No. 09 of 1917 (TO). It should be noted that although trusts law has been developed by linking it with many branches of law in many countries, similar developments are not evident in Sri Lanka. It is a widely held view that the TO has many outdated provisions and moreover, that it has failed to provide adequate guidance on some fundamental issues relating to trusts, such as legality of a trust, capability of holding a trust, standard of care, etc. Its language can be considered to some extent as complex and therefore, it is largely inaccessible to non-lawyers. Some provisions of the Sri Lankan TO are similar to the Indian Trusts Act of 1882. However, both countries are yet to take further action to make necessary amendments to their respective trusts law. It should further be considered that according to Section 02 of the TO, if there are no specific provisions in this law or any other enactment, all matters with reference to any trust shall be determined by the principles of equity for the time being in force in the High Court of Justice in England. However, the principles of equity have now been consolidated by several legislative enactments and which have subsequently been amended several times in England. Some of those legislation are; Trustee Act 2000; Trusts of Land and Appointment of Trustees Act 1996 and the Charities Act 2011. Therefore, the main purpose of this research is to identify some of the problematic aspects of the current TO of Sri Lanka and suggest recommendations to reform the Sri Lankan law through a comparative study with laws of the United Kingdom and India.

**A daughter's succession right to her parents' intestate property under the  
Thesawalamai and Kandyan law**

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This paper critically analyses the daughter's intestate succession rights under the Thesawalamai and Kandyan law in light of customary and statutory principles as well as international standards. The Convention on Elimination of Discrimination against Women ('CEDAW') and Article 12 of the Constitution both uphold equality. Under the Kandyan and Thesawalamai Law dowry is an alternative method of giving intestate property to the daughter. The Thesawalamai Code imposes a moral obligation on the parent to provide dowry to the daughter upon her marriage. The Kandyan Law also imposes a similar moral obligation on the father to provide dowry to a *diga* married daughter, which precludes further claims. Moreover, the undowered daughter under the Thesawalamai Law succeeds to the parent's property equally with the sons and unmarried sister. The Kandyan Law too recognizes a *binna* married and an unmarried daughters' rights equal to a son. Under the Thesawalamai Law the forfeiture of rights to inheritance would be applicable to parental property, but under the Kandyan Law it is only in respect of paternal property. Under the Thesawalamai law after the death of the father the obligation extends to the brothers, or to the surviving spouse, and to those relations who may be *in loco parentis*. However, the JMRIO does not impose a similar obligation on parents to provide a dowry. Therefore, the question arises whether a woman governed by the Thesawalamai could demand dowry from her parents. The study proves that a daughter'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. Having established that the intestate succession rights of daughters in Kandyan Law and Thesawalamai Law discriminate against women, the author makes recommendations for constitutional and legislative amendments, judicial activism and public awareness to promote equal rights of women in the area of intestate succession rights.

## **Viability of a registration system to protect geographical indications in Sri Lanka**

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Geographical Indications (GI) allow a product to be accorded a special status due to the conditions prevalent in the region that it hails from. Since a GI receives its coveted status due to some special quality, it enables producers to maintain standards instead of focusing only on increased production.

The implications of obtaining GI protection for unique products can hardly be overstated in a country like Sri Lanka. Though it is known universally for its tea, Sri Lanka produces less bulk tea than China and Kenya. Sri Lanka has managed to retain its place as the largest revenue earner for tea due only to the certification mark that it owns for the logo Ceylon Tea.

This example serves to highlight the fact that there are huge developmental returns waiting to be harvested in other areas where Sri Lanka has an advantage – Ceylon sapphires, Dumbara mats and Beeralu lace, to name just a few. However, these products have not been able to use their superior quality as a successful marketing tool primarily due to inadequacies in the legal system, which do not permit registration of products as geographical indications.

This study identified the economic potential that exists for products that could be afforded GI protection in Sri Lanka. It also examined the legal protection that is currently afforded domestically, and analysed its deficiencies. In addition, it analysed the legal position in comparable jurisdictions like India. Furthermore, it evaluated the international system for protection, and assessed Sri Lanka's position within this system. It also considered the work done thus far by the committee appointed to propose amendments to the Sri Lankan law on GIs. Based on these findings, it proposed some amendments that would enable the establishment of an effective regime for GI protection in Sri Lanka.

**Keywords:** Intellectual Property, Geographical Indications, Registration System

## **Transplanting requires tending the roots: Developing criteria for creating ‘Law and Literature’ syllabi for Sri Lankan universities**

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Introducing a new course to legal curricula in Sri Lanka, especially a ‘Law and Literature’ course which involves choice of legal and literary texts, requires academic discussion and research. The intention is that this initial study can be a foundation for discussion and research in this area and contribute guidelines for the development of future Law and Literature syllabi in Sri Lanka. Both primary and secondary sources (literature, legal texts, commentary and interpretation), as well as interviews and discussions were used as the basis for a critical analysis of how the approaches used by the Law and Literature movement which began in the United States, can be transformed and developed for ‘Law and Literature’ teaching and learning in Sri Lanka.

One of the main purposes of teaching and learning Law and Literature is to gain a better understanding of law and society as well to develop an empathetic and humanistic approach to the law. A Sri Lankan Law and Literature course is better equipped to achieve such a result, if the following criteria (discussed in more detail in the body of the paper) are followed:

1. Choosing internationally acceptable literary texts relevant for analyzing law and justice in its socio-legal context, which Sri Lankan learners can connect with.
2. Using Sri Lankan literary texts (those originally written in English as well as translations from Sinhala and Tamil) which highlight Sri Lankan socio-legal issues.
3. Literary materials in English should not be limited to ‘Western’ sources but should also include ancient and modern texts or translations into English from other parts of the world.
4. Legal materials (international, comparative and domestic) must also be used, parallel to the above extracts.

From the research and analysis, it is recommended that *all* the above criteria are used when choosing texts for analyzing chosen socio-legal issues. There must be a critical reflection on the development of syllabi, with the assertion that academics must pay attention to the needs of *Sri Lankan* students, scholars and society in doing so, but with a view that we are part of a global endeavor to communicate with each other on law, society and humanity. Effective use of a global language, English, is also important in this context.

## **Representation and democracy: A critical study of electoral systems for local authorities in Sri Lanka**

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The electoral system prescribed in election laws pertaining to the Local Government authorities in Sri Lanka is not adequate to promote representative democracy. The prevailing electoral system for the local authorities could be reformed in order to ensure that political representatives are properly elected in order to enhance representative democracy and to ensure their accountability to the electors. Thus, this paper seeks to examine whether the present electoral system of local government promotes representative democracy and promote effective local governance.

This study is a preliminary outcome of a literature survey. The necessary information is gathered from secondary sources accessible and available such as constitutions, laws, journal articles, textbooks, research and working papers, government publications, newspapers, electronic databases, and e-journals.

The present electoral mechanism for local authority elections in Sri Lanka is a combination of the proportional representation and ward system. It has been introduced through an amendment of the Local Government Election Ordinance in the year 2012. This paper seeks to discuss the weaknesses and strengths of the system introduced under the Local Government Election Ordinance in the year 2012. Further, this paper attempts to assess the representation of both women and youth who can be considered as vital stakeholders of democracy. This will be analysed with special reference to the recent Local Authorities' Amendment Bill and the proposed 20<sup>th</sup> Amendment to the Sri Lankan Constitution. For the purpose of the above discussion a conceptual analysis of local democracy, representation and electoral systems will be dealt with in this paper.

**Keywords:** Local Authorities, electoral system, ward system, quotas

**Towards a level playing field: Reintroducing family court to ensure justice and fair play in family disputes**

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The Sri Lankan family law regime provides for individual rights in family and matrimonial matters. The procedural law provides the means to realize these rights. Redress is delivered via multiple institutions depending on the law applicable to the parties in question. These procedures challenge justice and fairness. In many occasions litigants are compelled to seek the services of multiple courts / institutions, and court procedures are invariably adversarial. Such procedures and general court attitudes place the oppressed and marginalized, particularly women and low income groups, outside the formal legal system, and prevent them from accessing legal redress. They are often forced into out-of-court settlements.

Resolution of family disputes requires special procedure designed to cater to the unique nature of the relationship between parties. Despite several *ad hoc* reforms introduced into the substantive law in ameliorating the legal status of marginalized groups within the family system, the adversarial court procedure, through which the substantive rights have to be realized, has been retained. The adversarial procedure presumes equality of parties and does not assess their actual economic and social status; the complicated technicalities of the process necessitate legal representation, placing the justice system beyond the reach of many. Due to these and many other reasons the justice system has failed to deliver the objectives of many a reformed law, and has not served as a level playing field for the economically and socially marginalized groups.

Failure to accommodate all on a basis of substantive equality in the judicial and quasi-judicial procedure and the regulatory framework prevents socially and economically disadvantaged groups accessing the single road to justice and fairness. Hence, for some, there remains a gap between stated rights and reality. Achievement of justice and fairness for marginalized groups in respect of family matters requires a complete overhaul of existing procedure including laws, structures and concepts. This article intends to propose a simpler and fairer court procedure for adjudicating matrimonial and family matters.

## **Environmental integrity in international investment law: Challenges and opportunities – a theoretical perspective**

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Protection of the environment poses a great challenge to developing countries due to the upsurge of Foreign Direct Investment (FDI) and competition for FDI. It can be argued that there are opportunities to adopt environmental integrity into FDI to uphold sustainability in host countries. Nevertheless, there is wide criticism of home states' investment policies when investing in developing countries. Home states often follow a double standard that allows companies to maintain lower environmental standards in host states than in their own territory. Developing country host states too are reluctant to insist that investors follow best practices relating to environmental protection. It is interesting to note that when an investment treaty is made by home states, they disregard their international responsibility towards conservation of the environment, which is mandated via a number of international laws and declarations. The global community has accepted that environmental conservation is one of the core areas of the concept of sustainable development. However, implementation of such concept seems to be lacking due to a number of reasons. It is undeniable that FDI is necessary for development, particularly in developing countries. However, FDI should not harm or injure the environment of States which are vulnerable and weak with regard to their economic strength. It should be realized that upholding and promoting the environment is as equally important as socio-economic development. This research mainly focuses on environmental theories, such as the 'Environmental Kuznets Curve' theory and the 'Polluter Pays' theory. As per the Environmental Kuznets Curve theory, developing countries cannot target the concept of environmental sustainability unless a home state exports environmentally friendly modern technology. The Polluter Pays theory combats 'environment cost' through 'pollution taxes'. Thus, this research mainly analyses loopholes in investment treaties and considers how these treaties could utilize environmental theories and principles relevant to FDI to preserve the environment from harmful foreign investments. It proposes to set normative standards which postulate 'minimum standards of environmental protection' in investment treaties.

## **An appraisal of the law governing the protection of the environment in the context of armed conflict**

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War can be interpreted as a military combat between two or more opposing parties. Such military combat impacts not only the parties to the conflict but also causes damage to property and to nature. Furthermore, due to the development of sophisticated war strategies and military equipment, modern armed conflicts create extremely grave and long-term damages not only to human life but also to nature and natural resources. Although international environmental law and humanitarian law instruments, including the four Geneva Conventions and the two protocols, have enforced some limitations to the destruction of natural resources in the waging of armed conflict, due to practical constraints and lack of interpretation, effective application of the said laws are somewhat problematic. In the above context, the main research problem of this paper is to examine the adequacy of the existing law governing the protection of nature and natural resources during armed conflict.

This research will critically examine the effectiveness of the existing principles relating to both international environment law and humanitarian law, with relevant international conventions regarding the protection of nature and natural resources during armed conflicts. Further, it is expected that this research will provide a basis on which appropriate recommendations can be proposed to make necessary developments to the said legal regime.

The research methodology of this work will be mainly qualitative and a number of books, journal articles, and internet articles are used to gather secondary data. The relevant authorities at Governmental and non-governmental organizations will be interviewed with a view to obtaining their viewpoints in order to make necessary recommendations for further development of the area of this research. A few focused group discussions will also be conducted with people affected by the Sri Lankan internal armed conflict in order to evaluate the credibility of the research findings.

**Keywords:** Armed conflict, widespread damages, protection of nature and natural resources

**Preservation of confidentiality of trade secrets in the course of legal  
proceedings: a Sri Lankan perspective**

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*“Secrecy requires constant vigilance, however, since ideas, like wild animals, ferae naturae, have a tendency to escape. Once gone, they return to the commons as public property”.*

*–Robert G Bone*

Intellectual assets are the drivers of the knowledge-economy of the 21<sup>st</sup> century. Even though trade secrets protection is a relative latecomer to the intellectual property (IP) pantheon, it has become a key aspect of the creation of a favourable business environment in any country. In the eyes of the law, any information that is kept confidential in order to preserve competitive gains is considered a trade secret. Defining a trade secret is not easy; it may include customer lists, formulae, practices, business strategies, software programs, advertising strategies, marketing plans, manufacturing processes and information about R&D activities etc. Sri Lanka, being a state party to the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), has a TRIPS-compliant legal regime. Section 160 of the Intellectual Property Act of 2003 and the common law action for breach of confidence constitute the foremost legal means of trade secrets protection in Sri Lanka. However, there are a number of risks involved in trade secret litigation. One major concern is the preservation of confidentiality of the trade secret during and after legal proceedings. Survey evidence confirms that bringing a lawsuit against an infringement of a trade secret risks losing the confidentiality of that trade secret and its value. This was evidenced in the recent case of *Link Natural Products Ltd v Tropical Herbs Ltd*. The current IP Act of Sri Lanka does not contain any legal provision specifically designed to address this issue. Nor is there any solution found in case-law dealing with such a situation. Therefore, this paper aims to investigate the inadequacies of the enforcement mechanism of trade secret in Sri Lanka and to find possible solutions to protect secret information during court proceedings by drawing examples from other common law jurisdictions such as the UK.

**Keywords:** intellectual property, trade secrets, preservation of confidentiality.

## **Getting back to *Caveat Emptor*? A study relating to misleading advertisements**

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The old notion of *caveat emptor* requires the buyer to be cautious when dealing with the seller. The position changed with the development of trade law when welfare governments began legislating to safeguard buyers who became known as consumers. However, buyers do not enjoy protection at all times. One of the perils the buyers face is misleading promotional activities of the traders. This is mainly by way of advertising of products and services by various means to enhance sales. Advertisements are said to be tools to make available information to consumers in order to meet the challenges of the competitive market. While accepting that advertising is the key to marketing there is sufficient evidence that advertisements are not done within the limits of 'promotion' or 'trade puff'. As a result, consumers are misled. Misleading and deceptive advertisements are detrimental to the economic interests of consumers. Statements and pictures in advertisements amount to an actionable negligent misrepresentation under the law of contract.

Whether advertising, as a part of consumer protection, should be within the legal framework to ensure that the viewers or consumers are not misled, is the prime research question to be analysed. If this is answered affirmatively, then the next question is whether it should be through a statute or regulation. If the answer is negative, the option of self-regulatory codes (similar to the Singapore Code on Advertising Practices) will be considered.

The present law is contained in the Consumer Affairs Authorities Act No. 9 of 2003 as well as the common law liability in terms of Contract Law. It is revealed that these do not provide a sound advertising law or policy for Sri Lanka.

It is intended therefore to suggest possible remedial action considering the laws of other countries. Hence, the paper will critically compare the Sri Lankan advertising law with the laws of India, Singapore, United Kingdom and European Commission Directives on Misleading Advertisements with the objective of suggesting a possible solution that best suits Sri Lanka.

## **Moving towards no-fault compensation for medical malpractices in Sri Lanka**

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Article 27 [2] [c] of the Constitution of Sri Lanka mandates the government to take initiatives to improve the living conditions of its citizens. Accordingly, Sri Lanka is one of the pioneer countries in the world that provides free health care to citizens. Irrespective of whether health care is provided free by the state or at a price by the private sector, receiving the best possible health care is what concerns the general public. Medical malpractice incidents reported in the recent past have raised serious concerns regarding the healthcare service of Sri Lanka. In Sri Lanka, the Law of Delict is the primary means to obtain remedy for medical malpractices. In order to obtain compensation through courts, the law relating to medical malpractice relies on the fault concept. This, coupled with an aggressive adversarial system, creates anomalies. The objective of this paper is to assess the possibilities of adopting an alternative mechanism to compensate the victims of medical malpractice in Sri Lanka with the aim of overcoming the difficulties created by the traditional adversarial system. This study is based on secondary resources available in the library such as journal articles, textbooks, research papers, electronic databases, case law and e-journals. In this paper, the author attempts to focus on two different models that have been established within the sphere of Law of Delict as part of a “No-Fault Compensation System” to compensate medical malpractice incidents. One represents the model introduced in New Zealand and the other represents the model used in Sweden. Further, this paper attempts to suggest the best possible no fault model to be adopted in the Sri Lankan context to provide effective and reliable remedies for medical malpractices.

## **Child transgressors in delict in Sri Lanka**

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Children are protected with special care in every respect in many jurisdictions. This trend is apparent in legal regimes, which deal with child victims as well as child transgressors. Simply, the reason is the uniqueness of childhood. In this scenario, determining an age for delictual liability of children is difficult, as there is no universal age of majority. In some cases the age of 14 has been considered as the borderline while 16 is considered to be the cutoff age of maturity in other regimes. In the absence of such a standard of age, it is questioned whether the applicability of the ‘reasonable man’s test’ against a child in a delictual case is justified. It is noted that in early Roman Dutch Law as applied in South Africa, the youthfulness of the child as well as his/her intellectual development was concerned as valid factors for liability. This test is called the ‘reasonable child’s test’. However, in later stages the general test for determining fault of the adult had been used to decide negligence of the child under special circumstances. With the issue of applying adult criteria for children being criticized by contemporary writers, the South African court now considers whether the child has reached the emotional and intellectual maturity required to appreciate the particular danger to be avoided and to act accordingly. The English court has also adopted this moderate view and supports the ‘reasonable child’s test’ to be applied in tort cases. Against this background, it is interesting to see how the Sri Lankan courts look at this issue and adopt a criterion for child transgressors in delictual cases. Significantly, no case has yet evolved that relates to matters pertaining to children’s liability in delict in Sri Lanka even though children’s involvement in delictual cases is on the increase. Thus, in this qualitative research it is intended to analyze the judicial approach in two comparative jurisdictions operating under similar circumstances and recommend whether there should be a cut off age for delictual liability of children and what test should be applied for assessing negligence liability of child transgressors in Sri Lanka.

**Keywords:** child, delict, liability, reasonable man’s/child’s test

**Prospects and challenges of the concept of ‘Responsibility to Protect’: an appraisal of its application in the contemporary world**

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This research focuses on the suitability of the concept of ‘Responsibility to Protect’ (R2P) with reference to its incongruent application by powerful states in domestic crises based on humanitarian grounds. The concept posits that each state has the primary responsibility to protect its population from mass atrocities. When sovereign states fail in this responsibility, the international community should have a residual responsibility to protect people from such serious violations. In the post-Cold War era, the international community has increasingly intervened in many situations where the human security and rights of people were threatened. However, the legality of such interventions has become questionable due to several reasons. As a result, a need arose to craft a new and more measured concept, in order to differentiate the patterns of ‘humanitarian’ interventions, which emerged as an exception to the established legal framework set up by the United Nations Charter. Nevertheless, this responsibility of all states recognized through the ‘R2P’ was submitted without a distinctly envisaged criterion to safeguard the interests of sovereign states and a designated authority for close scrutiny. This led to the question as to whether the present day international interventions carried out under the shield of ‘R2P’ undermine the ‘sovereignty of states’ and also to the question as to how far such interventions could be justifiable as actions taken for the actual protection of ‘sovereignty of people. In this backdrop, this paper examines whether the concept of ‘R2P’ provides a viable answer to the unresolved questions associated with the legality of post-Cold War interventions by some states based on humanitarian reasons. The research concludes that the implementation of ‘R2P’ is highly dependent on domestic and international politics due to the absence of a proper rationale for its application. Therefore, ‘R2P’ should be revised and reformed with clear cut criteria to ensure its viability and efficacy.

**An analysis of the child's right to education with reference to the legal framework governing child labour in Sri Lanka.**

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This paper examines the legal framework relating to child labour in Sri Lanka and the right to education of children. It addresses the question whether the existing legal framework is sufficient to ensure the right to education while eliminating child labour. The main objective of this study is to examine the current legal framework governing the issues of the child's education and prohibition against child labour and to evaluate the impact of child labour on the right to education of children in Sri Lanka. Many children fail to achieve their basic right to education due to various reasons such as child labour. According to the reports of the International Labour Organization (ILO), child labour is frequently used in the following generic sectors: agriculture, services, and industry. In Sri Lanka, poverty is one of the main reasons for child labour. Hence, children are unable to access education and school dropout rates are on the increase. These children are not only being deprived of their right to education, but also access to higher education and decent employment opportunities in the future. Irrespective of certain positive steps taken to enhance child rights, statistics indicate that children are currently engaged in economic activities that affect their education. Some of them are even engaged in hazardous activities that are detrimental to their health.

The research establishes that legislative intervention is needed in order to revisit the existing legal framework to ensure that the best interest of the child is protected. It is expected that this would help to guarantee children's right to education and enable the close regulation of the recruitment of children for labour. This is a qualitative research project, which is inclusive of an analysis of the provisions of international conventions and national legislation.

## **Faculty of Management and Finance**



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## **Message from the Dean**



It gives me a great pleasure to share a few thoughts on the occasion of the Annual Research Symposium of the University of Colombo 2015.

I have truly observed that this year more than 100 researchers have contributed to this symposium. Through this research work, I am happy to note that University of Colombo has not only supported academics financially, but also offered a great platform for them to show some of their thesis research work and motivate them to do meaningful

and appropriate studies.

This Symposium has a unique character to accommodate researchers from multiple disciplines. It is great to observe that scholars are enthusiastic and passionate about the quality of their research work, developing knowledge in relevant fields, as well as advancing the research culture in the country.

I congratulate the coordinators and the staff and the organizers of this seminar and wish them all the best.

Dr. R. Senathiraja

Dean/Faculty of Management and Finance

## **Faculty of Management and Finance**

### **List of Abstracts**

- |   |    |
|---|----|
| 1. English language competence requirement as an unintended mode of discrimination in high-performing private sector organisations in Sri Lanka | 60 |
| 2. Employment preference: The case of Generation Y  | 61 |
| 3. The relationship between board characteristics and earnings management – evidence from Sri Lankan listed companies                           | 62 |

**English language competence requirement as an unintended mode of discrimination  
in high-performing private sector organisations in Sri Lanka**

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Although discrimination is a well-researched area in organisation studies, the possibility that organisations' demands for language skills of employees could become a form of discrimination has not been studied so far. However, language *in practice* is not a neutral phenomenon; literature indicates that language can be used for the exercise of power and marginalisation. In Sri Lanka scholars observe that English language competence has been systematically used to undercut opportunities of rural children. This research addressed this issue in the organisational context by examining the legitimacy of the levels of English language skills demanded by high performing private sector organisations in Sri Lanka in their practices of recruitment and promotion to managerial positions. Utilising a social constructionist approach, the study interviewed eight senior managers from eight organisations; the transcripts were analysed using thematic analysis.

The data suggests that the levels of English competence expected by these companies are often higher than the levels required for effective performance of managerial duties, and therefore, is not unambiguously related to performance requirements. The participants readily accepted that this requirement of English skills also tends to accord a favourable position to those who hail from privileged social backgrounds. Thus, expectations of English competence in these companies amount to discrimination. However, even participants who had faced this discrimination and had had difficulty in reaching their current position consider the requirements as legitimate, and all participants seek to improve language skills of the underprivileged, rather than changing organisational practices.

This discrimination is a form of *symbolic violence*. It is accepted as legitimate; it is an exercise of power in a *symbolic* form where neither those who exert the power nor those who are subject to it realise that the basis of the practices are arbitrary social constructions that privilege certain groups over others.

In addition to discriminating against competent individuals from underprivileged backgrounds, these practices are disadvantageous to the companies since they preclude obtaining services of competent employees at higher managerial levels.

## **Employment preference: The case of Generation Y**

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There is anecdotal and research evidence that there are generational differences in values, work attitudes and culture. Few studies have been conducted on the generational differences in work-related attitudes. Although some studies found no generational differences in work-related attitudes, there is a strong belief among employers and society that Generation Y is different in many ways. A generation is defined as a cohort of similarly aged people who experience common historical events. Generation Y is a demographic cohort born between 1983 to early 2000s. This study's aim was to identify the Generation Y's attitude and expectations in terms of employment. This is a descriptive study. Undergraduate students from four Sri Lankan state Universities representing six Faculties were surveyed and 2155 (response rate of 75.55%) returned the completed self-administered questionnaires. This large survey among GenY shows that preference for government employment still persists in quite a percentage. With regard to their expectations in a job, salary/rewards were ranked first, followed by job security and responsibilities to match qualification. The blue chip and other top companies and Banks are organisations which are preferred employers by these respondents. They also like to further their education in other fields to complement their current knowledge. In addition, they viewed various employer characteristics such as exciting working environment, supportive colleagues, and recognition as important. These findings with regard to the characteristics of Generation Y, their work values and attitudes and expectations are useful to offer appropriate policies and practices in the work place as well as for Sri Lankan employers to brand themselves accordingly in order to attract prospective employees.

The author wishes to acknowledge the research grant given by the University of Colombo to conduct this research.

**The relationship between board characteristics and earnings management –  
evidence from Sri Lankan listed companies**

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This paper aims to examine the impact of board characteristics on earnings management in Sri Lanka during the period from 2011-2014. It uses ordinary least squares regression (OLS) to examine the effect of board characteristics such as board size, board composition, board financial expertise and board meetings on earnings management for a sample of 150 listed firms in Sri Lanka. The Kothari, Lenon and Wesley (2005) performance adjusted discretionary accrual model was used to measure the earnings management explained by the discretionary accruals. The findings of the paper showed that there is a significant negative relationship between board composition, board financial expertise and board meetings to the earnings management. Also it was found that there is a significant positive relationship between the board size and earnings management. The findings of this study provide useful information for regulators and the practitioners in the country to understand the significance of board characteristics of firms to constrain the earnings management and enhance the financial reporting quality and transparency.

**Key Words:** Board characteristics, earning management, financial reporting quality, listed firms.

## **Faculty of Medicine**



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Development"

## **Message from the Dean**



The Annual Research Symposium brings together the academic and scientific community of our university. This provides an opportunity to exchange new information and strengthen the bonds among different groups of scientists working in varied domains of science. One of the goals of the Faculty of Medicine, University of Colombo is to be a centre of excellence for research and development in the region. This symposium will no doubt help to demonstrate this capacity and ability. I am hopeful that this event will enhance the professional relationships among researchers leading to building up of a stronger platform for more productive research.

Focusing on collaborative novel outcomes, we have selected the theme ‘Enhancing quality in research and health development’ for this year's research symposium. Multi-stakeholder collaboration in research has become the cornerstone to achieve better health outcomes, as health is affected by social, environmental and economic factors. This needs to be considered in planning research projects. It is also important for researchers to understand that mere publication of a research paper does not achieve the majority of the initially intended outcomes unless the research findings are used for changing practice or policy. This must be considered as a social responsibility of each researcher as most medically related research are conducted using public funds and humans. Ethics play a seminal role in ensuring that research is appropriately conducted as per prescribed guidelines and the benefits reach the wider population.

We at the faculty will be conducting our respective programme with the patronage of our chief guest -Professor Sirimali Fernando, a distinguished alumnus of our Faculty, who is the Professor of Microbiology of the Faculty of Medical Sciences, University of Sri Jayawardanapura, Chairperson of the National Science Foundation, and Chief Executive Officer, COSTI. I wish to thank Dr. Krisantha Weerasuriya, Former Professor of Pharmacology, Faculty of Medicine, University of Colombo, who will deliver the Keynote address and Professor Ajantha Dharmasiri, Director, Post Graduate Institute of Management, University of Sri Jayawardenepura, for delivering the Plenary talk at the symposium.

I thank the Research Symposium Organizing Committee led by Professor Deepika Fernando for organizing an event of this calibre with commitment and dedication. On behalf of the academics, administrators and the support staff of the Faculty of Medicine, University of Colombo, I send the organizing committee and all the participants of this Annual Research Symposium 2015, my sincere good wishes for a very productive and successful event.

Professor Jennifer Perera  
Dean, Faculty of Medicine

## Faculty of Medicine

### List of Abstracts

1.	<b>Keynote Address</b>	
	Universal health care in Sri Lanka: Failures and/or successes over 75 years	68
2.	<b>Plenary Lecture</b>	
	Academics as thought leaders: Promises and pitfalls	69
<b>Symposium: “Shaping the future of research for University Academics”</b>		
3.	How to secure funding for Research	70
4.	Bridging the gap between research and patient care	72
5.	Forming networks for research promotion	73
<b>Oral Presentations</b>		
6.	Validation of the Sinhala version of the eight item Morisky Medication Adherence Scale (MMAS-8) to determine medication adherence in patients with bipolar affective disorder on lithium therapy	75
7.	Vitamin B <sub>12</sub> levels and neurophysiological parameters in patients with diabetes mellitus on long-term metformin treatment	77
8.	Knowledge with regard to human leptospirosis infection in the Colombo district	78
9.	End of course views of students on the MBBS curriculum of the Faculty of Medicine, Colombo.	79
10.	Tracer study of early career graduates of a selected cohort of the Faculty of Medicine, University of Colombo	80
11.	A study on seroprevalence of cutaneous leishmaniasis in Sri Lanka using a locally developed enzyme-linked immunosorbent assay	81
12.	Whole-genome sequencing of ‘Godawee’ an indigenous Sri Lankan salt-tolerant rice variety ( <i>Oryza sativa indica</i> )	82
13.	Novel point mutation in the promoter region of the <i>inhA</i> gene causing isoniazid (INAH) resistance in clinical <i>Mycobacterium tuberculosis</i> (MTb) isolates in Sri Lanka	83
14.	Modification of existing protocol for neural stem cell (NSC) differentiation using low-cost matrices and NSC population assessment of mouse neurogenic zones	84
15.	A child with hyperlipidemia caused by a novel mutation in LPL gene	85

## Poster Presentations

16. Clinico-epidemiological pattern of cutaneous leishmaniasis in Sri Lanka	86
17. Determination of <i>in vitro</i> equivalence of selected Amoxicillin 500 mg capsules available in Sri Lankan market	87
18. Macrophage derived immunological markers in cutaneous leishmaniasis due to <i>Leishmania donovani</i>	88
19. Comparative study of cell viability, morphology and karyotype of the amniotic membrane before and after cryopreservation	89
20. Differentiation of endothelial cells from umbilical cord derived mesenchymal stem cells	90
21. Differentiation of osteogenic cells from umbilical cord derived mesenchymal stem cells	91
22. Assessment of malaria transmission intensity using anti-MSP1 <sub>19</sub> ( <i>Plasmodium vivax</i> ) antibody as a serological marker in Kurunegala district	92
23. Visceralizing potential of <i>L. donovani</i> in Sri Lanka: use of a BALB/c mouse model	93
24. Perception of web-based learning management system among medical undergraduates in the Faculty of Medicine, Colombo, Sri Lanka	94
25. Neurophysiological and biochemical parameters in patients on long term statin treatment; a case-control study	96
26. Tetrazolium-based colorimetric assay for antibiotic susceptibility testing of rapidly growing nontuberculous Mycobacteria	97
27. Preliminary findings of a study on knowledge, attitudes and experiences in parents of children admitted with acute febrile seizures	98
28. Medical and Physiotherapy undergraduates' perception on the importance of the roles of a medical teacher	99
29. Compliance on hand hygienic practices among health care workers – An observational audit in a tertiary care centre	100
30. Screening first degree relatives for fragile X syndrome carrier status	101
31. Trends in leadership skills among first and final year medical students and their lecturers	102

## **Keynote Address**

### **Universal health care in Sri Lanka: Failures and/or successes over 75 years**

*Dr. Krisantha Weerasuriya*

*Former Professor of Pharmacology, Faculty of Medicine, University of Colombo.*

Universal Health Care (UHC) ensures that all people obtain the health services they need without suffering financial hardship when paying for them. This requires a strong, efficient, well-run health system; a system for financing health services; access to essential medicines and technologies; a sufficient capacity of well-trained, motivated health workers.

Sri Lanka implemented UHC from the 1930s and has achieved impressive results with “hard” indicators such as infant, under 5 and maternal mortality. What have been the factors that contributed to the initiation and maintenance of UHC? Were there factors outside health that contributed? What may have been the innovative (for the particular time periods) strategies that contributed to the success?

On the other hand, where have been the missed opportunities to make the system more efficient and measure soft indicators such as patient satisfaction? Has there been a planned expansion of health workforce or is it one that has been distorted by promotion of self-interest by different groups? What has been the role of regulation in achieving the objective of UHC? Has the voice of the ultimate beneficiary of UHC (the patient) been heard or decisions made on their behalf by the decision makers?

The presentation will be a necessarily selective perspective that will provide few answers and will leave many questions unanswered. The objective is to start the process of thinking about the answers.

## **Plenary Lecture**

### **Academics as thought leaders: Promises and pitfalls**

*Professor Ajantha S. Dharmasiri*

*Director, Postgraduate Institute of Management,  
University of Sri Jayewardenepura.*



Academics have multiple roles to play. They have to think and act as knowledge creators as well as knowledge sharers. In doing so, they engage in *exploration*, *explanation*, and eventually, *exclamation*. Academics influence the attitudes and aptitudes of student community. This is where the “thought leadership” comes into the forefront. Superiority in scientific thinking, blended with socio-cultural realities, is what an academic should smartly possess. It qualifies them to join the constellation of thought leaders. In fact, leadership is not about positions and titles but decisions and actions. It refers to a mindset of *influencing*, *inspiring*, and *instructing*. Leaders as opposed to laggards, deliver results. As has been observed, leadership is a vastly explored but least understood phenomenon on earth. Many definitions of leadership in the limelight portray its multi-dimensional nature. Academics should shift from their perennial plight of “publishing or perishing” to a new paradigm of thought leadership. Such a transformation requires *vision* and *passion*. Overcoming socio-economic as well as religio-cultural barriers in moving ahead with a strong intrinsically-driven motivation is the need of the hour. It requires a persevering personality and a conducive climate. Whether our academics are geared for such an endeavour, or whether our academic institutions have such an environment, could be worthy points to ponder. The individual as well as institutional responses in recognizing the need to encourage research and teaching and responding with required resources are vital for sustained thought leadership. In such a context, academics should not only be cognitively intelligent, but emotionally and spiritually as well. It requires a holistic approach towards life, encompassing work-family-society *harmony*. At the end of the day, academics have to be worthy human *beings* rather than human *doings* in order to depict values in action. Hence, academics should be properly aware of promising prospects and possible pitfalls in their continuing journey of thought leadership.

## ***Symposium: “Shaping the future of research for University Academics”***

### **How to secure funding for Research**

*Dr. Neelika Malavige*

*Department of Microbiology, University of Sri Jayewardenepura.*



Currently all universities in Sri Lanka are predominantly undergraduate teaching universities with very limited research output, resulting in low world rankings. Many academics are criticized for their poor research output and inadequate focus on research. The initial and most important step in beginning a research project is securing funding.

Many local research organizations such as the National Research Council and the National Science Foundation and many international organizations such as the National Institute of Health, Wellcome Trust and the ICGEB, provide research grants to Sri Lankan scientists. However, all research grants are awarded in a competitive basis and one of the key factors that are considered is whether the research proposal will provide ‘value for money.’ As all granting agencies have limited funds whether they are local or international bodies, they will seek to fund the best research proposals, which will benefit the majority. Therefore, the three main factors that are considered when making such decisions would be the quality of the research proposal, the track record of the applicant and the available resources in order to carry out the project.

Since funds are limited, research proposals which aim to address diseases affecting the majority or those that are likely to find solutions to key health problems are more likely to be funded. However, even if the research proposals are based on an important health problem, if the research question and the methodology is flawed, it is obviously unlikely to be funded. Therefore, at the outset it would be important to carefully consider the research topic and the gaps in knowledge. The experiments or other types of research tools used should be meticulously planned and chosen to best answer the research question. It is important to find out what has already been done through a comprehensive literature review.

In addition to the research proposal, the track record of the applicant is of utmost importance. Needless to say, researchers with a good track record are more likely to get funded as the granting organizations will be confident that the grantee is likely to deliver what is stated in the research proposal. As most research grants ask applicants to list the publications in the relevant field, it is important to select a field of research and thrive to be an expert in the chosen field. In addition, it is also important to show the grant organizations that facilities and resources that are needed to implement the research project are available and that the group of researchers will have access to them. In short, the granting agencies should have confidence that the applicant and the team have the knowledge and skills to carry out the research project and adequate facilities and resources are available.

Obtaining the first grant is always the most difficult, due to lack of experience and a good track record. However, what is most important in securing funds is not to give up, learn from reviewer comments and resubmit a better one. Do not give up!

## **Bridging the gap between research and patient care**

*Professor Senaka Rajapakse*

*Faculty of Medicine, University of Colombo.*



There are many different reasons which drive individuals to do research in Sri Lanka. It is an integral part of the life of a university academic to be involved in research, and research output is an important measure of credibility and excellence as an academic. Most postgraduate study programmes have an integrated research component, and postgraduate trainees seek to do research to fulfill these requirements. In Sri Lanka, there is a proliferation of research in the field of medicine; the largest number of publications emanate from the medical field. Only a small proportion of such research is actually aimed at, or translates into, improving patient care. There are many important issues related to patient care in Sri Lanka which are unique to this country, and many research questions which need answers. There is a paucity of research related to the management of locally relevant conditions such as tropical infectious diseases (dengue, leptospirosis and typhus), poisoning due to agrochemicals and plant poisons, and snakebite envenoming. The burden of non-communicable diseases is growing. The epidemic of chronic kidney disease of unknown aetiology is claiming many lives and placing a huge burden on the healthcare system. A coordinated effort to promote locally relevant research aimed at directly improving clinical care is the need of the hour. National funding agencies have recognized the importance of this, and are promoting such research by preferentially funding research into key diseases. There is an urgent need to bring clinically relevant research to the bedside.

## **Forming networks for research promotion**

*Dr. Prasad Katulanda*

*Department of Clinical Medicine, University of Colombo.*



For high quality research work, there should be adequate funds, research infrastructure, expertise and samples. In addition, such research work carried out with much difficulty needs to be published in high impact journals for proper dissemination and visibility.

Research networks are essential when a multi-centre study is to be carried out. When planning to carry out a multi-centre study, one needs to establish a research network to identify institutions, groups or researchers who have access to the target populations of interest in the study. For example if a study is needed to look at genetics of diabetes in South Asians one needs to establish a research network including researchers in India, Pakistan, Bangladesh, Nepal and Sri Lanka.

In research, it is not always an easy task to establish research infrastructure for a planned study. For example, if one is interested in carrying out genetic studies without existing infrastructure for genotyping, it would be extremely costly to develop infrastructure for a single study. In addition investment on such very expensive infrastructure would also be futile unless there are further plans to conduct regular research work using the developed infrastructure. In such situations, the answer would be to form a collaboration or network. Similarly, if one does not have expertise on a particular area of research, such as genetic methods or complex statistical modelling, forming a network would help in finding necessary expertise.

Research funders, especially the international funding bodies such as the Wellcome Trust, Medical Research Council (MRC), National Institute of Health (NIH) and European Union, look at the research outcomes and also whether your findings will be published in high impact journals. They would prefer to fund a research network looking at a research question rather than different groups competing for funds to look at the same research question. For large studies on genetic research on diabetes, Wellcome Trust suggested the researchers to come together rather than separately to fund their research work and enabled the formation of research consortia such as the Wellcome Trust Case Control Consortium.

Finally although the journals look at the quality of research work when it comes to publication, very high impact journals generally have a tendency towards accepting more research publications from reputed research groups rather than unknown individuals. Therefore, it is always useful to be in reputed research collaboration or network, if you are targeting to publish your research in high impact international journals.

## ORAL PRESENTATIONS

### **Validation of the Sinhala version of the eight item Morisky Medication Adherence Scale (MMAS-8) to determine medication adherence in patients with bipolar affective disorder on lithium therapy**

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A main reason for poor response of patients with bipolar affective disorder is poor adherence to therapy. This study aimed to validate the Sinhala version of the eight item Morisky medication adherence scale (MMAS-8) as a measure of adherence to medication among those with bipolar affective disorder.

The MMAS-8 was translated to Sinhala using a standard protocol according to international guidelines, which included seven versions of forward and backward translations from English to Sinhala. Patients with bipolar affective disorder on stable doses of lithium were administered the Sinhala version of the MMAS-8. Criterion validity was assessed using therapeutic serum lithium concentration as the gold standard. Internal consistency was assessed using Cronbach's alpha, and Spearman's rank correlation was used to assess test-retest reliability where the MMAS-8 was re-administered to 46 patients after two weeks. Concurrent validity was assessed using Spearman's correlation coefficients between lithium concentrations and MMAS-8 scores.

The mean age of the 240 patients included were 45.3 (range 18-73 years), and 127 (52.9%) were male. Of the 240 patients, 197 (82%) were considered adherent, with serum lithium concentration > 0.4 mEq/L, and 43 (18%) were considered non-adherent with serum lithium concentration ≤ 0.4 mEq/L. The mean MMAS-8 score was  $6.9458 \pm 1.3$ . A cut-off value of 6.875 provided the best balance between sensitivity (81.4%) and specificity (30.5%). The test-retest reliability value was 0.58 ( $p < 0.001$ ). Lithium concentrations correlated with the MMAS-8 scores ( $r = -0.133$ ,  $p < 0.05$ ).

Moderate internal consistency was found (Cronbach's alpha = 0.599) for the eight items of the scale. The lowest discriminatory value came from the question on taking medications the day before

the questionnaire was administered. The highest discriminatory value came from not being able to take medication within the past two weeks for reasons other than forgetting.

Due to the low specificity and reliability it is concluded that the Sinhala version of MMAS-8 is not a good tool at determining medication adherence to mood stabilizers in patients diagnosed with bipolar affective disorder in Sri Lanka. It is recommended to explore whether revisions will improve validity and reliability.

## **Vitamin B<sub>12</sub> levels and neurophysiological parameters in patients with diabetes mellitus on long-term metformin treatment**

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Metformin is widely used in treatment of type 2 diabetes mellitus. Metformin is reported to be associated with B<sub>12</sub> deficiency with the B<sub>12</sub> levels negatively correlating with dose and duration of treatment. However, the association between metformin and B<sub>12</sub> levels in the Sri Lankan population is unknown. The objective of the study was to compare serum vitamin B<sub>12</sub> levels in patients on long-term metformin with a control sample and to correlate treatment parameters and neurophysiological parameters with the vitamin B<sub>12</sub> levels.

Ninety six patients (n = 96) with diabetic mellitus on metformin for > 2 years attending medical clinics of National Hospital, Sri Lanka and twenty nine healthy individuals (n = 29; no history of diabetes mellitus and peripheral neuropathy) were studied using an interviewer administered questionnaire and testing HbA<sub>1c</sub> (Fast Ion-Exchange Resin Separation Method) and Vitamin B<sub>12</sub> levels (Immunoassay, reference rang: 200-950 pg/ml). Neurophysiological tests were done using NCV-EMG system-Nicolet Biomedical.

Comparative analysis between patients (n = 96; mean age = 60.76 ± 7.96 yrs) with mean duration of diabetes, duration of metformin treatment and daily metformin dose of 10.48 ± 6.29 years, 8.52 ± 5.38 years and 1492.86 ± 748.74mg respectively, and controls (n = 29; mean age = 56.42 ± 4.64 yrs.) revealed that there was no significant difference between B<sub>12</sub> levels in patients (513.63 ± 307.20 pg/ml) compared to controls (616.42 ± 215.78 pg/ml; p = 0.35). There was no significant difference in HbA<sub>1c</sub> levels in patients (6.32 ± 1.32%) compared to controls (5.6 ± 0.51%; p = 0.26). There were no correlations between HbA<sub>1c</sub> and B<sub>12</sub> levels either in patients (r = 0.19, p = 0.075) or controls (r = 0.25, p = 0.3). There was no significant difference in latencies, amplitudes and conduction velocities of lower limb nerves between patients and control (p > 0.05). There was no significant correlation of B<sub>12</sub> levels with latencies, amplitudes and conduction velocities of lower limb nerves both in patients and control.

Vitamin B<sub>12</sub> levels in patients on metformin were in normal range and did not significantly differ from the control group. Long-term use of metformin in the dosage range used in the patients of the current study had no significant effect on the serum B<sub>12</sub> levels or the neurophysiological parameters tested in the study. Further analysis of the results in relation to clinical scoring and subdivision of B<sub>12</sub> levels into different cut-off values are required to provide further insight to the findings. Further studies on the diet and nutritional state are recommended.

*The study was funded by the National Science Foundation (Research Grant RG/2011/HS/17).*

## **Knowledge with regard to human leptospirosis infection in the Colombo district**

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Surveillance data for leptospirosis shows that 47% of cases are from the Colombo District. This study assessed the knowledge of adults with regard to leptospirosis with the view of developing targeted interventions for prevention of the disease.

A community based cross sectional study was carried out in the Colombo District using two-stage cluster sampling with probability proportion to size. Clusters of 30 households in 27 Grama Niladhari Divisions were selected across all 15 Medical Officer of Health areas. A pre-tested interviewer administered questionnaire was used to collect data. Descriptive analysis was performed on household-level data to determine knowledge of the sample population.

Of 690 participants, 58.3% (402) were women. Over 70% of the population had a primary level of education. Over 85% (596/690) had heard of leptospirosis, of which 43.6% were aware that the mode of transmission was by contact with rat urine. Contact with urine of other mammals was known by 64.1% to cause leptospirosis. Clinical symptoms of leptospirosis were identified correctly by 59.2% of those who had heard about the disease, and the three most common clinical manifestations identified were fever (78.5%), headache (19.3 %) and myalgia (16.1%). While 66.3% believed that leptospirosis could be prevented, 67% stated that prevention was by taking tablets, and 5.4% thought it was possible by a vaccine. It was stated by 79.5% thought that leptospirosis is a curable disease, and 92.3% were aware that it carries a high mortality. The main sources of information on leptospirosis were media sources (47.1%) and word of mouth (39.1%). Only 7.4% had received information from a healthcare worker.

Knowledge regarding leptospirosis in this population in the Colombo district is satisfactory, with over 85% individuals having heard about the disease and 67% knowing about chemoprophylaxis. This is probably attributable to the high literacy rate of the population, the emphasis given by the Medical Officers of Health in the area, and the media which gives publicity to the general public regarding disease prevention.

*We acknowledge University of Colombo research grants (Grant No. AP/3/2/2014/RG/14) for funding.*

## **End of course views of students on the MBBS curriculum of the Faculty of Medicine, Colombo.**

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Obtaining end of course views of students regarding undergraduate medical curricula is carried out for purposes of quality assurance and curriculum revision worldwide. Since 1995 students at Faculty of Medicine, Colombo, follow a five-and-half-year, integrated, system-based medical curriculum comprising five streams. This survey is aimed at evaluating the current medical curriculum at Faculty of Medicine, Colombo. The general objective of the study was to identify student perceptions regarding the current innovative medical curriculum of the Faculty of Medicine, Colombo. Specific objectives were to find the strengths and the weaknesses of the curriculum.

A cross-sectional survey was conducted with final year students just after the final MBBS examination, before the results were released. A self-administered questionnaire was used to obtain the views of respondents. Quantitative data were analyzed by SPSS and results were presented as frequency percentages. Qualitative data on strengths and weaknesses of the curriculum were classified into common themes.

Response rate was 51.5% (101/196). Around 90% of students said that their educational experience on the overall MBBS programme was good. Approximately 70% said that Introductory Basic Sciences Stream objectives were clear. Around 96% and 68% thought that their educational experience in Applied Sciences and Community Streams (ComS) respectively was good. 93% and 96% students rated their educational experience in Behavioural Sciences Stream (BSS) and Clinical Sciences Stream also to be good respectively.

Among the themes that emerged during the analysis, a well organized module system and good variety in clinical appointments were some of the strengths, while increased frequency of assessments, lack of specific objectives and assessments at clinical appointments, lengthy duration of course, inadequate knowledge provided on pharmacology and pathology were some of the areas students thought that need to be improved. Students perceived that BSS and ComS beneficial, but time consuming, although these occupy approximately 2.7% and 3.9% of the timetabled time, respectively.

Although there are areas to be improved, majority of students perceived their educational experience to be good at the completion of the Colombo medical curriculum. Results, however, should be interpreted with caution due to the low response rate.

**Tracer study of early career graduates of a selected cohort of the Faculty of Medicine,  
University of Colombo**

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Colombo.*

Career practice information, including enrolment in postgraduate programmes provides useful data regarding graduate placements and graduate career preferences. The objective of this study was to describe current practice locations of early career graduates in a selected entry cohort of the Faculty of Medicine, Colombo.

This descriptive cross-sectional study traced all registered students of the 2001/2002 intake. Graduates were contacted directly in person, over the phone or via social media. Current designation, postgraduate status and involvement in the government/private health sector were recorded. Where direct contact was not possible, proxy information was obtained from fellow graduates, and cross validated from at least 2 sources.

A total of 195 (M = 99) students were registered and 194 completed the course, with 149 (76.4%) completing final MBBS in the first attempt. Three were Bhutanese students. Tracing was done six years after internship. Details of 175/194 graduates (90.2%, M = 86) were available for analysis. Details were obtained through direct contact (phone/personal contact, 71.4%), social media (21.1%) and by proxy (7.5%). Of the 172 Sri Lankan respondents, 140 (80%) were working for the Ministry of Health, 2 (1%) in the University sector, and 1 (0.5%) full time in the private sector. One was not in active service and 31 (17.7%, M = 16) had migrated. The majority (n = 106) were stationed in Colombo, A total of 105 (60%) had pursued postgraduate studies. Popular specialties were Medicine and related subspecialties (n = 26), Surgery and related subspecialties (n = 10), Anaesthesia (n = 9), Paediatrics (n = 9), Pathology (n = 9), Psychiatry (n = 7) and Community Medicine (n = 7). Enrolment in postgraduate programmes was not significantly associated with gender or migrant status ( $P > 0.05$ ).

Details of a vast majority of graduates of the selected cohort were traced. Although most worked for the Ministry of Health, Sri Lanka, close to one fifth had migrated. Majorities have pursued postgraduate studies, with Medicine being the most common career choice. While limited to a single cohort, this study provides useful information for curriculum planners.

**A study on seroprevalence of cutaneous leishmaniasis in Sri Lanka using a locally developed enzyme-linked immunosorbent assay**

M.A.B. Deepachandi,<sup>1</sup> N. Ali,<sup>2</sup> S.S.S.B.D.P. Soysa,<sup>1</sup> N.D. Karunaweera,<sup>1</sup> and H.V.Y.D. Siriwardana<sup>1</sup>

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<sup>2</sup>Indian Institute of Chemical Biology, Kolkata, India.

*Leishmania donovani*, a usually visceralizing and the most virulent species in the genus results in cutaneous leishmaniasis (CL) in Sri Lanka. Though CL is generally not considered to evoke a humoral immune response, serological studies would be important due to the immunogenic nature of the causative agent. This study evaluated the sero-prevalence of local CL using an indirect enzyme-linked immunosorbent assay (ELISA).

An indirect ELISA based on crude Ag of local *L. donovani* promastigotes was optimized. The ELISA was evaluated using the sera from 101 CL patients collected from 2002 to 2015, 70 endemic healthy controls (EHC) and 55 patients with other skin diseases (NCL). Clinico-epidemiological and experimental data were cross analyzed using SPSS version 19.0.

There were n = 29/101 (28.7%) seropositive patients among the CL group. None of the sera from EHC or NCL were positive. There were no significant relationships between sero-positivity and year of sample collection ( $P > 0.05$ ). Sero-prevalence was more in children and teenagers up to 20 years old when compared to older patients. Sero-prevalence was comparable between males and females up to 20 years of age, but the seropositive rate was higher in females than males after 40 years. Most of early stage (up to 6 months) lesions were seropositive (n = 19/27, 70.4%) than chronic (greater than 6 months) lesions (n = 8/27, 29.6%). Among the chronic lesions, lesions greater than 12 months did not include seropositive lesions. At early stages, most of the seropositive lesions were not ulcerated (n = 10/19, 52.6%) while most of seropositive lesions were ulcerated in the chronic stage (n = 5/8, 62.5%). Within the seropositive group, most lesions were single (n = 24/29, 82.8%), ulcerated (n = 14/27, 51.9%) with the size of up to 3 cm (86.7%).

This study points towards the presence of a serological response in a proportion of CL patients. Relevance and clinical/prognostic significance are being investigated. Sero prevalence may also suggest the visceralization potential in a proportion of locally acquired *L. donovani* infections which is under study at present.

We acknowledge University of Colombo research grant (AP/3/2/2014/RG/13) and National Institute of Health research grant (1RO1AI099602) for funding.

## **Whole-genome sequencing of ‘Godawee’ an indigenous Sri Lankan salt-tolerant rice variety (*Oryza sativa indica*)**

*S. Singhabahu, C. Wijesinghe, D. Gunawardene, and V.H.W. Dissanayake*

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‘Godawee’ a Sri Lankan traditional rice variety known for its salinity tolerance has been sequenced as an initial step of a whole genome-based polymorphism study to identify genes involved in salinity tolerance and the effects of their variants through analysis of single nucleotide polymorphisms (SNPs) and insertions/deletions (InDels).

Whole genome sequencing of ‘Godawee’ rice variety using Illumina Miseq platform generated 11.5 GB of extremely high quality sequence data (45 million sequencing reads). Extremely high quality sequence reads were first mapped to *Oryza sativa indica* Reference ASM465v1 using BWA software. Overall mapping rate of 91.64% and 24x depth of coverage was obtained with duplicate masking. Unmapped reads (8.36%) were filtered out and further analyzed by *de novo* assembling using ABySS-Pe. Since the average rice gene is 3223 bp in size, the resultant contigs filtered out according to their lengths with 1890 sequences >1000bp and 6688 sequences < 1000bp followed by annotation using Blast2GO software.

Calling of single nucleotide polymorphisms (SNPs) and insertion deletions (In-dels) of ‘Godawee’ with regards to reference genome resulted in total 4,334,404 variants prior to quality filtering. Quality filtering produced 3,242,518 of SNPs and 586,808 of InDels. The highest total number of variants was found to be on chromosome 1 (423,088) whereas the lowest was on chromosome 9 (245,321). The average number of variants per chromosome was calculated to be 319,111 at the rate of one variant for every 97 bases. Analysis of SNPs resulted in 607,372 number of effects by functional class, including 342,641 (56.414%) of missense mutations, 13,485 (2.22%) of nonsense mutations and 251,246 (41.366%) of silent mutations. Salt tolerant genes (STRGs) of salt tolerant pathways consist of approximately 23 known genes in rice. The 23 STRGs contained 3609 SNPs and 869 InDels. HKT (high affinity potassium transporter) gene exhibited the most number of missense mutations (38). Further analysis on mutations of HKT and other salinity tolerance gene functions using computational production algorithms are underway.

Salinity tolerance of ‘Godawee’ could be due to the variants in HKT and other salinity tolerance genes in the pathway which may be contributing towards decreasing Na<sup>+</sup> levels within the cytoplasm. Further, functional analysis is underway in order to confirm the effects of these variants.

**Novel point mutation in the promoter region of the *inhA* gene causing isoniazid (INAH) resistance in clinical *Mycobacterium tuberculosis* (MTb) isolates in Sri Lanka**

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The emergence and spread of drug resistant tuberculosis poses a threat to tuberculosis control in Sri Lanka. INAH is an important first line drug in anti-tuberculosis therapy. The promoter of the *fabG1(mabA)–inhA* operon (*inhA* promoter) is a significant region for isoniazid resistance. The objective of this study was to identify *inhA* gene mutations of INAH resistant MTb strains in Sri Lanka.

Sixteen INAH resistant MTb isolates were used for this study. Acid Fast Bacilli positive sputum samples were collected from Central Chest Clinic, Colombo. Decontaminated sputum was cultured on LJ medium and drug susceptibility testing was carried out using the agar proportion method (APM). The total sample included INAH resistant isolates identified by APM (n = 8) and INAH resistance confirmed cultures (n = 8) directly collected from the National Tuberculosis Reference Laboratory.

Genomic DNA was extracted by the phenol chloroform method. Two primer sets were designed to amplify regions flanking the *inhA* promoter region and the entire *inhA* gene by Polymerase Chain Reaction. DNA sequences of amplified products were analyzed using BioEdit7.2.5 software and NCBI sequence alignment tools.

DNA sequence analysis revealed the presence of two point mutations at -15 [(C to T), (n = 1, 6.25%)], at -34 [(C deletion), (n = 4, 25%)] in the promoter region of *inhA* gene and one point mutation at codon3 [(GGA to GGC), (n = 1, 6.25%)] in the structural *inhA* gene.

Although the point mutation at -15 has been reported as the most common *inhA* mutation worldwide, it was observed only in a single isolate (6.25%). The structural gene mutation at codon3, found in one isolate (6.25%), has been previously reported with low frequency. However, to confirm these mutation frequencies it is important to analyze a larger sample of INAH resistant isolates.

The C deletion mutation at -34 promoter region is a novel mutation and has not been previously reported globally. The novel mutation and its high frequency emphasize the need for raising the geographical profile of the mutations to develop a rapid molecular detection method for drug resistant MTb isolates in Sri Lanka.

National Research Council (Grant No: NRC 12-140) is acknowledged for funding.

## **Modification of existing protocol for neural stem cell (NSC) differentiation using low-cost matrices and NSC population assessment of mouse neurogenic zones**

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Neural stem cell (NSC) differentiation protocols traditionally use poly-D-lysine, laminin and Matrigel, which are expensive, as neurosphere attachment matrices. There are no published reports regarding NSC growth on less expensive and more widely available matrices such as collagen and gelatin. *In-vitro* grown NSCs are vital for research into neurological diseases and injury. Readily available sources of NSCs are scarce, therefore it is important to identify suitable neurogenic sites for NSC harvesting and develop low-cost protocols for NSC growth. Variations in NSC density in the hippocampus and lateral ventricle regions of the mouse brain, and parallels between mouse and human brains have been reported.

The aims of this study were to modify an existing protocol for *in vitro* differentiation of NSCs using low-cost alternatives to traditionally used matrices, and isolate and expand mouse neural progenitor cells from the hippocampus and lateral ventricle regions to assess the NSC density.

Ethical clearance was obtained from the Ethics Review Committee of Faculty of Medicine, Colombo. Tissue sections from the hippocampus and lateral ventricle regions of two, 8-week-old ICR strain mice were dissected and grown in NSC culture media (Stemcell) according to standard protocol. At passage 2, neurospheres were transferred to collagen, gelatin, and negatively ionised tissue culture plates (control), and were observed for neuronal differentiation. Neuronal differentiation was confirmed by cytoplasmic nestin IgG1 antibody staining and nuclear DAPI counterstaining.

NSCs differentiated on both collagen and gelatin matrices but not on the control tissue culture plate. NSC density in the lateral ventricle region was significantly higher ( $p = 0.038$ ) and passage 0 lateral ventricle derived NSCs were more prominent and compact than NSCs derived from the hippocampal region. The differentiated NSCs stained positively for the neural stem cell marker, nestin.

The novel finding of this study was that gelatin and collagen can be used as low-cost alternative matrices for NSC differentiation; this requires validation by further studies. The results obtained for NSCs in the hippocampal and lateral ventricle regions of the mouse brain are comparable with previously reported data on mouse NSCs. No COI.

## **A child with hyperlipidemia caused by a novel mutation in LPL gene**

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An 8-month old child was presented to the Human Genetics Unit of the University of Colombo, born to consanguineous parents. Despite the parents being normal, patient had high levels of serum triglyceride (1500 mg/dl) and VLDL Cholesterol (300.04 mg/dl), thus being diagnosed with hyperlipidemia. Nevertheless, development of the child was appropriate to the age and had normal feeding patterns. The objective of this study was to identify the genetic aetiology underlying this condition.

Exome sequencing was performed in pooled samples of the patient-parent trio on Illumina Miseq next-generation sequencer. Variants were identified from the paired end nucleotide sequences using an in house developed variant calling and annotation pipeline. A virtual panel consisting of genes with confirmed association to dyslipidemic disorders was used to filter out benign variants. Potential candidate variants were scrutinized for their functional impact on proteins, presence in publicly available databases and the level of conservation. Pathogenicity of the variant was further confirmed by performing *in silico* function prediction of the mutation.

The aforementioned analysis criterion identified a homozygous SNP (NM\_000237: c.808C>G); (NP\_000228: p.Arg270Gly) in the “lipoprotein lipase” (LPL) gene of the proband as pathogenic for the hyperlipidemia condition. This causes a non-synonymous substitution in the amino acid sequence of the LPL protein thus altering the tertiary structure and predicted to be leading to a functional loss. Parents were proven to be carriers for the mutation. This is a novel variant which has not been previously recorded in the database for short genetic variants (dbSNP) and 1000 Genomes Project and Exome variant server databases. Furthermore, this variant resided in a highly conserved region of the gene and was universally predicted to be deleterious by *in silico* functional prediction tools. The clinical synopsis of the patient was matched to the autosomal recessive HyperLipoproteinemia, Type 1 (MIM 238600).

This case study emphasizes the need for exome sequencing as an accurate and efficient approach in understanding the aetiology of unexplained familial cases with complex lipid metabolic traits. To the best of our knowledge this is the first time that this approach has been used to diagnose a patient in Sri Lanka.

POSTER PRESENTATIONS

**Clinico-epidemiological pattern of cutaneous leishmaniasis in Sri Lanka**

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Cutaneous leishmaniasis (CL) is a parasitic disease endemic to Sri Lanka. Identification of emerging trends in immunological and clinical presentations would be extremely important in designing control methods since CL has become a major health problem today. Nevertheless, the clinico-epidemiological pattern has been studied for the CL epidemic in Sri Lanka at different time points, and a retrospective study was carried out to identify the clinical and epidemiological trends of latter part of the CL epidemic in Sri Lanka.

A heterogeneous group of suspected 110 patients referred for diagnosis of CL to Department of Parasitology, Faculty of Medicine, University of Colombo, from 2012 to 2015, were studied. Parasitological identification was done using microscopy and culture. Clinico-epidemiological data and laboratory results were cross-analyzed using SPSSv19.0.

Patients were referred from Western (n = 63/110, 57.3%), Southern (n = 23/110, 20.9%), North-Western (n = 9/110, 8.2%) and North-Central (n = 8/110, 7.3%) provinces of Sri Lanka. Diagnosis of CL was confirmed in n = 67/110 (60.9%) patients with 7, 20, 24 and 16 patients in years 2012, 2013, 2014 and 2015 respectively. Most positive patients originated from Southern (n = 17) and Western (n = 34) provinces. CL was more common in males (n = 14/15, 93.3%) than females (n = 8/13, 61.5%) in the period of 2012 to 2013 ( $P = 0.041$ ). Positive patients represented different lesion patterns [plaques (n = 25/67, 37.3%: mean = 2.1 months), nodules (n = 15/67, 22.4%: mean = 2 months), ulcerating-nodules (n = 7/67, 10.4%), complete ulcer (n = 6/67, 9.0%) and other (n = 14/67, 20.9%)]. Duration of lesions ranged between 2 weeks to 36 months with the mean of 6.4 months. Analysis of lesion distribution in the body showed that most of the lesions (n = 22/67, 32.8%) were on face and neck area, n = 20/67 (29.9%) on arms, n = 9/67 (13.4%) on leg/foot, n = 13/67 (19.4%), and in other areas. There were no significant relationships in number of lesions and diameter of induration with positivity for CL ( $P > 0.05$ ).

Although the disease cannot be confirmed by clinical characteristics only, findings suggest that conjunction of epidemiological and clinical characteristics with laboratory data will enhance the diagnostic efficiency and accuracy of cutaneous leishmaniasis, leading for successful disease control in Sri Lanka.

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**Determination of *in vitro* equivalence of selected Amoxicillin 500 mg capsules  
available in Sri Lankan market**

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Biopharmaceutics Classification System (BCS) based biowaiver studies 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 as recommended by the WHO. The objective of this study was to see whether two selected generic brands of amoxicillin 500 mg capsules, (a BSC class 1 drug according to WHO classification), are equivalent to the innovator product using the *in vitro* dissolution methodology. If equivalence can be shown in an *in vitro* dissolution study, an expensive *in vivo* bioequivalence study is not required for registration with the Regulatory Authority.

Axcil 500 mg tablets from Astron Ltd and amoxicillin 500 mg tablets manufactured by the State Pharmaceutical Manufacturing Corporation (SPMC) were selected as test products. Amoxil 500 mg from GlaxoSmithKline was used as the innovator product. Pharmacopoeial quality tests (BP 2012 and USP 2011) were conducted for the selected products. The *in vitro* biowaiver study was done in a Pharmatest dissolution apparatus, validated after installation qualification (IQ), operational qualification (OQ), and performance qualification (PQ) testing. De-aerated USP buffer media of pH 1.2, 4.5 and 6.8 on 12 capsules each was used with basket apparatus at 100 rpm at 37°C. Samples were withdrawn at 10, 15, 20, 30, 45, and 60 min intervals and analyzed using a Shimadzu HPLC system with a C8 column, pH 4.5 KH<sub>2</sub>PO<sub>4</sub> buffer and acetonitrile 95:5. Absorbance was measured at 229 nm. The analytical method was validated for five parameters.

Dissolution time profiles were constructed using percentage amount dissolved vs. time. Difference factor ( $f_2$ ) and similarity factor ( $f_1$ ) were calculated for each product. At pH 1.2 both test drugs and the innovator showed very rapid dissolution (>85% in 15 min.). Thus calculation of  $f_2$  was not necessary. At pH 4.5,  $f_2$  was 52 and 35 and  $f_1$  was 11 and 13 for Axcil and SPMC amoxicillin respectively. At pH 6.8,  $f_2$  was 50 and 77 and  $f_1$  was 14 and 3 respectively for Axcil and SPMC amoxicillin. Dissolution profiles are considered similar if  $f_2$  is  $\geq 50$  and  $f_1$  is  $\leq 15$ .

All 3 products passed pharmacopoeial quality requirements. Only one product out of two was *in vitro* equivalent to the innovator product, and thus therapeutically equivalent. SPMC amoxicillin requires an *in vivo* bioequivalence study to show interchangeability.

**Macrophage derived immunological markers in cutaneous leishmaniasis due to  
*Leishmania donovani***

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Leishmaniasis has a spectrum of manifestations which includes cutaneous, mucosal and visceral disease. The clinical outcome of *Leishmania* infection is determined primarily by the infecting species and the immune response of the host. Sri Lanka is endemic for localised cutaneous leishmaniasis (LCL) caused by *Leishmania donovani*; a species which usually causes visceral disease. We hypothesized that distinct alterations in the innate immune response contributed to the outcome of infection observed in Sri Lanka. The aim of this study was to characterize the immune response in LCL by macrophages, which is central to both replication and elimination of the parasite. Preliminary findings are presented.

Peripheral blood mono nuclear cell (PBMC) derived macrophages from newly diagnosed LCL patients (n = 8) and healthy non endemic controls (n = 8) were differentiated for 6 days *in vitro* and stimulated with *L. donovani* antigen (50 µg/ml). IL-10 and nitric oxide (NO) production were measured by ELISA and Griess reaction respectively, in the macrophage culture supernatant harvested at pre-determined time intervals. The two groups were compared using Student's T-test for parametric data and Mann-Whitney test for non- parametric data.

Patients consisted of four males and four females, with single cutaneous lesions. The duration of lesions ranged from one month to two years. None showed evidence of secondary infection. Macrophages from LCL patients produced a higher level of IL-10 production at 72 hours when compared to controls (p < 0.01). However IL-10 production did not vary markedly between the two groups at 24 and 48 hours. Levels of production of NO remained similar in patients and controls at 24 hours.

These data suggest that IL-10 may play a role in determining disease outcome in LCL due to *L. donovani*. The findings should be interpreted in the context of changes in other inflammatory mediators to better understand the underlying pathogenic mechanisms.

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## **Comparative study of cell viability, morphology and karyotype of the amniotic membrane before and after cryopreservation**

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Amniotic membrane (AM) due to its anti-inflammatory, anti-scarring and anti-angiogenic properties is used as corneal and wound grafts. When developing AM tissue banks, cell viability, membrane morphology and genomic stability should be preserved following cryopreservation. The objective of the study was to analyze the changes rendered to the AM during the process of cryopreservation by comparing different combinations of standard cryopreservation media such as fetal bovine serum (FBS), dimethyl sulfoxide (DMSO), dulbecco's modified eagle's medium (DMEM) and glycerol at -80°C and at -196°C for a period of 6 weeks.

Following ethical clearance, placentae of healthy term pregnancies delivered by elective Cesarean Section were collected and AM separated in to 5x5cm size sections, obtained under sterile conditions and stored in 9:1 DMSO+FBS and 1:1 DMEM+Glycerol at -196°C and -80°C for 6 weeks. After 6 weeks the following were assessed; AM epithelial cell viability by trypan blue vital stain, membrane morphology by H&E stain, genomic stability by conventional G- banded karyotyping and epithelial cell proliferation capacity by cell doubling time; cells were cultured in DMEM+10% FBS in humidified atmosphere of 5% CO<sub>2</sub> at 37°C. All these parameters were also assessed in fresh AM.

AM were obtained from 4 term placentae. Mean cell count and mean cell doubling times in days respectively; for fresh AM  $3.8 \times 10^5$ ; 1.59, after 6 weeks in DMSO+FBS at -196°C  $3.0 \times 10^5$ ; 2.38 and at -80°C  $2.1 \times 10^5$ ; 1.60, in DMEM+ Glycerol at -196°C  $3.6 \times 10^5$ ; 2.33 and at -80°C  $2.3 \times 10^5$ ; 1.66. H&E sections from fresh AM showed an intact epithelial monolayer, thick basement membrane (BM) and avascular stromal matrix. AM at -196°C showed morphology similar to fresh AM in both preservation media. AM at -80°C showed disruption of the stromal matrix. Fresh AM karyotype was 46XX. Analyzable spreads for karyotype were not obtained from stored AMs.

AM is best preserved at -196°C either in DMSO+FBS or DMEM+glycerol, which preserves both cell viability and membrane integrity up to 6 weeks. We cannot comment on the genomic stability of the cryopreserved membranes as we couldn't obtain analyzable chromosome spreads from cell cultures.

## **Differentiation of endothelial cells from umbilical cord derived mesenchymal stem cells**

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Multipotent differentiation capability of mesenchymal stem cells (MSC) and their immunosuppressive qualities, have been the basis of their use in tissue regeneration. Differentiation of MSCs into endothelial cells has been less explored. Endothelial differentiated cells show a characteristic polygonal shape with secretory vesicles. Endothelial cell derived vascular models are used for drug screening and as vascular grafts.

Our objective was to establish protocols for isolation of MSCs from umbilical cord (UC) Wharton's jelly (WJ) and umbilical cord lining (UCL), and differentiation of MSCs derived from WJ (WJ-MSC) and UCL (UCL-MSC) into endothelial cells.

Ethical approval was obtained and, UC from a healthy mother undergoing elective Caesarean section was collected into sterile phosphate buffered saline containing antibiotics and antimycotics and transported to laboratory. Vascular tissue and blood were removed, and under aseptic techniques, WJ and UCL were minced, and digested overnight using type 1 collagenase, and cultured in standard tissue culture media containing knock out Dulbecco's Modified Eagle's medium (DMEM) containing 10% foetal bovine serum (FBS) and MSC differentiation media (MesenCult™-SF Culture Kit). Flow cytometry analysis was performed to confirm MSC lineage using markers CD34, CD45, CD73, CD90, and CD105. At passage 1, endothelial cell differentiation media (endothelial growth media 2; LONZA - containing FBS and vascular endothelial growth factor (VEGF)) was added to WJ-MSCs and UCL-MSCs and cell morphology was observed for endothelial cell differentiation.

MSCs showed fibroblast like spindle shaped morphology, and were plastic adherent and were positive for MSC markers and negative for haematopoietic and leucocyte markers (CD 73+(86%), CD90+(99%), CD 105+(39%), CD34-, CD45-). The time taken for 80% confluency using standard media and MSC differentiation media for UCL and WJ were 17 and 21 days respectively. Initial features of endothelial differentiation appeared at approximately 12 days in WJ-MSC, and 10 days in UCL-MSCs. Differentiated WJ-MSCs displayed characteristic polygonal shape with vesicular cytoplasm of endothelial cells.

This study established protocols for isolating UC-MSCs using standard and specific culture media. Differentiation into endothelial cells needs to be confirmed using specific markers and our findings need to be verified by studying larger numbers.

## **Differentiation of osteogenic cells from umbilical cord derived mesenchymal stem cells**

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Mesenchymal Stem Cells (MSCs) are plastic-adherent, fibroblast-like cells with specific surface phenotype, having the ability to differentiate into osteoblasts, chondroblasts and adipocytes *in vitro*. Umbilical cord (UC) is a readily available source of MSCs without ethical constraints. Lower MSC numbers are obtained from adult tissue with age, with longer cell doubling times, and lower differentiation potential *in vitro*, unlike more primitive UC-derived MSCs (UC-MSCs). The objective of the study was to derive MSCs from the human UC Wharton's Jelly (WJ) and differentiate to osteogenic cells.

Following obtaining ethical approval, UCs from healthy mothers undergoing elective Caesarian sections were collected, cleaned with phosphate buffered saline and blood vessels were removed. WJ was subjected to overnight 0.2-0.5% collagenase digestion and cultured in complete media (DMEM supplemented with 10% FBS, 1% L-glutamine and 1% penstrep) at 37° C in 5% CO<sub>2</sub>. Cells were refed every 3-4 days with media, and passaged at 70%-80% confluency. At passage4(P4), osteogenic basal medium (1mg/ml ascorbic acid, 1nM dexamethasone and 1mM β-glycerophosphates) was added and incubated at 37°C, in 5% CO<sub>2</sub>. Culture was fed every 2-3 days and maintained for 21 days. On day 21, media was removed and cells were fixed in 4 % paraformaldehyde and stained with 2% Alizarin red and Von Kossa stains. Cell viability was determined by trypan blue test. . Flow cytometry analysis was performed for positive; CD73, CD90, CD105, and negative MSC markers; CD45 and CD 34. Oct4 and G6PD gene expression in MSCs were analyzed by RT-PCR. G-banded karyotyping was carried out in MSCs and differentiated cells.

Five UCs were processed. Cultured cells were plastic-adherent showing fibroblastic spindle shape morphology. They were positive for CD90, CD73 and CD105 and negative for CD34 and CD45 markers. They expressed Oct-4 and G6PD. Karyotypes were normal. Alizarin red stain gave bright orange red and Von kossa stain gave black-brown deposits demonstrating presence of extracellular calcium deposits.

A UC MSC line was established for future therapeutic application. Oct-4 expression demonstrated the embryonic origin of the MSCs, which maintained a genomic stability up to P4. Differentiating UC-MSCs into osteogenic cells opens up new perspectives for cell-based bone tissue engineering.

## Assessment of malaria transmission intensity using anti-MSP1<sub>19</sub> (*Plasmodium vivax*) antibody as a serological marker in Kurunegala district

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Serological markers have been identified as good indicators of malaria transmission intensity, as evidence of reduction in transmission and elimination. This study assesses the ability of using anti-malaria antibody MSP1 for *Plasmodium vivax* (P.v) malaria to predict changes in transmission intensity.

Serum was collected from 637 individuals and was subjected to standard ELISA to determine the sero-positivity for anti-malarial antibody MSP1 (P.v). Sero-conversion rate ( $\lambda$ ) and sero-reversion rate ( $\rho$ ) were estimated by fitting the OD values to a reversible catalytic conversion model.

Females were 3 times more numerous than the male participants. Age ranged from 1 – 84 years (mean = 43.31 yrs, median = 46 yrs). Study participants were grouped into 4 age groups, *i.e.*, 1-5 years, 6-10 years, 11-20 years and >20 years. Previous exposure was low (18.8%) and the number of individuals with previous exposure was significantly high in the 11-20 and >20 years categories when compared to the other age groups. Over 60% of the population was sero-positive for MSP1 (P.v.) antibody. Sero-prevalence did not significantly differ between the DS divisions, nor between males and females. The number of sero-positive individuals below 10 years were significantly lower than the expected counts, while the number of sero-positive individuals were significantly higher than the expected counts in the 11-20 and >20 year age groups. The association between sero-positivity and malaria exposure was relatively poor and not significant. The age specific sero-prevalence was fitted to a simple reversible catalytic model using maximum likelihood method. The estimated annual sero-conversion for the particular area was  $\lambda_2 = 0.011/\text{year}$ , indicating the transmission intensity is very low in the Kurunegala. This was significantly lower when compared to the sero-conversion rates 30 years ago where the sero-conversion rate ( $\lambda_1$ ) = 0.101 and sero-reversion rate ( $\rho$ ) = 0.030. The maximum log likelihoods indicated that a reduction in *P. vivax* transmission intensity occurred approximately 30 years ago in Kurunegala.

Sero-prevalence of the anti-malarial antibody MSP1 (P. v.) is high in Kurunegala district. The lower (estimated) annual sero-conversion rate for the district indicates the very low active transmission of the disease in the area. Reduction in vivax malaria transmission started approximately 30 years ago.

## Visceralizing potential of *L. donovani* in Sri Lanka: use of a BALB/c mouse model

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Cutaneous leishmaniasis (CL) in Sri Lanka is caused by a genetic variant of *Leishmania donovani*, a usually visceralizing parasite in other parts of the world. The visceralization potential of *L. donovani* in Sri Lanka is not yet fully understood. The current study was aimed at investigating the ability of local parasites to establish disease within an animal model.

Parasite isolates from five patients with single large ulcerated lesions (>4 cm) and confirmed as CL through laboratory means were studied after informed consent. Lesion aspirates were grown in artificial media and parasites were harvested. Six female BALB /c mice were infected through the tail vein with  $10 \times 10^6$  metacyclic promastigotes from each isolate with two control BALB /c mice similarly treated with normal saline (n = 40). Similar experiments were conducted in a second group of BALB/c mice (n = 40), with intra-dermal inoculations with  $10^3$  metacyclic promastigotes. Mice were euthanized in 2 batches (n = 3 each) at 4-6 weeks and at 10-12 weeks after inoculation. Both spleen and liver were removed and a portion each of spleen and liver was cultured. Diagnosis was made using microscopy, culture and/or PCR. Parasite loads were determined using Dab smear.

In the group infected intravenously, none of the mice euthanized at 4-6 weeks showed any sign of infection. However, visceralization was evident in 9/15 infected mice, euthanized between 10-12 weeks (60%, n = 9/15). All infected mice showed spleen infection (9/9) and 1/9 (11%) had liver infection. In the group infected intradermally, 3/15 (20%) infected mice euthanized at 4-6 weeks and 10/15 (66%) infected mice euthanized between 10-12 weeks showed cutaneous lesions. There were no signs of systemic infection in any of the animals in the second group infected intradermally, though evidence of a skin lesion at a site of infection was observed.

Local strain of *L. donovani* has the capacity to establish infection in BALB /c mice, inducing visceral disease when parasites are directly introduced into the systemic circulation. This might indicate the potential of this parasite strain to induce visceral disease in humans in the long term. This study may also imply that the mode of infection of *L. donovani* has a critical role in disease development in BALB/c mice and is a factor to be considered in developing an appropriate experimental model for *L. donovani* infection.

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## **Perception of web-based learning management system among medical undergraduates in the Faculty of Medicine, Colombo, Sri Lanka**

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E-learning has become one of the mainstream trends in medical education. Most of academic institutions deliver E-learning programmes through a web-based Learning Management System (LMS). The Faculty of Medicine, University of Colombo (FoM, UoC) maintains a MOODLE based LMS, which contains lecture materials and interactive lessons. The content is organized according to the curriculum structure which consists of five academic streams, *i.e.*, Basic Sciences Stream, Applied Sciences Stream, Community Stream, Behavioral Sciences Stream, and Clinical Sciences Stream.

The objective of the study was to assess perception towards the LMS among medical undergraduates of the Faculty of Medicine, University of Colombo. Data on students' perception of LMS, its usefulness and adequacy of content was collected through a self-administered questionnaire.

A total of 182 students participated in the study (First, Second, Third, and Fourth Year students) at a response rate of 91%. A total of 541 students are accessing the LMS. The study found that students had an overall positive perception regarding the LMS. Students found LMS was easily accessible (70.9%), contained useful material (77.5%) that was helpful in exams (58.8%), and that it had satisfactory administrative support (68.7%). LMS was interactive (67%) and user friendly (70.3%), with adequate instructions for guidance (66.4%). However, 55.5% had faced technical problems when using the LMS. Students perceived material in LMS on different subjects was useful: anatomy (48.9%), physiology (46.9%), and biochemistry (34.1%). However students were unsure of the usefulness of content on cardiovascular (39.7%), respiratory (33%), gastrointestinal (26.5%) systems and on nephrourology (39.4%) and nutrition (48.5%). They perceived the content to be adequate in anatomy (78.8%), physiology (75.7%) and biochemistry (65.8%). Majority of participants found amount of content regarding body system based modules of cardiovascular (70.6%), respiratory (76.1%), gastrointestinal (90.9%) and nephrourology (90.4%) inadequate. These findings were comparable with the actual amount of content and material provided in the LMS by each subject and module.

Students' perception on LMS is generally positive. LMS can be made more useful to students by providing more material, increasing the interactivity and regular updating. Technical and administrative support needs to be improved to ensure optimum utilization.

## **Neurophysiological and biochemical parameters in patients on long term statin treatment; a case-control study**

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Statin induced-peripheral neuropathy is reversible if detected early and stopping statin is done early. Neuropathy is due to adverse effects on myelin formation and the remyelination process in neurons by statins. The objective of the study was to compare lipid profile parameters with statin treatment parameters and neurophysiological findings in study and control population.

Patients (n = 45) on atorvastatin for >2 years and a control group (n = 23) with no history of Type 2 diabetes mellitus, hypertension, or dyslipidaemia were studied using an interviewer-administered questionnaire. Lipid profiles were done using enzymatic colorimetric test with an auto analyser. Motor Nerve Conduction Studies (amplitude, latency, conduction velocity) in lower limbs were done by NCV-EMG System (Nicolet Biomedical). Data analysed with SpSSv20.

In patients (n = 45; age =  $61.76 \pm 8.86$  years; mean  $\pm$  SD) atorvastatin dose and duration of treatment were  $14 \pm 4.96$  mg and  $5.08 \pm 2.58$  years respectively. The control (n = 23; age =  $55.5 \pm 4.1$  years) had higher level of total serum cholesterol (TC;  $193.08 \pm 28.12$  mg/dl) and lower level of Triglyceride (TGs;  $117.88 \pm 47.1$  mg/dl) compared to TC ( $154.22 \pm 28.6$  mg/dl) and TG ( $120.00 \pm 54.57$  mg/dl) of patients ( $p < 0.001$ ); No significant difference in low density lipoprotein (LDL) was found in patients compared to controls ( $p = 0.925$ ). Patients had shorter latencies of the bilateral peroneal nerves compared to controls (right =  $3.7 \pm 0.5$  ms;  $4.2 \pm 0.9$ ;  $p = 0.04$ ) (left =  $3.6 \pm 0.45$ ;  $4.5 \pm 1.6$ ;  $p = 0.03$ ). Patients' TC positively correlated with motor latency of right peroneal (n = 45,  $r = 0.37$ ,  $p = 0.015$ ), left peroneal (n = 45,  $r = 0.35$ ,  $p = 0.029$ ) and right tibial (n = 45,  $r_s = 0.33$ ,  $p = 0.036$ ). LDL positively correlated with motor latency of left peroneal nerve (n = 45,  $r_s = 0.37$ ,  $p = 0.020$ ). TGs positively correlated with motor latency of right peroneal (n = 44,  $r = 0.36$ ,  $p = 0.017$ ) and right tibial (n = 42,  $r = 0.37$ ,  $p = 0.016$ ) nerves. There was no correlation between amplitude, velocity and lipid profile parameters and between LDL, TG, total serum cholesterol levels and nerve conduction findings in controls.

There is no neurophysiologically detectable neuropathy in long-term statin users of the current study. Motor latency of lower limb nerves correlate with biochemical parameters (LDL and TC) in patients on statin treatment. Further studies are recommended to ascertain the significance of TC and LDL in early detection of statin-induced peripheral neuropathy.

*The study was funded by the University of Colombo research grant AP/03/02/2011/M/08*

## **Tetrazolium-based colorimetric assay for antibiotic susceptibility testing of rapidly growing nontuberculous Mycobacteria**

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Broth microdilution method is the standard testing method recommended by the Clinical and Laboratory Standards Institute (CLSI) for susceptibility testing of nontuberculous mycobacterial species (NTM), which uses the visual observation of turbidity to determine the Minimum Inhibitory concentration (MIC) of the drug. The objective was to design a rapid and inexpensive colorimetric microdilution assay for antibiotic susceptibility testing which utilises a tetrazolium salt that reduces in the presence of living cells to form insoluble purple crystals.

Sixteen isolates, *M. fortuitum* (n=13), *M. chelonae* (n=2) and *M. abscessus* (n=1) isolated from patients who had pulmonary mycobacterium diseases were used in this study. The assay was carried out in a 96 well plate with Middlebrook 7H9 broth containing dilutions of the antibiotics amikacin, cefoxitin, ciprofloxacin, clarithromycin, doxycycline, imipenem, sulfamethoxazole, linezolid and moxifloxacin. Plates were inoculated with bacterial suspension (0.5 McFarland) and incubated at 37°C. After 5 days incubation, tetrazolium solution was added to a control well (bacterial suspension without antibiotics) and incubated for 24 h for colour development. Once the colour development was observed, tetrazolium solution was added to all testing wells and incubated overnight. The MIC was determined based on the lowest shade of purple in series. ATCC(American Type Culture Collection) cultures 6841 and 700686 were used as control strains.

The *M. abscessus* isolate and 92% of the *M. fortuitum* isolates were resistant to clarithromycin, doxycycline, imipenem, sulfamethoxazole and linezolid. However, the *M. abscessus* isolate also showed resistance to cefoxatin. *M. chelonae* showed the same resistance patterns except one isolate which was susceptible to sulfamethoxazole and both were intermediate for doxycycline. All isolates showed susceptibility towards moxifloxacin, ciprofloxacin and amikacin except a few *M. fortuitum* isolates; where three were resistant to moxifloxacin, one resistant and one intermediate towards ciprofloxacin and one resistant towards amikacin.

The modified tetrazolium colorimetric assay for antibiotic sensitivity testing was found to be user-friendly in determining the MIC of rapidly growing mycobacteria with a colour change in comparison to the observation of turbidity in the classical microdilution method. It was also found to be cost effective in relation to the quantity of antibiotics used and labour.

*Financial Assistance by the National Science Foundation Grant No: NSF/RG/2012/HS/02 is gratefully acknowledged.*

## **Preliminary findings of a study on knowledge, attitudes and experiences in parents of children admitted with acute febrile seizures**

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This was a descriptive cross sectional study carried out to describe the parental knowledge, attitudes and experiences towards febrile seizures in their child. The study was done at the Lady Ridgeway Hospital from May to August 2015. The required sample size was 196. Up to now, 90 patients have been recruited. Participants were parents of children with confirmed first or recurrent febrile seizures. Children with past history of afebrile convulsions were excluded. They were interviewed with a pre-tested interviewer-administered questionnaire.

A score was generated to assess the knowledge of febrile seizures by obtaining marks from experts for each question and the mean was calculated out of 100. Cut off marks were obtained from experts to decide whether the knowledge is satisfactory or not. Responses for the attitudes were categorized as favourable/unfavourable, and percentages for each group were obtained.

In the study population, 66 (73.3%) were simple febrile convulsions and 24 (26.7%) were complex febrile convulsions. 55 (61.1%) were presenting for the first time. The mean age of the children was 2.19 years (SD – 1.44).

During the convulsion, 84 (93.3%) experienced irrational fear, 49 (54.4%) were not sure of what to do and 24 (26.7%) tried to insert an object into the mouth. Favourable experiences included turning the child to a side by 49 (54.4%) and shouting for help by 68 (76.4%).

The mean (SD) knowledge scores were 49 (24.9), 72.91 (11.5) and 69 (18.7) for the general aspects, prevention of the convulsion, and management during the convulsion, respectively. Based on the predetermined cut-off values, 13 (14.4%), 83 (92.2%) and 60 (66.7%) parents had satisfactory knowledge in relation to above three aspects. Attitudinal responses demonstrated a wide variation of favourable (44.4% to 96.7%) as well as unfavourable attitudes (3.3% to 55.5%).

This study has identified the need for better parental education as well as addressing parental attitudes during presentation of a febrile convulsion.

## **Medical and Physiotherapy undergraduates' perception on the importance of the roles of a medical teacher**

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Medical educators have the responsibility of transferring information uniformly among diverse learners with varying learning habits. To accomplish this, medical educators have to fulfill a variety of roles. The Faculty of Medicine, University of Colombo conducts MBBS and BSc physiotherapy degree programmes following an innovative student-centred curriculum where educators play diverse roles to fulfill their responsibilities. Looking at them from a student's perspective will help understand what they expect from teachers. Study aimed at identifying medical and physiotherapy undergraduates' perception on importance of different roles of a medical teacher and comparing their perception based on study programme.

Based on Professor Harden's paper (2000) on 12 roles of a medical teacher a questionnaire was developed with 20 different roles of an educator. A Likert scale was used to identify the perceived importance of different roles. Study followed an analytical cross-sectional design representing three academic years of the faculty. Randomly selected, 41 physiotherapy and 147 medical undergraduates participated. Data was analyzed using 16<sup>th</sup> version of SPSS.

Students' perception on importance of different roles of teachers had a close overlap with Harden's 12 roles. According to students' perception 12 priority roles were identified: information provider as a lecturer in the class room (95.8%), in clinical settings (89.9%), in practical settings (88.8%), developing learning materials for lectures (87.7%), clinical educator (85.7%), role model in teaching setting (80.8%), resource developer (79.3%), on-the-job role model (Clinic/ward) (78.2%), learning facilitator in SGDs (76.6%), learning facilitator in PBLs (75%), course organizer (75%), curriculum evaluator (72.9%). Importance of being an examiner and curriculum planner was rated relatively low by students.

Physiotherapy undergraduates had a more positive perception towards educators' role as researchers and course organizers than MBBS undergraduates. Difference in perception was statistically significant ( $P > 0.05$ ). This may be because physiotherapy students have closer contact with educators since their batches are smaller and they observe the roles educators play as researchers and course organizers more closely.

Study findings will help educators understand what learners expect from them and help students understand the different roles of educators. They also can be used in planning teaching evaluations.

## **Compliance on hand hygienic practices among health care workers – An observational audit in a tertiary care centre**

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Hand washing is the simplest and one of the most effective measures of reducing hospital acquired infections. However, the compliance of Health Care Workers (HCWs) on recommended hand hygiene techniques is known to be suboptimal. The aim of this audit was to assess the frequency of hand hygienic practices among HCWs at the potential opportunities they encountered during patient handling and to identify the deficiencies.

Two out of five movements of hand washing recommended by the WHO, which were: wash and rub hands or wear sterile gloves before touching the patient and wash/rub hands or dispose the gloves after touching the patient were observed at the ward 01, Lady Ridgeway Hospital (LRH). Data was collected using a data collection form for two hours in the mornings for two weeks in March 2015. The HCWs were unaware about the data collection.

The total number of observations was 142. Among them, only 13 (9.15%) washed or rubbed hands before touching the patient. Among them 10 (76%) did it at the initiation of the ward round and not before touching individual patients. Five observations revealed that HCWs wear sterile gloves before the ward round. But they continue to wear the same gloves even after touching the patients. Only Nursing Officers practiced this.

Consultants recorded the highest percentage of hand washing/rubbing before touching the patients (28.57%) but it was only before the initiation of the ward round.

Eight (5.63%) washed/rubbed hands after touching patients. Senior Registrars recorded the highest percentage of washing/rubbing hands after touching patients.

Hand hygienic practices were sub optimal among HCWs in ward 01, LRH. Frequency of hand washing was higher before than after touching patients. Consultants and senior registrars adhered to hand hygienic practices more than junior doctors and other HCWs. The technique of using sterile gloves was poor.

Next step of the study is to identify the prevalence of hospital acquired infections for three months prior to the interventional workshop on hand hygiene. Thereafter, post workshop prevalence of hospital acquired infections will be studied to evaluate the success.

### **Screening first degree relatives for fragile X syndrome carrier status**

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Fragile X syndrome (FXS) is an X linked dominant disorder associated with expansion of cytosine-guanine-guanine (CGG) triplet repeats present in 5' untranslated region of the fragile X mental retardation 1 (*FMRI*) gene. Based on the number of CGG repeats, they are classified as normal (NL, 5-44), grey zone (GZ, 45-54), pre-mutation (PM, 55-200) and full mutation (FM, >200). Individuals with GZ and PM are carriers and are at risk of developing tremor-ataxia syndrome (FXTAS) in the male and premature ovarian failure (POF) in the female, later in life. Hence, screening first degree relatives of affected children will create an opportunity for prevention of FXS as well as early detection of POF and FXTAS. The aim of this study was to screen first degree relatives of children with expanded CGG repeats to determine their carrier status.

The samples for this case-based study was selected from available first degree relatives of children with expanded CGG repeats detected in a population based study of special education attendees. Informed written consent was obtained from all individuals. Samples were tested using direct triplet primed PCR (dTP-PCR) followed capillary electrophoresis (CE) and methylation specific PCR (MS-PCR) which were validated by FXS positive DNA (Coriell Institute for Medical Research, USA).

Nine mothers (age 30 to 44 years), two female siblings (age 8 and 12 years) and one male sibling (age 5 years) of nine affected children (all male) participated in the study. The nine indexed children represented seven with FMs, one PM and one GZ. The carrier status of all mothers were identified as either GZ (n = 1), PM (n = 6) or FM (n = 2). The two female siblings had FM and the CGG repeats were in the normal range in the male sibling.

This study identified carrier status of first degree relatives. Further study of large population is justified in view of clinical importance of the method used and outcome of this study.

*The University of Colombo and National research council Sri Lanka funded this work.*

## **Trends in leadership skills among first and final year medical students and their lecturers**

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This study was carried out to compare leadership skills among medical students in their first and final years and their lecturers and to identify the trends in leadership skills.

The study was conducted in two phases. In phase one, leadership skills of the first year medical students and lecturers of the Colombo medical faculty were assessed. In the second phase, leadership skills of the medical students who participated in the first phase were reassessed as a follow-up study in their final year of the medical curriculum. Self and Rater versions of the Authentic Leadership Questionnaire (ALQ) was distributed among the study population. The score calculated for each of the 4 components; Transparency (TR), Ethical skills (ES), Balanced processing (BP), Self-awareness (SA) of the ALQ, is the average of the score from 1 to 4 ( $\geq 3$  each indicates good leadership skills). Data was analysed using SPSS-v20.

Among final year students who completed ALQ, (n=101; females=52, males=49) 54.5% had good leadership skills ( $3.05 \pm 0.43$ ; mean  $\pm$  SD of whole sample) compared to 41.7% in their first year (n = 115; females = 64, males = 51;  $2.73 \pm 0.38$ ; mean  $\pm$  SD of whole sample;  $p < 0.001$   $t = 4.597$ ). Among lecturers (n = 24; females = 13, males = 11) 67% had good leadership skills ( $3.17 \pm 0.37$ ;  $p < 0.001$ ). Final year students demonstrated improvement in all the components of ALQ compared to their first year; TR- ( $3.03 \pm 0.54$ ;  $2.79 \pm 0.44$ ;  $p = 0.003$ ), ES- ( $2.86 \pm 0.64$ ;  $2.48 \pm 0.47$ ;  $p < 0.001$ ), BP- ( $3.18 \pm 0.56$ ;  $2.84 \pm 0.61$ ;  $p < 0.001$ ) SA- ( $3.17 \pm 0.57$ ;  $2.85 \pm 0.55$ ;  $p < 0.001$ ). Students rated themselves less than their leaders (rater) in first year (self-  $2.76 \pm 0.42$ , rater-  $2.91 \pm 0.53$ ;  $p < 0.001$ ), while they rated themselves greater than their leaders in the final year (self-  $3.07 \pm 0.43$ , rater-  $2.75 \pm 0.68$ ;  $p < 0.001$ ). Lecturers too underrated their leaders, (self-  $3.17 \pm 0.37$ , rater-  $2.71 \pm 0.81$ ;  $p = 0.012$ ). 40.6% Of females and 43.1% of males showed good leadership skills in first year (females-  $2.68 \pm 0.36$ , males-  $2.82 \pm 0.46$ ;  $p = 0.086$ ), compared to final year, in which 46.2% of females and 63.3% of males showed good leadership skills (females-  $2.97 \pm 0.37$ , males-  $3.14 \pm 0.47$ ;  $p = 0.042$ ).

Students had improved leadership skills at final year compared to their first year. Lecturers had better leadership skills compared to students. Professionals tend to underrate their leaders with increasing seniority. Males had better leadership skills and improvement compared to females. It is important to determine contributing factors for poor leadership skills among medical students and address them during their undergraduate training.

## **Faculty of Science**



"Human Resource Development through Science  
and Technology"

## **Message from the Dean**



The Faculty of Science is eager to join with the sister faculties to endorse its postgraduate research proficiency at the Annual Research Symposium 2015 of the University of Colombo under the theme of “Human resource development through scientific research”. This theme complements our degree programmes to strengthen the competent human resources in the disciplines of sciences and mathematics.

Though the primary function of the Faculty of Science is undergraduate teaching and research, currently the seven departments of the Faculty of Science offers 15 taught postgraduate programs leading to diploma/M.Sc. degrees. In addition, all departments conduct programs leading to M.Phil/Ph.D degrees. During the past nine months over 300 postgraduate students have enrolled in our programmes. I am happy to note that the postgraduate convocation of 2015 saw the graduation of 11 Ph.D., 3 M.Phil., 140 M.Sc., and 57 Postgraduate Diploma holders to strengthen the work force of the country.

At this Annual Research Symposium 35 abstracts will be presented on 30<sup>th</sup> October 2015 at the Faculty of Science research sessions reflecting innovative research carried out by our postgraduate students under the able guidance of the proficient academic staff.

The endeavour of preparing the abstracts and making the presentations is cordially 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 non-academic staff of the Faculty of Science, I send my profound gratitude to the organizing committee and all the participants at this Annual Research Symposium 2015, and my noble wishes for a very rewarding and productive event.

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

## Faculty of Science

### List of Abstracts

1. Measurement of indoor radon concentration in the premises of the Faculty of Science, University of Colombo, using activated charcoal method	107
2. Do cattle egrets in Sri Lanka show breeding migration?	108
3. Historical and current records of <i>Cylindera (Ifasina) labioaenea</i> Horn, 1892 (Coleoptera: Cicindelidae) in Sri Lanka	109
4. Vector surveillance suggests an enhanced vector status for <i>Ae. albopictus</i> compared to <i>Ae. aegypti</i> in the Kandy district	110
5. Oviposition activity of dengue vectors in response to two different organic infusions	111
6. Anti inflammatory activity of <i>Haliclona (Soestella)</i> sp marine sponge crude extract in murine models: inhibition of pro inflammatory cytokines and leukocyte migration	112
7. The mature leaf concentrate of Sri Lankan Wild type <i>Carica papaya</i> stimulates <i>in vitro</i> proliferation and phagocytosis of rat immune cells	113
8. Toxicity and mutagenicity of a selected heavy metal mixture revealed by the <i>Allium cepa</i> bioassay	114
9. Genetic clustering and hybrid inferiority support distinct species status of the Red-backed Woodpecker ( <i>Dinopium psarodes</i> ) of Sri Lanka	115
10. Phylogenetic status of <i>Zosterops</i> white-eyes in Sri Lanka	116
11. Population diversity of Weligama coconut leaf wilt phytoplasma strains in Weligama, Sri Lanka	117
12. Constructing an urbanization index at Grama Niladari level for Western Province of Sri Lanka	118
13. Joint modeling of a survival and a count response	119
14. Generalized estimating equations (GEE) for modelling correlated data and its future potentials: A review	120
15. A case study on factors associated with the birth weight	121
16. Statistical model to assess vulnerability for adverse health outcomes in elderly	122
17. Eco-friendly, sustainable and low cost bio-fertilizer to reduce 50% of urea recommendation for rice, with even better yields	123
18. Floristic diversity and plant associations in Ussangoda National Park	124

19. Improving phosphorus nutrition of rice using fungal inocula	125
20. Morphological variation of sesame/thala ( <i>Sesamum indicum</i> L.) grown in Sri Lanka	126
21. Regeneration potential and species interactions of selected woody species at Ussangoda serpentine plains	127
22. Heavy metal hyperaccumulating plants in the Ussangoda serpentinite	128
23. A comparison study of binding affinity of cortisol and steroid molecules from Sri Lankan flora to corticosteroid-binding globulin	129
24. Development of a GC method to assess the adulteration of coconut oil by palm oil	130
25. Electron capture dissociation of multiply-charged cations of Polymyxin B using electrospray ionization Fourier transform ion cyclotron resonance mass spectrometry	131
26. Development of a fluorimetric method for assessing paracetamol in pharmaceuticals	132
27. <i>In vitro</i> elastase, tyrosinase, hyaluronidase inhibitory and antioxidant activities of <i>Curcuma aromatica</i> from Sri Lanka	133
28. A case study on lightning protection of houses in the proximity of a 70 m tall communication tower	135
29. Development of a diode laser based chlorophyll sensor	136
30. An optical technique for evaluating the slope errors of a reflective parabolic trough	137
31. Theoretical study on the performance of a cross flow steam condenser	138
32. Designing a steam condenser for water desalination for parabolic trough solar thermal energy plant	139
33. Controlling of a parabolic trough concentrator for tracking sun by implementing solar position algorithm on a microcontroller	140
34. Analysis of a two-wheeled self-balancing autonomous robot	141
35. Cu <sub>2</sub> O thin film based LP gas sensor of spiral geometry	142

## **Measurement of indoor radon concentration in the premises of the Faculty of Science, University of Colombo, using activated charcoal method**

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A preliminary study was done to determine if indoor radon concentration levels and the annual effective doses in the premises of Faculty of Science, University of Colombo, are within the levels recommended by the International Commission on Radiological Protection (ICRP). Different locations were chosen including laboratories, office rooms and lecture rooms from various departments in the Faculty of Science.

Air samples were collected using canisters containing activated charcoal, from the selected sampling locations. Gamma spectrum for each charcoal canister was obtained using a NaI (TI) scintillation detector. The integral count for the energy range of 267 keV – 685 keV, acquired from the spectrum was used to calculate the radon concentrations. Calibration of the charcoal canisters was done using a charcoal canister exposed to a relatively high radon concentration, which was created artificially inside the darkroom of the Department of Nuclear Science. Radon activity concentration in the dark room was measured using the alpha spectrum obtained by a calibrated RAD7 radon detector.

A background measurement for each charcoal canister was done using a sealed charcoal canister. This was done to ensure that all radon and radon daughter products which could have been trapped inside the charcoal prior to the exposure to the sampling location, was deducted from the final activity calculation.

The activity concentrations varied from  $2.43 \text{ Bq m}^{-3}$  to  $272.45 \text{ Bq m}^{-3}$ . The corresponding annual effective dose values calculated for these locations were 0.02 mSv and 1.96 mSv. The highest activity concentration was reported from the faculty library while the lowest activity concentration was reported from the office room of the Dean.

The recommended ranges for radon concentrations and for annual effective doses were 500-1500  $\text{Bq m}^{-3}$  and 3-10 mSv. All the radon activity concentrations and annual effective dose values calculated for the selected locations were lower than the recommended ranges.

**Key words:** Indoor radon, activity concentration, annual effective dose, charcoal canister, NAI scintillation detector.

## **Do cattle egrets in Sri Lanka show breeding migration?**

*R. L. Jayaratne, I. C. Perera, D. K. Weerakoon, and S. W. Kotagama*

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Cattle egret (*Bubulcus ibis*), a common wetland bird in Sri Lanka, is a common member in communal roosting sites of water birds throughout Sri Lanka. There are no published records on sightings of cattle egret nesting within the boundaries of Sri Lanka during the breeding season. Although there are speculations of migratory behaviour towards India, this has not been systematically analyzed. In an ongoing study, the preliminary observations are reported on annual population variation of *B. ibis*.

From January 2013 to July 2015, five (05) roosting sites were selected from Colombo, Kandy and Anuradhapura districts located in wet, dry and montane climatic zones, respectively. Over 30 heronries within 10 districts, including Kumana and Wilpattu national parks, were observed to find out breeding colonies of cattle egrets.

According to the observation of roosting sites, the maximum population of cattle egrets was recorded during the months of January and February. In mid March, cattle egrets start to show breeding plumage that peaks at the end of May.

The population of egrets gradually decreases from March to June and no birds were observed in July, August and September. During these months rarely small groups of (4-5) non-breeders were observed in paddy fields and grasslands. The observed heronries contained mixed species; little egrets, intermediate egrets, great egrets and other heron species such as night heron, purple heron, pond heron and grey heron, but no cattle egret nests were detected. Considering the extent of observations and the greater numbers observed at roosts, it is unlikely that cattle egrets breeding within the country would not be sighted. These findings strengthen the hypothesis of breeding migration of cattle egrets beyond the boundaries of Sri Lanka.

Financial support by the HETC grant, HETC/CMB/QIGW3/SCI/OS/2012/02 is acknowledged.

**Historical and current records of *Cylindera (Ifasina) labioaenea* Horn, 1892  
(Coleoptera: Cicindelidae) in Sri Lanka**

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Sri Lanka is regarded as a global hot spot for tiger beetle diversity with 55 recorded species, 32 being endemic to the country. *Cylindera (Ifasina) labioaenea*, recorded since 1904, is a common, widely distributed tiger beetle species in Sri Lanka and is only known to occur elsewhere in India. We reviewed available distribution records of five publications dating from 1904 to 2006 and museum collections to establish the historical distribution range of *Cylindera (Ifasina) labioaenea*. In addition, seventy-seven (77) locations representing the three climatic zones of Sri Lanka were surveyed from June 2014 to August 2015 for the tiger beetles. Of the total 77 locations surveyed 35 represented the wet zone, 31 the dry zone and 11 the intermediate zone. Collected beetles were preserved in 70% alcohol and identified using taxonomic keys and descriptions. Environmental parameters of the locations were measured using a portable weather station and soil parameters were estimated using standard equipment and procedures. *Cylindera labioaenea* were recorded from 55 locations - 41 locations from previous publications and 14 locations from the current study, of which 46 locations lay in the wet zone (84%), 7 locations lay in the intermediate zone (12%) and 2 locations lay in the dry zone (4%). The findings revealed that *C. labioaenea* is predominantly distributed in the wet zone of the country and that at present the species is restricted to the wet zone and not found in the dry zone and the intermediate zone. The species indicated preferences for slightly acidic very low saline reddish brown soils with relatively high soil moisture levels in habitats with close distance to a water body with well sunlit bare patches. Understanding the distribution and habitat preferences of *C. labioaenea* is essential for future conservation of the species and there is high potential for future studies in the use of *C. labioaenea* as a successful biological indicator for ecological parameters and taxa of the wet zone of Sri Lanka.

**Keywords:** *Cylindera(Ifasina) labioaenea*, wet zone distribution, micro-habitat preferences, indicator potential.

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## **Vector surveillance suggests an enhanced vector status for *Ae. albopictus* compared to *Ae. aegypti* in the Kandy district**

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Sri Lanka is a dengue endemic country with more than 50,000 cases reported annually. Although both *Aedes aegypti* and *Aedes albopictus* transmit the disease, the former acts as the main epidemic vector. *Ae. albopictus* is believed to contribute more as a maintenance vector. Therefore, this study was conducted to re-assess the vector status of the two species in relation to dengue epidemics in the Kandy district based on their abundance. A total of 195 ovitraps were placed in Edaduwwa (39), Thalwatte (36), Hanthana Road (44), Nawalapitiya (40) and Peradeniya University premises (36) during October 2014. Collected mosquito larvae were identified with taxonomic keys and the ovitrap indices (OI) were calculated.

The abundance of *Ae. albopictus* within the total area was significantly high in both indoor and outdoor habitats (OI<sub>indoor</sub>: 0.098; OI<sub>outdoor</sub>: 0.278;  $P < 0.05$ ) compared to that of *Ae. aegypti* (OI<sub>indoor</sub>: 0.054; OI<sub>outdoor</sub>: 0.096;  $P < 0.05$ ). The same tendency was observed in all individual sampling sites. The overall OI values for the two species were OI<sub>aeg</sub> = 0.29 and OI<sub>albo</sub> = 0.73, respectively. Furthermore, except for Nawalapitiya, in all other areas, OI values obtained for *Ae. aegypti* were less than 10 %. However, for *Ae. albopictus*, OI was maintained above 10% in all five areas.

According to this study, *Ae. albopictus* was more abundant compared to *Ae. aegypti* in both indoor and outdoor habitats in the Kandy district with a highly stable population as indicated by an overall OI > 40%. The OI values greater than 10% for *Ae. albopictus* emphasize the possible risk of a dengue outbreak, which could have been the likely cause for the high dengue incidence rates reported in this area during this period. The low abundance (< 10%) of *Ae. aegypti* may indicate its minimum contribution to the epidemic. As such, this study confirms the previous observation, that *Ae. albopictus* is replacing *Ae. aegypti* at least in semi-urban and rural areas and warrants further investigations on susceptibility of *Ae. albopictus* to circulating dengue virus serotypes to confirm its possible role as an epidemic vector, as suggested by vector abundance.

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## Oviposition activity of dengue vectors in response to two different organic infusions

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Oviposition data of gravid female mosquitoes carry a high epidemiological importance. This information can be obtained through ovitraps. To attract mosquitoes, various infusions such as hay are used in ovitraps. The efficiency of hay infusion is partly attributed to the fetid odour. However, a recent study has reported non-fetid cashew leaf (*Anacardium occidentale*) infusion to be more effective compared to fetid grass hay infusion in attracting *Aedes aegypti*. A similar relationship is likely to exist between the non-fetid cashew leaf and fetid rice hay infusions as well. Hence, the present study was aimed to assess the oviposition stimulant capacity of rice hay (*Oryza sativa*) compared to cashew leaf (*Anacardium occidentale*) infusion on the dengue vectors, *Aedes aegypti* and *Aedes albopictus*.

Infusions were prepared by steeping 125g of dried material in 15L of de-chlorinated water for seven days. A total of 195 ovitraps containing 175ml of 10% hay or cashew infusions ( $N_{\text{hay}} = 106$ ;  $N_{\text{cashew}} = 89$ ) were placed in both indoor and outdoor places in the Kandy district in October 2014. The total number of positive ovitraps for each infusion for each *Aedes* species was counted. Eggs were reared up to 3<sup>rd</sup> /4<sup>th</sup> instar level and the total larval number for 100 positive ovitraps was calculated as a percentage of positive ovitraps.

According to the results, a significantly ( $P < 0.05$ ) higher number of ovitraps with hay infusion (30.2%) became positive for either of the two species analyzed compared to the ovitraps containing cashew leaf infusion (19.1%). This tendency was also apparent with respect to the total number of larvae (128.3 and 71.91 for hay infusion and cashew leaf infusion respectively ( $P < 0.001$ )). Since *Ae. albopictus* laid eggs equally in both types of ovitraps ( $N_{\text{hay}} = 20.75\%$ ;  $N_{\text{cashew}} = 17.98\%$ ) this increase is likely to have been brought about mainly by the significant preference of *Ae. aegypti* towards hay infusion over cashew leaf extraction (11.3% vs 3.4%;  $P < 0.05$ ).

The current study confirms the importance of organic infusions as attractants in ovitraps for gravid *Aedes* mosquitoes. *Ae. aegypti* particularly preferred the fetid rice hay infusion although non-fetid cashew leaf infusion was equally effective in attracting *Ae. albopictus*. Further, this study highlights the effectiveness of rice hay in attracting gravid female mosquitoes over cashew leaf infusion. Thus the ovitraps treated with rice hay, which is found abundantly around the country, could continue to be used as a simple, cheap and effective method of surveillance and control of dengue vectors.

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## **Anti inflammatory activity of *Haliclona (Soestella)* sp marine sponge crude extract in murine models: inhibition of pro inflammatory cytokines and leukocyte migration**

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Marine sponges of genus *Haliclona* contain prominent anti-inflammatory compounds. We previously substantiated significant inhibition of the first phase oedema in the carrageenan induced Wistar rat model by a Sri Lankan *Haliclona (Soestella)* sp marine sponge crude extract (SCE). The present study reports the inhibition of pro-inflammatory cytokines, TNF- $\alpha$  and IFN- $\gamma$ , in the first phase of oedema in Wistar rats, and of leukocyte migration in IRC mice by the same SCE.

*Haliclona (Soestella)* sp was harvested from Unawatuna, Galle and thoroughly refluxed with methanol/dichloromethane. The SCE was filtered, concentrated by rotary evaporation, and three groups of Wistar rats (N = 6/group) orally gavaged (5, 10 & 25 mg/kg) 30 min prior to carrageenan injection. Control and reference groups received 5% ethanol, and indomethacin, respectively. Following 1 hr post treatment, TNF- $\alpha$  and IFN- $\gamma$ , in fresh plasma, were quantified using sandwich ELISA kits (BD Bioscience, USA).

The effect of the SCE on leukocyte migration was evaluated using adult male IRC mice, (N = 6/group) orally gavaged with SCE (10, 25, 50 mg/kg) prior to intra peritoneal injection of carrageenan. Betamethasone served as the reference drug while the control group received 5% ethanol. Total leukocyte counts in the peritoneal fluid were used to calculate percentage inhibition of leukocyte migration *in vivo*.

The SCE significantly reduced TNF- $\alpha$  and IFN- $\gamma$  in all the tested doses ( $P < 0.05$ ). TNF- $\alpha$  and IFN- $\gamma$  were not reported in 10 mg/kg dose while IFN- $\gamma$  was also absent in 25 mg/kg dose. All tested doses of SCE resulted in a significant percentage inhibition of the leukocyte influx to the peritoneal cavity ( $P < 0.05$ ). Importantly, the highest inhibition reported with the 25 mg/kg dose, was similar to that of the reference drug.

In conclusion, the anti inflammatory effect of the SCE was confirmed by inhibition of pro-inflammatory cytokines in the first phase oedema of the Wistar rat model. Concurrently, the ability of the SCE to inhibit leukocyte migration *in vivo* was corroborated in a murine model.

**Key words:** Proliferation, phagocytosis, cytokine secretion, mature leaf concentrate, *in vitro* assays.

Financial assistance by the HETC project, Ministry of Higher Education, Sri Lanka (SJP/O-AS/N1) is acknowledged.

## **The mature leaf concentrate of Sri Lankan Wild type *Carica papaya* stimulates *in vitro* proliferation and phagocytosis of rat immune cells**

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The mature leaf concentrate of *Carica papaya* is a traditionally claimed ethno medicine against numerous diseases. In the present study, the immunomodulatory efficacy of mature leaf concentrate of *C. papaya* (MLCC) of Sri Lankan wild type variety was investigated on rat immune cells *in vitro*.

Bone marrow cells (BMCs), splenocytes (SCs), peripheral blood leukocytes (PBLs) and peritoneal macrophages (PMs) were aseptically collected from Wistar rats (180-200g) and cultured in complete RPMI medium. (i) The effect of the MLCC (15.6, 31.25, 62.5, 125 and 250 µg/ml) on BMCs, SCs and PBLs proliferation was established using the MTT assay; (ii) phagocytic activity of PMs and PBLs were assessed using NBT dye reduction assay, and (iii) Th1 (IFN $\gamma$ ) and Th2 (IL-10) cytokine levels of BMC and PM culture supernatants were assessed using sandwich ELISA based kits. Experiments were performed in triplicate and data were analyzed using ANOVA.

Compared with the control, the MLCC at 31.25, 62.5, 125 µg/ml concentrations significantly enhanced *in vitro* proliferation of rat BMCs, SCs and PBLs ( $P < 0.05$ ); the strongest proliferative effect was recorded for BMCs where 15.6, 31.25, 62.5 and 125 µg/ml MLCC treated cells released significant ( $P < 0.05$ ) amounts of IL-10, while IFN $\gamma$  levels were comparable to the control, indicating a Th2 cytokine polarization. Conversely, 250 µg/ml of MLCC significantly increased the IFN $\gamma$  level ( $P < 0.05$ ) while IL-10 was unaltered, manifesting a Th1 cytokine polarization. The MLCC at 31.25, 62.5, 125 µg/ml significantly increased the phagocytosis of rat PMs and PBLs ( $P < 0.05$ ). Compared with the control both IFN $\gamma$  and IL-10 levels were significantly higher in MLCC treated PMs ( $P < 0.05$ ), that evidenced a Th1 polarization. However, 250 µg/ml treated cells showed a Th2 cytokine polarization by releasing higher levels of IL-10 than IFN $\gamma$ .

The present study thus established that the MLCC of *Carica papaya* Sri Lankan wild type effectively modulates the proliferation, the phagocytic capacity and the secretion of cytokines of rat immune cells, *in vitro*.

**Key words:** Proliferation, phagocytosis, cytokine secretion, *Carica papaya*, mature leaf concentrate, *in vitro* assays.

**Acknowledgment:** Financial assistance by the Collaborative Research Grant (AP/3/2012/CG/29) of the University of Colombo

## **Toxicity and mutagenicity of a selected heavy metal mixture revealed by the *Allium cepa* bioassay**

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*Allium cepa* bioassay is a widely used tool for rapid screening of xenobiotics in contaminated water. As the waterways in the Bellanwila-Attidiya sanctuary were detected with heavy metals, Cd, Cr, Cu, Pb and Zn in significantly high concentrations (~5 ppm) *A. cepa* bioassay was applied to test the toxic and mutagenic potential of this heavy metal mixture in the laboratory. After 48 hrs exposure to this mixture in 0.005, 0.05, 0.5, 5 and 50 ppm concentrations, *A. cepa* root length (of n= 18 bulbs from three generations), and chromosomal aberrations were recorded in meristematic cells by staining with acetocarmine. Toxicity and mutagenicity measures such as mean root length and the mitotic index decreased significantly ( $p < 0.05$ ) with increasing metal ion concentrations while the incidence of chromosomal aberrations increased. Growth retardation was entirely dose dependent while mito-depressive effect was partially dose dependent as it scored  $5 \pm 1.2$  (per 1000 cells) with percentage decrease of 89% for all the concentrations below 0.5 ppm. Increasing incomplete anaphase incidences with the increasing metal ion concentration indicated a decline of the rate of cell division. Higher concentrations above 5 ppm, caused cell death *via* necrosis and apoptosis, showing major characteristics of cell death, such as spheres of condensed chromatin, condensed and marginal nuclei, fragmented DNA, and formed apoptotic bodies, etc; This further reduced the mitotic index to ~2, with percentage decrease above 96%. Chromosomal aberrations were evident in all the heavy metal exposed *A. cepa* roots, resulting in prominent aberrations, such as chromosomal adherences, bridges, vagrant and laggard chromosomes, C-metaphase, polyploidy and polarised division. Chromosomal adherences, which, lead to cellular apoptosis, were dominant among the aberrations at higher metal concentrations. We infer from the study that heavy metal ions tested affect *A. cepa* meristematic cells by causing chromosomal aberrations leading to irreversible cell damages including cell death *via* necrosis and apoptosis in a dose dependent manner.

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## Genetic clustering and hybrid inferiority support distinct species status of the Red-backed Woodpecker (*Dinopium psarodes*) of Sri Lanka

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Studies of hybrids can demonstrate the strength and integrity of species boundaries. Hybridization at the same time has presented a challenge for taxonomists, since hybridizing forms could be stable evolutionary entities or temporary forms that blend together. *Dinopium* is an old world group of flameback woodpeckers, consisted of five species from the Indian subcontinent and South East Asia. It has been considered that Sri Lanka has two subspecies of *D. benghalense*: *D. b. jaffnense* in the north and *D. b. psarodes* in the south. Red plumage clearly separates the endemic taxon *D. b. psarodes* from all other subspecies of *D. benghalense*, however intermediate plumage types ranging from red to yellow can be seen in sympatry. The recent world checklist of birds has elevated *D. b. psarodes* to a status of full species (*D. psarodes*) primarily based on its plumage. To evaluate this taxonomic advancement, we examined the phenotypic, genetic affinities and hybridization of *D. psarodes* within the *D. benghalense* cluster. We sampled 70 woodpeckers along a linear transect across the island as well as 55 museum specimens. DNA sequence variation in a nuclear non-coding region of the Z chromosome and chromosome 11, and the CO1 and Cyt b genes of the mitochondrial genome was evaluated. Sequences of other species of *Dinopium* and an outgroup from a neighbouring biogeographic region were studied by aligning them in ClustalW. Maximum Likelihood (ML) and Neighbor-Joining (NJ) trees were generated using MEGA 6 using rapid bootstrap, for 1000 replicates with the GTR+I+G model. To summarize patterns of co-variation between plumage variables, we carried out principal components analysis (PCA). We used the program CFit-7 to test the concordance of morphometric, plumage and genetic markers. Plumage colour ranged from red in the south to yellow in the north, with varying proportions of orange found in sympatry. Phylogenetic analysis within the *D. benghalense* cluster, showed that the Sri Lankan yellow form (*D. b. jaffnense*) and the Indian yellow forms are clustered together while the Sri Lankan red form (*D. psarodes*) is sister to *D. benghalense*. *D. psarodes* and *D. b. jaffnense* clustered separately at Cyt b in the genetic analysis. The clinal change of both phenotype and genotype across the hybrid zone has narrowed its width (112 km) compared to that of a neutrally expanding zone. This narrowness suggests that selection limits the spread of hybrids into the range of parental forms likely through lower fitness of hybrids. Morphometric, plumage and genetic traits show limited hybridization in a narrow transitional zone between the two taxa, support the treatment of *D. psarodes* as a distinct species.

**Keywords:** *Dinopium psarodes*, hybrid zone, Flame-back woodpeckers, hybridization, Island endemism, clines, molecular markers, speciation.

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## Phylogenetic status of *Zosterops* white-eyes in Sri Lanka

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Fauna and flora of Sri Lanka (SL) is considered closely related to India mainly due to the geological history and geographic proximity to India. Despite regular contact during Pleistocene glaciations SL harbours its own endemism. However, very few evolutionary explorations have been carried out to study the genetic relationships of Sri Lankan biota with Southwestern India. Here we use white-eyes, a group of small song-birds, to explore the connectedness of birds across the South Asian region. White-eyes diverged only about two million years ago and have very high diversification rates. They are an old world group with a widespread distribution continentally and inhabit most of the tropical islands particularly in South-east Asia and in western Pacific Ocean. White-eyes are excellent island colonizers showing high island endemism, thus a great model to study avian evolution and speciation on islands. The *Zosterops* species complex in SL includes the endemic *Z. ceylonensis* and its regional congener *Z. palpebrosus*, which is described as the race *Z. p. egregius*. The race in Western Ghats (WG) *Z. p. nilgiriensis* is morphologically closer to *Z. ceylonensis* than to *Z. p. egregius*. Mees in 1957 considers *Z. p. nilgiriensis* a link between the two. We carried out sampling to represent both the species and its races, and ~2000 bp sequence data were generated. The sequences were analyzed with modern phylogenetic tools using Maximum Likelihood and Bayesian approaches. Results show that *Z. palpebrosus* forms a monophyletic group sister to the African species, with *Z. p. nilgiriensis* and *Z. p. egregius* being sister taxa. *Z. palpebrosus* and *Z. ceylonensis* belong to two distinct lineages, but the exact position of *Z. ceylonensis* cannot be inferred due low supported nodes. Since the *Z. palpebrosus* clade is strongly sister to the African clade, it is possible that *Z. ceylonensis* is not sister to *Z. palpebrosus* and that the range-restricted *Z. ceylonensis* is not diverged in the central highlands but an 'avian relict' stuck in the mountains of Sri Lanka

## **Population diversity of Weligama coconut leaf wilt phytoplasma strains in Weligama, Sri Lanka**

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Coconut is a major source of revenue and an integral part of the livelihood of more than 0.8 million people of Sri Lanka. Currently, the main threat to the local coconut industry is a devastating outbreak of a phytoplasma borne, non-lethal disease syndrome, “Weligama Coconut Leaf Wilt Disease (WCLWD)”, first reported in 2006 from the Weligama area in the Southern Province.

Understanding the population diversity of a plant pathogen is crucial to develop rational control strategies, where individuals of a homogenous population tend to respond in the same manner. *SecA* is a relatively less conserved gene that enables finer differentiation of closely related phytoplasma strains. Thus this study was undertaken to comprehend the factors determining evolutionary change, stasis, the amount and pattern of genetic variation of *secA*, within the WCLWD associated phytoplasma population in the Weligama area.

Partial *secA* sequences of WCLWD (N = 15) were generated by amplicons primed by SecAfor1 / SecArev3 and RiceSecAfor2 / RiceSecArev3. The minimum required sample number (N = 10) was fulfilled in this prototype study. Population diversity parameters were determined by DnaSP version 5.10.01.

Analysis of the partial sequences (263 bp) of *secA* revealed 6 polymorphic sites with a haplotype diversity (Hd) of  $0.8 \pm 0.074$ . The nucleotide diversity ( $\pi$ ) of the WCLWD phytoplasma population was calculated to be  $0.00818 \pm 0.00113_{SD}$  and the average number of nucleotide differences (k) as 2.152. Highest  $\pi$  value was observed within the nucleotide range 177–263 window, while the lowest was observed between 26–176. Two prominent conserved regions were observed on the entropy plot, spanning nucleotide positions 5 – 189 and 191 – 259. The neutrality of the population WCLWD associated phytoplasma was determined by the Tajima's D test, Fu and Li's D\* test and codon based Z-test and the values obtained were positive, reading 0.58265, 1.27929 and 1.724 respectively. Nevertheless, a non-significant ( $p > 0.1$ ) deviation from neutrality was evidenced.

This prototype study on population genetics of WCLWD associated phytoplasma strains deduced that the *secA* had a high genetic diversity compared to the size of the gene sequence and the considered population size. Thus, an extensive population study based on more sequences generated from samples representing the whole affected area would give a better rationale to introduce a proper disease control strategy.

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## **Constructing an urbanization index at Grama Niladari level for Western Province of Sri Lanka**

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This study uses methods to create an urbanization index using Principal Components Analysis (PCA) and develops an index which represents the magnitude of urbanization of a Grama Niladari (GN) division in the Western Province of Sri Lanka. Currently, an urbanization index at Divisional Secretariat (DS) level is available that utilizes a modified Factor Analysis approach. However for the local governance it is very important to determine an urbanization index at GN level. PCA is an effective way for reducing the dimensionality of data. If the loss of information by this reduction is negligible, PCA gives very good results in many situations. Data collected from the Census of Population and Housing – 2012 (provisional data) and basic GN level data collected by the Department of Census and Statistics parallel to the Census of Population and Housing are used for this study. Data on seven variables, namely, population density, density of housing units, density of households, density of households having water, density of households having electricity, density of establishments, and density of pre-schools, were used in the index constructing process. The number of principal components was based on the scree-plot and the magnitude of the eigenvalues. According to the ranking of the urbanization index by GN Divisions in the Western Province, the Digana GN Division in the Palinda Nuwara DS Division of Kalutara District ranked at the bottom of the list whereas Nawagampura GN Division in Colombo DS Division of Colombo District topped the list. Therefore, the created index can be used to identify undeveloped areas from developed areas.

## **Joint modeling of a survival and a count response**

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Survival and incidence are two common response variables in medical data. Thus, statistical models with responses of survival and incidence (count) are common in medical data analysis, though these two responses have not been considered in the literature as a bi-variate response within a single model. However, in many cases these two responses can be correlated, *i.e.* survival time of a patient can have some bearing with the rate of incidence of the disease. For example, diseases that occur rarely can have a shorter survival time or vice versa. When two responses are correlated, joint modelling of them simultaneously within a single model would provide improved results since such models take into account the correlation between the two responses. This study considered formulating a methodology for jointly modelling a survival and frequency (count) response. The difficulty of obtaining a joint distribution between the two variables for survival and Poisson, due to the former being continuous with censored observations and the latter being discrete was overcome by survival times being fitted as a Poisson random variable which was realistic due to the equivalence of the log-likelihoods of survival times and Poisson random variables under the assumption of proportional hazards. This required specifying the censoring indicator of the survival time as a Poisson random variable. Then, the joint density of the two Poisson distributions was considered as ‘bi-variate Poisson’ for fitting the joint model. Using R software, a bi-variate Poisson model was fitted for a partially simulated data set, which consisted of actual survival times of some leukemia patients with two treatment groups and a positively correlated count variable was simulated. It was assumed survival times are exponentially distributed. Model fitting revealed that only significant predictor was ‘treatment’ and the joint model was better than two univariate models with respect to the BICs of the models. The predicted correlation between the two responses was quite closer to the actual correlation of the data. Using different parametric distributions and semi-parametric models for survival times and using different distributions for the joint distribution of two Poisson random variables can be suggested as further developments.

## **Generalized estimating equations (GEE) for modelling correlated data and its future potentials: A review**

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Correlated data has become a ‘hot’ research interest in recent past, as these are applicable in a wide range of disciplines. Mainly, two modelling techniques, Generalized Estimating Equations (GEE) and Mixed Models, can be identified to model correlated data. Due to the advantages of GEE, such as allowing for weaker distributional assumptions, working naturally for the models specified marginally, and allowing for non-specification of correct correlation structure when multiple levels of correlations are not present, the GEE method was preferred over mixed models in modelling the data. This study was carried out to review the adoption of GEE as a technique for modelling correlated data and further, it attempts to elaborate on future potential in this area.

Generalized Estimating Equations (GEE) were introduced by Liang and Zeger as a method for handling correlated data that would typically be analyzed with GLMs. The GEE method could be emphasized as an attractive method to model correlated data, because of its ability to estimate models where the response variable can be in forms of continuous, binary or count data. It is a non-likelihood-based approach that does not rely on any distributional assumption and works well for models specified marginally. It yields consistent estimators for main effects even when the association structure is mis-specified. However, severe mis-specification may seriously affect the efficiency of the GEE estimates and GEE should be avoided when some scientific interest is placed on the association structure. Many statistical software packages such as, SPSS, R, SAS, Stata, SUDAAN and S-Plus allow for modelling GEE as well.

Many studies which illustrate the superiority of GEE compared to traditional linear regression and GLM have been carried out by many researchers, and some of them have attempted to develop extensions to the existing GEE method (e.g., GEE2). However, GEE’s have mainly been developed and used in the framework of univariate responses from the exponential family of distributions. Some of the researchers such as Ross and Moore, Carey, Zeger and Diggle, Hanley *et al.*, have attempted to extend the theory of GEE to the multivariate scenario. The multivariate modelling approaches are extremely vital in various fields such as epidemiology, biostatistics, social sciences, etc. Thus, much future potential is available in this area to come up with different extensions to GEE.

**Key Words:** Correlated data, GEE, multivariate GEE.

## **A case study on factors associated with the birth weight**

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Birth weight is the most important indicator of intrauterine wellbeing, and is the main predictor of a newborn's chance of survival as well as subsequent physical and psychosocial development. Low Birth Weight Rate (LBWR) for Balangoda is 15.3%, whereas National LBWR is 13.6% for the year 2011. The aim of this study was to assess the factors associated with the birth weight of the babies delivered at Base Hospital Balangoda for the period of three months (03) from August to October 2014. This study was conducted as a cross sectional descriptive case study where the mother and the baby were taken as the study unit. After obtaining the administrative approval, relevant data to achieve the objectives of the study were extracted from 572 study units using mother's record and bed head ticket. The sample was selected using the non-probability consecutive sampling method excluding the pre-term deliveries and the mothers having medical illnesses. The majority of the sample were Sinhala (83%), had education above grade 5 (91%), house wives (86%) and family income above Rs 10,000 (80%). The average age of the mother was 28 years, height 152 cm, weight 50 kg, weight gain during the pregnancy 9.71 kg and the mean birth weight of the new born was 2850 g. In univariate analysis; maternal height (HT), body mass index group (BMIG), pre pregnancy weight, total weight gain during pregnancy (TWG), previous caesarean scar, bleeding during pregnancy (BduP), income category and employment category (Em) were significant. In the binary logistic regression model to predict low birth weight, significant predictors were HT, TWG, BduP, BMIG, Em and interaction of TWG and BMIG. Among the modifiable factors only TWG and BMIG were the significant predictors. Hence low birth weight could be prevented by providing comprehensive health care services aiming to preserve total wellbeing of the females in the Balangoda health division.

## **Statistical model to assess vulnerability for adverse health outcomes in elderly**

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The elderly population in Sri Lanka is on the rise as a result of demographic transition. The aim of this study was to assess old age vulnerability for adverse health outcomes among the hospitalized elders in selected hospitals in Colombo district using the Vulnerable Elders Survey – 13 (VES – 13) instrument and to develop a statistical model to predict vulnerability.

A cross sectional descriptive study was carried out among a group of 248 elders recruited to the study by convenient sampling methodology, excluding critically ill and psychologically unsound elders. Univariate methods were used to find the factors associated with vulnerability and the individual and joint effects of selected factors were assessed by fitting a binary logistic model.

The majority of the elders were females. According the VES – 13, 51.6% of the study population was vulnerable. Gender, age, activities of daily living (ADL), instrumental activities of daily living (IADL), marital status, level of education, having a paid job, family income, self rated health, health status change during past 6 months, doing household work, shopping, cooking, use of electrical appliances, adequacy of income and having membership in social organizations were significantly associated with the vulnerability. In the binary logistic regression model to predict the vulnerability, age, IADL, ADL, occupation, income, ability to cook, movement, and self rated health (SRH) emerged as the significant predictors without interaction terms in the model. Unit increase in age increases the vulnerability, whereas ADL and IADL decrease the vulnerability. Having an occupation and the ability to cook were negatively, and poorly rated health, low income, and limitation of movements were positively associated with vulnerability.

Cost effective geriatric health care programmes should be established to minimize vulnerability among the elders.

**Eco-friendly, sustainable and low cost bio-fertilizer to reduce 50% of urea recommendation for rice, with even better yields**

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*Azorhizobium caulinodans* is a diazotroph with unique characters. Biofilms are beneficial microbial associations. A biofilm between *Azorhizobium caulinodans* ORS 571 and *Aspergillus* spp. (AAB) resulted in a highly effective rice root colonizer in the presence of the flavonoid naringenin (Nar). This study investigates the effect of the AAB/Nar combination coupled with four urea fertilizer percentages, i.e., 4 treatments (100 % urea recommendation with no AAB/Nar, 75% urea & AAB/Nar (75%U<sup>AAB/Nar</sup>), 50%U<sup>AAB/Nar</sup>, and 25%U<sup>AAB/Nar</sup>) on the crop yield in pot (100 kg paddy soil/pot) experiments. Each treatment was replicated three times, and the experiment was arranged in completely randomized design. Total grain weight, 100 grain weight, total filled grain weight, numbers of filled, un-filled spikelets and filled to un-filled spikelet ratios were obtained from 3 ½ month old plants and the data were statistically analysed at 5% probability level using SAS version 9. Total grain weight, 100 grain weight and the total filled grain weights resulted in numerically higher values with 50%U<sup>AAB/Nar</sup> than 100%U but with no significant difference, indicating that applying only 50%U with the combination AAB/Nar would yield similar or even better results than the norm, but 75%U<sup>AAB/Nar</sup> and 25%U<sup>AAB/Nar</sup> resulted in significantly lower values. There was no significant difference between the number of filled spikelets with 50%U<sup>AAB/Nar</sup> and 75%U<sup>AAB/Nar</sup> compared to 100%U. The total number of spikelets showed no significant difference among all four treatments. Ratio of filled : unfilled spikelets was highest in the 50%U<sup>AAB/Nar</sup> and lowest in the 25%U<sup>AAB/Nar</sup>, indicating that addition of 50%U<sup>AAB/Nar</sup> does not alter the number of spikelets, but results in more productive spikelets. It can be concluded that, 50% of recommended urea applied with *Azorhizobium caulinodans*–*Aspergillus* spp. biofilm in the presence of naringenin contributes to rice plants with same or better yield than the norm of 100%U and is a highly effective biofertilizer, which is eco –friendly, applicable and cheap.

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## Floristic diversity and plant associations in Ussangoda National Park

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Ussangoda National Park (UNP) is a unique site consisting of a distinct Serpentine plain with 'islands' of scrub patches. These islands consist of thorny shrubs and trees while the rest of the plains support only dwarf prostrate herbs. The plains are also bordered by scrub vegetation. A floristic survey was conducted to identify plant associations in scrub and herbaceous communities of the UNP using randomly placed fifteen plots (sized 12 m x 6 m and 6 m x 3 m respectively) in each community. Plant species composition, density and frequency of plant species, diameter at breast height (DBH) of woody plants, and cover abundance of herbs were recorded. The dominant species in scrub was identified using Important Value Index (IVI) for woody species. Cluster analyses using "PAST" software package (v2.04) was conducted to identify plant associations in each community, incorporating data on species and family richness, IVI of woody species for scrub community and species, family richness of herbs, and their cover estimation using the Braun-Blanquet cover-abundance scale for the herbaceous community. A total of 79 plant species belonging to 54 genera and 33 families were identified, including 12 herb species belonging to 7 families from the Serpentine plains. The most common plant families in scrub were Malvaceae, Fabaceae, and Capparaceae, while that in plains were Fabaceae and Cyperaceae. Dominant woody species in scrub were *Morinda tinctoria* (IVI - 8.39), *Azadirachta indica* (IVI - 7.63), and *Ziziphus oenoplia* (IVI - 6.54). The results of cluster analysis proved that the scrub contains one plant association, while the plains consist of three plant associations, dominated by *Eragrostis tenella*, *Evolvulus alsinoides* and *Fimbristylis* spp respectively. The distribution pattern of these three herbaceous plant associations may reveal micro habitat conditions of the Serpentine plains. These findings strengthen the conservation value through highlighting the fine scale floristic diversity of UNP.

## Improving phosphorus nutrition of rice using fungal inocula

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The major barrier in employing native Eppawala Rock phosphate (ERP) in rice cultivation is its low solubility. Hence, utilization of phosphate solubilizing microorganisms (PSM) to improve ERP solubility in a rice cultivation system has been evaluated in a pot study. Two efficient native phosphate solubilizing fungi; *Penicillium oxalicum* and *Aspergillus* sp. were tested for their performance in increasing Phosphorus (P) nutrition of the rice variety Bg 300. A total of 14 different treatments including the standard treatment with recommended rates of chemical fertilizers were evaluated at different levels of P from TSP and ERP together with and without the fungal inocula. Fertilizer applications were done according to the recommendations given by the Department of Agriculture and pots were arranged in a completely randomized design with five replicates. Plant growth, yield and soil parameters were measured. All the data gathered were subjected to one way ANOVA and multiple mean comparison test using the Minitab 16.1.1 statistical software. Among the growth parameters measured, mean shoot height of the plants, mean number of the tillers per plant and mean number of leaves per plant showed significant variability of  $p = 0.000$  among the treatments. Yield parameters such as mean number of panicles per plant, mean length of the panicle per treatment, mean number of seeds per panicle, total number of filled seeds per pot, total number of seeds per pot and total seed weight per pot showed significant differences among the treatments. The highest seed weight per pot ( $15.214 \pm 1.692$  g) was given by the treatment containing only the inoculum of two fungi without applied chemical fertilizers. In almost all the parameters measured, significant increments were observed in treatments containing the inoculum over treatments with chemical fertilizers. Hence, the study identified the potential of using the fungal combination together with ERP or with reduced levels of TSP in improving phosphorus nutrition of rice cultivation system.

**Key words:** Rice, *Aspergillus* sp, *Penicillium oxalicum*, phosphate solubilizing fungi, rock phosphate.

## Morphological variation of sesame/thala (*Sesamum indicum* L.) grown in Sri Lanka

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Sesame (*Sesamum indicum* of family Pedaliaceae) is a drought tolerant crop that exhibits a high potential to survive with increasing global temperatures. Although it is an economically important oilseed crop in Sri Lanka, limited scientific information is available on sesame varieties and their responses to environment conditions. This study investigated morphological variation of Sesame varieties grown in Sri Lanka to understand their distinct features. Field visits were made to Sesame chena cultivations in Anuradhapura, Mannar, and Puttalam during Yala season and Hambanthota during Maha season in 2012 and 2013 respectively. Black seeded sesame, white seeded sesame *Idal*, *Pokuru* and local races (*Uma* and *Malee*) were found in cultivation. Five mature individual sesame plants were collected from each site and morphological observations were conducted for agronomic descriptors recommended by the International Plant Genetic Resources Institute (IPGRI). These included plant height at maturity, mean capsule length and width, petiole length of top, middle and basal leaves, length and width of top, middle and basal leaves, internode length, number of capsules per plant, number of seeds per capsule, and mean capsule thickness. The data were subjected to cluster analysis using SAS version 9.3. The dendrogram showed three main clusters at an average distance of 1.10 distinctly separating black seeded sesame from others. Black seeded sesame plants were short, with long, petiolated top leaves and short, petiolated basal leaves. They had few capsules per plant and seeds per capsule. White sesame plants were characterized by medium size plants having many capsules per plant and seeds per capsule. Local varieties *Uma* and *Malee* were also tall plants with long internodes, longer basal leaves, and many seeds per capsule. The phenotypic differences of all sesame varieties (except *Pokuru*) reflected their consistent morphologies. The *Pokuru* variety reflected its site-specific phenotypic variability by grouping into three clusters representing samples obtained from Hambanthota, Anuradhapura, and other locations. The results suggest whether *Pokuru* variety is more responsive to environmental conditions than other sesame varieties grown in Sri Lanka.

## Regeneration potential and species interactions of selected woody species at Ussangoda serpentine plains

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The regeneration potential of a seed plant is highly dependent on flowers and fruits produced, successful dispersal, germination of seeds, and seedling establishment. Plant animal interactions also assist in various ways to complete these phenological processes. Plants growing in serpentinite soil have been exposed to elevated levels of heavy metals, hence subjected to stress conditions throughout. Our first objective was to compare flower and fruit production, germination of seeds and seedling establishment of three woody species, *Cassia auriculata* (Ranawara), *Carissa spinarum* (Karamba), and *Ziziphus oenoplia* (Heen eraminiya) growing in the serpentinite soils of Ussangoda. Our second objective was to observe and record fauna and their interactions with above plant species. Flowering and fruiting was observed in five individuals of each woody species growing in serpentinite soils, transitional and non-serpentinite soils. Observations were recorded during dry to wet season (August – September 2014) weekly for 6 weeks. Number of flowers/inflorescences and fruits produced per plant were counted. Flowers and flower : fruit ratios were compared by ANOVA using the “SPSS” statistical package (v20). Seed germination was tested by germination techniques, *ex-situ*, using a volume of 12500 cm<sup>3</sup> soil spread on trays and *in-situ*, in 0.5 m x 0.5 m plots. Seedling emergence was observed weekly for six weeks. Plant–animal interactions were recorded using “transect walk method” in a line transect of 1.5 km across serpentinite plain. One way ANOVA proved the significant reduction in flower and fruit production of woody species growing in serpentinite plain. Zero germination of seeds at *in-situ* and *ex-situ* conditions exhibited the poor germination capacity of seeds in serpentinite soil. Visitation of nine bird species feeding on *Cassia auriculata* and *Ziziphus oenoplia*, sixteen butterfly species and two bee species feeding on all test species may suggest whether the pollination and seed dispersal process is facilitated by these fauna. The study reveals that the regeneration capacity of woody plants growing in serpentinite plains is at a low level and this could partly be a reason for why the woody plants are seen as ‘islands’ on Ussangoda serpentinite plains without extending their spread into the plains.

## Heavy metal hyperaccumulating plants in the Ussangoda serpentinite

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Ultramafic rocks, and the soils derived from them collectively known as ‘ultramafic soils’ or ‘Serpentine soils’, occur throughout the globe in localized patches. The serpentine soils are often shallow and rocky and consist of high concentrations of Fe and Mg as well as heavy metals such as Ni, Cr, Cd, and Co. As a result of the unusual chemical characteristic of these soils, they form specialized habitats that host unique species and communities. Native species that naturally grow on serpentine substrates typically contain specialized physiological mechanisms to tolerate the adverse chemical conditions imposed by the substrate. Some serpentine plants bear the unique physiological mechanism of hyper-accumulation, in which plants can actively uptake and accumulate heavy metals in their tissues. Heavy metal hyper-accumulating and/or tolerating plants and micro-organisms represent an unusual and valuable biological resource with great potential for use in a variety of strategies, particularly for soil remediation. In Sri Lanka, five serpentine locations (Ussangoda, Uda-walawe, Yodhaganawa, Katupotha and Rupaha) have been identified. The objective of the reported study was to identify metal tolerant and/or hyper-accumulator plant species growing in the Ussangoda serpentinite, in the Hambantota District. This serpentinite has dusty red soils, with a pH and soil moisture percentage ranging from 5.42 - 6.27, and 3.2 - 5.4% respectively. Elemental analysis of the soil and plant samples were conducted using Flame AAS, after acid digestion of the dried samples in a closed vessel microwave digester. Of the soil samples collected from 60 locations to represent the entire serpentinite, the mean ( $\pm$ SD) concentrations of Al, Mg, Ca, Zn, Mn, Ni and Fe ranged from  $15 \pm 0.45$  –  $9870 \pm 793$ ,  $425 \pm 8$  –  $9964 \pm 119.8$ ,  $215 \pm 12.7$  –  $916 \pm 147.3$ ,  $23 \pm 2.12$  –  $105 \pm 18.1$ ,  $30 \pm 6.36$  –  $131 \pm 15.77$ ,  $646 \pm 97.6$  –  $2053 \pm 129.6$  and  $4520 \pm 97.6$  –  $9012 \pm 201$   $\mu$ g/g, respectively. The mean ( $\pm$ SD) concentrations of the same elements in 10 locations of the adjacent non serpentine area ranged from  $235 \pm 15.6$  –  $662 \pm 76.2$ ,  $850 \pm 51$  –  $2515 \pm 98.7$ ,  $1415 \pm 92.2$  –  $3750 \pm 104.3$ ,  $3 \pm 0.01$  –  $30 \pm 0.45$ ,  $10 \pm 0.21$  –  $23 \pm 0.11$ ,  $12 \pm 0.4$  –  $180 \pm 0.97$  and  $2450 \pm 36.8$  –  $6150 \pm 42.9$   $\mu$ g/g, respectively. When comparing the elemental compositions of the serpentine soil and the adjacent non-serpentine soils, it has clearly been shown that the serpentine soil has a higher concentrations of Al, Zn, Mn, Ni and Fe and a low Ca/ Mg ratio.

In the Ussangoda serpentinite 68 plant species belonging to 30 families were identified. Of those, *Chamaecrista nictitans* and *Cyanotis tuberosa* var. *adscendens* were identified as Mn hyper-accumulators, while *Calotropis gigantea*, *Evolvulus alsinoides* and nine other plant species were identified as Ni hyper-accumulators.

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## **A comparison study of binding affinity of cortisol and steroid molecules from Sri Lankan flora to corticosteroid-binding globulin**

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The “Sri Lankan Flora” web based information system which contained nearly 200 chemical compounds isolated and identified from flora of Sri Lanka was created and hosted under the [www.science.cmb.ac.lk/tools/slflora](http://www.science.cmb.ac.lk/tools/slflora) web address. This information system comprised of basic computational parameters for each compound and several structural parameters that can be used in molecular modelling studies.

Corticosteroid-binding globulin (CBG) belongs to the structural family of serine protease inhibitors. However, it does not have any known intrinsic serine protease inhibitor activity. This is a known transport protein for the steroids glucocorticoids and progesterin in the blood of most vertebrates. Its physiological function is conventionally thought to be the transport of the less water-soluble hormone, cortisol, throughout the circulation, though not much experimental and/or theoretical studies found in literature.

The molecular docking procedure with DOCK6 software was employed to predict binding affinity of a naturally binding steroid, cortisol, to CBG protein and the grid score which indicates the binding affinity was recorded. The same docking procedure was used for the seven (07) steroids found from Sri Lankan Flora and respective grid scores were recorded. One steroid namely, sitosterol palmitate showed a comparable binding affinity to that showed by cortisol with the CBG receptor. The complexes of cortisol and sitosterol palmitate with CBG were pursued for molecular dynamics simulation study for a 10 ns time period to investigate the stability of the complexes in aqueous medium. The stability of the above systems was studied in terms of Root Mean Square Deviations (RMSD), Radius of gyration (Rg), volume and Solvent Accessible Surface area (SAS). The MD results show that the steroids cortisol and sitosterol palmitate behave in a similar manner in aqueous medium. Therefore it could be concluded that the steroid sitosterol palmitate, found from Sri Lankan flora is a suitable candidate to conduct an extensive investigation to find the structure and function of CBG and these studies are already underway.

**Key words:** Chemistry of plant extracts, cortisol, corticosteroid-binding globulin, docking, molecular dynamics, sitosterol palmitate, Sri Lankan flora database.

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## **Development of a GC method to assess the adulteration of coconut oil by palm oil**

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Coconut oil rich in shorter chain saturated fatty acids is used as a cooking oil and in food manufacturing processes in Sri Lanka. For economic gains, coconut oil is known to be adulterated with other cheaper oils such as palm oil, which has similar chemical and physical characteristics to coconut oil.

In this research project, a novel approach was developed based on chromatographic analysis of methylated fatty acid esters in the coconut oil samples. Chromatographic data from different blends of coconut and palm oil were investigated to identify a reliable analytical parameter for quantification. Log ratio of the peak area for lauric acid to palmitic acid was found to be the best parameter which exhibit a linear correlation ( $r^2 = 0.990$ ) to the added palm oil in coconut oil. Validity of the developed method was tested using classical methods which were often used to characterize coconut oil including refractive index, free fatty acids, saponification value and iodine value.

Twenty coconut oil samples randomly collected from distribution centres in Colombo were analysed against the standard samples. A standard sample of coconut oil prepared from dried kernel of coconut and palm oil extracted from palm fruit were used as references and their authenticity was confirmed based on the food regulation standard guidelines.

Based on the developed method, only six commercial coconut oil samples had no detectable levels of palm oil and one sample had less than 2% palm oil. Classical methods suggested that all these seven samples are pure coconut oil. Rest of the thirteen coconut oil samples had the palm oil adulteration levels from 6 -100% based on the chromatographic and classical methods.

It is evident that the developed chromatographic method is a reliable method in evaluating the levels of palm oil adulteration in the commercial coconut oil samples.

**Electron capture dissociation of multiply-charged cations of Polymyxin B using electrospray ionization Fourier transform ion cyclotron resonance mass spectrometry**

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The determination of the amino acid sequence of cyclic peptides has always been a challenging task due to multiple ring-opening pathways. In the present study, Polymyxin B (PMB) has been chosen as the cyclic peptide, which consists of six non-amino acid,  $\alpha,\gamma$ -diaminobutyric acid (Dab) moieties combined with amino acid moieties in a ring and a fatty acid (FA) side chain. The collision activated (induced) dissociation (CAD/CID) and electron capture dissociation (ECD) are well established tandem mass spectrometric techniques used for inducing fragmentation in mass spectrometry. Sequencing studies of PMB have been performed by ECD tandem mass spectrometry using a commercially available electrospray ionization (ESI) Fourier transform ion cyclotron resonance (FTICR) mass spectrometry. Mass spectra of PMB has initially been acquired over a full mass range, and subsequently ECD (electron energy  $\sim 6$  eV) and CAD (collision energy  $\sim 25$  eV) experiments were performed by isolating ions of desired charge states of interest. The ESI mass spectra of PMB have shown dominant peaks corresponding to  $[M+2H]^{2+}$  and  $[M+3H]^{3+}$  of PMB. ECD performed on these isolated precursor ions have shown the full sequence of  $c'/z\bullet$  and  $b/y'$  fragments result from the linear part of PMB molecule. Furthermore, ECD performed on precursor ion  $[M+3H]^{3+}$  have shown a doubly charged peak corresponds to  $\{[M + 3H]^{3+} - [FA+Dab]^+\}^{2+}$ . ECD performed on this isolated doubly charged ion has produced fragments formed by a combination of  $c$ - and  $y$ -type cleavages as well as  $b$ - and  $y$ -type cleavages relating to the cyclic part of the molecule. However, since there are alternative structural assignments, ECD conditions do not unambiguously establish the complete sequence of the PMB molecule. Furthermore, ECD sequence information is found to be complementary to that obtained under CID/CAD conditions and the combined use information is more beneficial.

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## Development of a fluorimetric method for assessing paracetamol in pharmaceuticals

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A simple, sensitive, quick, cost effective, and reliable fluorimetric method for determination of paracetamol has been developed. The method was based on oxidation of paracetamol by potassium chlorate in the presence of sulphuric acid and subsequent monitoring of the fluorescence quenching of quinine sulphate by chloride ions at the excitation wavelength of 360 nm and emission wavelength of 446 nm. The fluorescence emission was corrected with correction factor using absorbance for each and every sample. All absorbances were monitored at  $\lambda = 360$  nm, at the same time as monitoring emission.

Different variables affecting the reaction conditions such as the concentration of potassium chlorate, type of acid and its concentration, reaction time, temperature and solvent dilution were carefully studied and conditions were optimized. Under those optimum conditions, a linear relationship was found between quantum yield ratio and paracetamol concentration with a correlation coefficient of 0.996. The detection limit and quantitation level were  $8.0 \mu\text{g cm}^{-3}$  and  $20.0 \mu\text{g cm}^{-3}$  respectively. The precision and accuracy of the method was satisfactory and the value of standard deviation of recovery not more than 2.1 %.

Table1. Comparison of the weights of paracetamol samples by fluorimetric and HPLC methods

Sample	Estimated paracetamol weight $\pm$ SD (mg)		% weight by fluorimetric compared to HPLC method $\pm$ SD
	Fluorimetric method	HPLC method	
1	485.7 $\pm$ 2.0	496.5 $\pm$ 0.7	97.9 $\pm$ 0.3
2	473.0 $\pm$ 3.3	484.3 $\pm$ 1.6	97.9 $\pm$ 1.0
3	465.0 $\pm$ 5.7	479.5 $\pm$ 2.2	96.4 $\pm$ 1.5
4	401.6 $\pm$ 7.7	404.7 $\pm$ 1.4	99.6 $\pm$ 2.1
5	437.5 $\pm$ 2.5	447.3 $\pm$ 1.3	97.9 $\pm$ 0.9
6	419.8 $\pm$ 3.6	413.9 $\pm$ 0.6	101.6 $\pm$ 1.8
7	449.1 $\pm$ 3.4	468.2 $\pm$ 0.9	96.1 $\pm$ 0.8

Table 1 compares the amount of paracetamol estimated by the developed fluorimetric method with the standard HPLC method. Compared to the HPLC method, % weights from the fluorimetric method were found to be  $96.1 \pm 0.8$  to  $101.6 \pm 1.8$  % suggesting the high reliability of the developed method.

***In vitro* elastase, tyrosinase, hyaluronidase inhibitory and antioxidant activities of  
*Curcuma aromatica* from Sri Lanka**

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Reactive oxygen species (ROS) and free transition metal ions cause oxidative damage to various biomolecules resulting aging and skin pigmentation. Plant extracts are rich in inhibitors that can protect the skin in various ways; scavenging ROS, absorbing UV light and suppressing physiologically important enzymes such as elastase, hyaluronidase, collagenase and tyrosinase.

*Curcuma aromatica* Salisb. (Zingiberaceae) is extensively used as a cosmetic ingredient and applied externally to cure bruises, sprains, skin eruptions and infections to improve complexion. Although sufficient research has been done in India and China on antioxidant activity of rhizome extracts of *C. aromatica*, elastase, tyrosinase and hyaluronidase inhibitory activities have not been not studied to the best of our knowledge. Hence this study is aimed at determining elastase, tyrosinase and hyaluronidase inhibitory activities of an ethanol extract of Sri Lankan grown *C. aromatica* rhizomes along with antioxidant activity, as changes in agrochemical properties of soil can lead to changes in plant metabolite composition affecting the antioxidant activity.

A cold ethanol extract of air-dried and powdered rhizomes was evaluated *in vitro* for tyrosinase, hyaluronidase and elastase inhibitory activities. Antioxidant activity of this extract was determined by DPPH (1,1-diphenyl-2-picrylhydrazyl) free radical scavenging, ferric ion reducing antioxidant power (FRAP) and oxygen radical absorbance capacity (ORAC) assays, and for total phenolic content (TPC) and total flavonoid content (TFC).

The ethanol extract of *C. aromatica* rhizomes showed significant elastase inhibitory activity having an IC<sub>50</sub> value of  $252.7 \pm 6.9$  µg/mL compared to that of positive control, quercetin (IC<sub>50</sub> value of  $221.7 \pm 5.5$  µg/mL) and hyaluronidase inhibitory activity of 100% at 500 µg/mL compared to that of the positive control tannic acid (90.28%). No tyrosinase inhibitory activity at 500 µg/mL was observed compared to those of the positive controls ascorbic acid and kojic acid (IC<sub>50</sub> values of  $69.3 \pm 2.6$  and  $76.6 \pm 0.8$  µg/mL, respectively). Cold ethanol extract of rhizomes of *C. aromatica* possessed good antioxidant activity having a DPPH free radical scavenging activity with IC<sub>50</sub> value of  $50.9 \pm 1.1$  µg/mL (green tea extract IC<sub>50</sub>  $6.7 \pm 0.1$  µg/mL and Trolox  $5.3 \pm 0.1$  µg/mL), ORAC value of  $1533 \pm 96$  mg TE/g extract and FRAP value which was  $600.6 \pm 6.8$  mg TE/g of extract.

Ethanol extract of *C. aromatica* showed good TPC of  $76.3 \pm 4.7$  mg GAE/g of extract and moderate TFC of  $11.8 \pm 1.1$  mg quercetin/g. These values supports the antioxidant properties and elastase, hyaluronidase inhibitory activities, which favours the use of *C. aromatica* as an ingredient in cosmetic products.

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## **A case study on lightning protection of houses in the proximity of a 70 m tall communication tower**

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As a country located close to the equatorial belt, Sri Lanka experiences a high number of thunder days varying from 70 – 140 per year. A growing concern has arisen among the public as to the effects of antenna structures on their neighbourhood. Arisen out this concern, the Telecommunication Regulatory Commission (TRC) formulated both a national policy and guidelines to control their construction and maintenance. The Ministry of Disaster Management has also set up a committee to investigate safety against lightning hazards.

A comprehensive study has been done for lightning threats of ten domestic houses in the vicinity of a 70 m high telecommunication tower situated in Western Province, Sri Lanka. According to the data, the number of lightning activities are higher in this region and it is more than 21 strikes/year/sq.km. The telecommunication tower and the nearby ten houses takes electricity from the same transformer. Among them, eight houses are protected with Surge Protection Devices (SPD's) at the power entrance and remaining two have not been protected. Those houses are about 65 m to 195 m away from the centre of the tower and have a history of lightning damage. No evidence has been found to prove that damage caused by direct lightning strikes or side flashes to neighbourhood houses can be related to the presence of the tower. The tower has high earth resistance, varied between  $71\ \Omega$  to  $93.5\ \Omega$  measured in different directions around the tower. As the communication tower is connected to the local power network most of the damage was found to be caused by lightning surges carried via the cables to nearby houses. Houses fixed with SPD's showed a 90 percent reduction of damage after fixing the SPD's. To reduce the lightning damage it is recommended to improve the grounding system of the tower to all directions around the tower, and to fix power line SPD's at the power entrance of every house in the proximity of the tower.

**Keywords:** Lightning protection, tower safety, equipment damage, ground resistance,

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## **Development of a diode laser based chlorophyll sensor**

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A sensor capable of detecting relative chlorophyll concentration in a water sample due to suspended microorganisms that contain chlorophyll was developed using commercially available diode lasers of emission wavelength 405 nm and 680 nm and LED of centre emission wavelength 525 nm as light sources to measure absorbance and excite fluorescence. Hamamatsu s5972 photodiodes together with the optical transmission filters were used as detectors. A multivariate model incorporating fluorescence and absorption signals of chlorophyll samples were developed to estimate relative chlorophyll concentration of a given sample. The sensor was calibrated to a relative scale using a chlorophyll extract of a spinach sample diluted to different concentrations. Leave-one-out supervised learning technique was used for training and evaluating the model. Water samples obtained from different locations (Lake House, Floating Market, and Hunupitiya) of Beira Lake were measured using the sensor and it was found that the specificity of the sensor is reduced. The reason was that fluorescence excited due to other constituents such as detergents in the sample diverts the results from the true value. As such, this sensor can be used with the samples where constituents are known or controllable. Since, the sensor is based on the unique optical absorption and fluorescence spectral finger prints of chlorophyll, non-destructive *in-situ* measurements can be taken with the sensor.

## **An optical technique for evaluating the slope errors of a reflective parabolic trough**

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An optical technique for evaluating the slope errors of the reflective surface of Parabolic Trough Solar Concentrators (PTSC) is reported. The system consists of eight laser diodes of wavelength 680 nm mounted to a platform which can be moved horizontally along both transverse and longitudinal directions of the parabolic trough. The laser diodes are mounted on the platform in a straight horizontal line in such a way that laser beams are vertically pointing towards the parabolic trough when it is rotated to a position where its reflective surface is faced down and the directrix plane is aligned horizontally. A rectangular target board is fixed horizontally at the theoretical focal line of the parabolic trough. The platform is moved horizontally in order for laser beams to scan through the reflector while recording the deviations of the reflected beams from the ideal focal line in order to derive the reflector slope error. The deviated angle of the slope of the reflective surface at the point where the laser beam is confronted is then derived using the above length deviations. This scanning process is continued at one inch steps, hence the slope errors were obtained at one inch intervals along a single contour line of the parabolic reflector. All the eight lasers simultaneously scan the trough at eight different contour lines with one foot separation along the axis of the parabola. The same laser arrangement was used to optimize the shape of the parabolic reflective surface by adjusting the adjustable screws which holds the reflective sheets while scanning the reflector along the longitudinal direction, until the deviation of each reflected laser beam on the target board lies within the maximum acceptance range of  $\pm 35$  mm from the theoretical focal line. The deviation from the ideal focal line of the developed PTSC with the aperture area of  $22 \text{ m}^2$  was evaluated and the intercept factor was found to be 78.9 % within the range of  $\pm 35$  mm by considering 16 contour lines of the reflector.

Financial assistance provided by the University of Colombo (Grant No: AP/03/2012/CG/13) is gratefully acknowledged.

## **Theoretical study on the performance of a cross flow steam condenser**

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Transverse heat transfer rate ( $\dot{Q}$ ) of single pass cross-flow horizontal tube condenser was modelled by considering the convective heat transfer coefficients inside and outside the cross-flow tube bank and conductive heat transfer coefficient through the tube walls. The developed model was used to investigate the changes of efficiency by varying the length of tubes (0 – 10 m) of three diameters (19 mm, 25 mm and 32 mm), cooling water flow rate (0 – 50 m<sup>3</sup>/h), tail velocity of steam (0 – 2 m/s) and input temperature of cooling water (0 – 100 °C) for two configurations of tube bank (in-line and staggered). It was found that  $\dot{Q}$  increases with the length of tube bank up to 1.1 m linearly irrespective of the diameter and then gradually the gradient decreases. There is no difference of  $\dot{Q}$  whether a staggered or in-line arrangement is used by the tube bank when cooling water flow rates are low. When the cooling water flow rates are high, the staggered arrangement performs well.  $\dot{Q}$  decreases significantly when increasing the cooling water temperature. It can also be concluded that non-zero tail velocities of steam have the same effect on  $\dot{Q}$ .

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## **Designing a steam condenser for water desalination for parabolic trough solar thermal energy plant**

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Theoretical comparison of material usage and cost of two types of cross-flow steam condensers that can be used for water desalination in conjunction with a parabolic trough solar energy concentrator type plant (PTC) is reported. Traditional shell and tube condenser (steam flows inside the tubes) and surface condenser where steam flows in the shell and cooling water flows in the tubes are considered in this study. It has been found that the energy production from the PTC of dimension  $4.5 \text{ m} \times 4.8 \text{ m}$  with the aperture area of  $22.3 \text{ m}^2$  is  $19.7 \text{ kW}$ . It has been calculated that the distilled water production capacity of the solar energy harnessing system per day is  $55.6 \text{ l}$  by assuming solar irradiance as  $0.9 \text{ kW m}^{-2}$  and the efficiency of solar energy harnessing system is  $50 \%$ , if the sun is available for four hours. The cooling water input temperature was assumed to be  $30^\circ\text{C}$ , the minimum length required for a SS 304 tube of  $\varnothing 9.5 \text{ mm}$  is  $7.16 \text{ m}$  for the traditional condenser and  $1.30 \text{ m}$  for the surface condenser.

The efficiency of the traditional condenser is reduced due to the formation of a condensed water layer on the surface of the tube, as it acts as a thermal barrier, but in the surface condenser, efficiency is enhanced due to easy condensation while pressurizing the system, density separation of wet vapour by changing the flow direction near the wet sump. Fabrication cost and maintenance cost are also found to be less in the surface condenser.

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## **Controlling of a parabolic trough concentrator for tracking sun by implementing solar position algorithm on a microcontroller**

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Controlling a Parabolic Trough Concentrator (PTC) is playing a major part in collecting solar energy and it directly affects increasing the efficiency of the plant. The Solar Position Algorithm (SPA) is a well known predefined algorithm, which is mostly used to control such systems with high accuracy. A mid-scale PTC was used to control tracking the sun by implementing SPA on an eight-bit ATmega32 microcontroller as a low cost reliable controlling system. Solar azimuth and zenith angles were calculated using the SPA, considering the geometrical factors in order to obtain the single axis tracking angle values for the PTC. These tracking angles were then written into a lookup table on a Secure Digital (SD) card with the time value. When the time value of the real time clock of the controlling system matches with that of the lookup table, the corresponding tracking angle value is extracted and the PTC is rotated accordingly by activating the mechanical actuator system. Since the diameter of the Heat Collecting Element (HCE) of the PTC is 90 mm, the concentrated solar beam has a linear position tolerance of  $\pm 37$  mm from the theoretical focal line of the parabola and it leads to an angular tolerance of  $1.3^\circ$  around the tracking axis of the PTC. Therefore, the PTC should track the sun at four minutes intervals in order to maintain the concentrated solar beam on the HCE within the above maximum acceptance range. Hence the mechanical actuator system should be activated only in four minutes intervals, and it leads to a reduction in the power consumption of the entire controlling system. It was found that the power consumption is 198 W when the mechanical actuator is activated and 5 W when the system is in the standby condition.

## **Analysis of a two-wheeled self-balancing autonomous robot**

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Two-wheeled self-balancing robots have become popular among robot enthusiasts in the recent years, mainly due to the success of the Segway. In this work, such a robot was constructed and its performance was experimentally analyzed in order to find its suitability as a self-balancing platform for mounting a robotic arm for purposes like fruit picking. The two wheeled robot, constructed by following widely available recipes in the Internet, consisted of an Arduino Uno microcontroller board, an MPU6050 motion tracking device with a 3-axis accelerometer and 3-axis gyroscope. The two wheels were controlled by two independent DC motors. The best estimate of the inclination angle of the robot was calculated by combining data from the accelerometer and the gyroscope. A PID controller used the inclination angle as an input to generate a counterbalancing signal for the motors, in order to keep the robot from falling. A Bluetooth communication link between the robot and a smart phone was used for real-time data acquisition and control. By varying the response time of the controller, it was found that, unless the controller generates counter balancing signals at time intervals less than 50 ms, the system was not able to keep its balance. In normal operation of self-balancing robots, the controller is programmed to maintain the inclination angle at zero. It was also found that the system was capable of maintaining stability at inclinations (in either direction) of the order of 1 degree, without falling. However, when travelling on inclined planes, and when doing various manoeuvres of an arm attached to the robot it was necessary to set the desired value of the inclination angle to non-zero values.

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### **Cu<sub>2</sub>O thin film based LP gas sensor of spiral geometry**

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Detection of possible leakages of liquefied petroleum (LP) gas is of utmost importance in its usage in industrial and domestic applications. The present abstract reports the fabrication of *n*-type Cu<sub>2</sub>O layered structures on a Cu substrate with spiral geometry (coil), its characterization, and performance as an LP gas sensor. Thin films were potentiostatically deposited in a three electrode electrochemical cell. A bath containing a mixture of sodium acetate and cupric acetate was used for the electrodeposition of *n*-type Cu<sub>2</sub>O layered structure on Cu coil. The topographical properties of the deposited thin films were analyzed by scanning electron microscopy (SEM) which revealed microcrystalline structure. The gas sensing properties of the coil made using conductometric measurements were studied by placing it inside a custom made sensor chamber with contacts made of thin copper wires. Ambient resistance was measured by sending dry air into the chamber and allowing it to equilibrate. Thereafter, LP gas (100 %) was mixed with an incoming dry air flow at 1:100 ratio and sent to the gas chamber until steady state resistance was achieved while maintaining the thin film at constant temperature. Measurements were repeated at different temperatures. It was observed that upon exposure to LP gas, the resistance of the film increases and reaches to a steady state around 4-5 min. The sensitivity of the film increases with temperature. Furthermore, in the temperature range 90 °C - 140 °C the film shows good recovery characteristics.

## **Sri Palee Campus**



## **Message from the Rector**



I am delighted to write this message to the annual research symposium journal of the University of Colombo, 2015.

Peirce discusses four methods of knowing: Tenacity, Intuition, Authority and Science. Many attempt to apply science to find answers. It is their belief that “truth” is found through a series of objective analyses. One of the glories of scientific endeavour is that any scientific belief, however firmly established, is constantly being tested to see if it is truly universally valid. Also, the scientific method may be inappropriate in many areas of life. Therefore it is interesting to find all these methods applied in one place.

This symposium proceeding seemed to provide a lifelong experience to all researchers whose genuine effort is to investigate modern facts. Also, it contains research in different academic disciplines such as medicine, engineering, education, humanities, management, law etc. Therefore this academic piece of writing can be considered as a valuable handbook or a model research journal for academics from all disciplines. It also can be evaluated as a primary source for many scholars. Considering the appealing and prominent academic interest in this journal, I believe that this resource reference may find a place in all public and private libraries of academia in the world.

I thank all those who contributed to this journal and I wish all the participants at this symposium a fruitful time at their respective sessions.

Dr. Ranjan Hettiarachchi  
Rector, Sri Palee Campus

## **Sri Palee Campus**

### **List of Abstracts**

- |    |   |     |
|----|---|-----|
| 1. | A case study on child language acquisition in a trilingual communication environment  | 146 |
| 2. | Research on the cinematic interest of Sri Lankan youth and its new trends   | 147 |
| 3. | Social media adoption behaviour among international students in a transnational environment: A case study based on Wuhan University in China. | 148 |

## **A case study on child language acquisition in a trilingual communication environment**

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This study mainly focuses on language growth of a six year old trilingual child who was born in Sri Lanka but grew up in Japan until the age of four, and has now been living in Sri Lanka for almost two years. It also reports how the child masters one code at the expense of another at a later stage. The regular language growth recordings reported that the child grew up as a trilingual child picking Japanese, English and Sinhala as her main means of communication in relevant social contexts. This study was basically based on qualitative data, which were collected throughout her two year stay in Sri Lanka since she returned from Japan. The study showed that the multilingual child differentiated the languages she was exposed to. The results did not support the claim of delay in language development of the multilingual children. Children who experience a balanced exposure to more than one language develop those languages simultaneously. When language exposure is less balanced, there may be more linguistic transfer and more frequent use of the vocabulary system of one language in the grammatical system of the other.

## **Research on the cinematic interest of Sri Lankan youth and its new trends**

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Sinhalese voice cinema started from “Kadawunu Porondura” in 1947 and reached its golden era at 1960s and 1970s. Those days, cinema was the most famous art form of the young generation.

“Cinema” has now been extended from national cinema to international cinema. Internationally cinema has become a very profitable industry nowadays. As a result, several films are screened in the same cinema complex at the same time and these advanced cinema complexes are called multiplexes. As the next step, a market place has been created for buying DVDs of the films produced in various countries, at affordable prices. But when we compare this with Sri Lanka’s context, the reality is that cinema goes decrease gradually. This has resulted in lowering the income for theatre.

While considering this matter, the aim of this study was to understand the Sri Lankan younger generation's cinematic interest, and moreover, to observe the new trends of their cinema entertainment. The research was done based on the students entering the department of Performing Arts at the Sri Palee campus in 2015, and the method of questionnaire, interviewing and observation was used for this research.

It was revealed that people show more interest in children’s movies and family movies, than ones which are made for youth. Even though the world cinema is at a very sound footing, still Sinhala Cinema is the first choice of the young generation of Sri Lanka. Some social factors have been the root cause for the decrease of the number of fans going to cinema halls. Moreover, now Sri Lankan cinema fans easily get access to films via DVDs. This situation also explains why Sri Lankan cinema fans are not interested in going out for movies.

**Key words:** Golden era, national cinema, young generation, children’s movie

**Social media adoption behaviour among international students in a transnational environment: A case study based on Wuhan University in China.**

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In the past decades, China has made noticeable progress in the education sector, especially, with regard to increased immigration of international students (Nzivo & Chuanfu, 2013). According to the CSC data China has become a leading country in Asia to receive international students with 6% of the total international mobility. This results in converting the Chinese university community to a transnational one. There is a close relationship between transnational society and communication technology. According to Giddens' Structuralism Theory (1990), transnational concepts represent the 'embedding' activities that help emigrants reconnect with local structure and institutions despite their physical absence from the community (Fong *et al*, 2010). This paper examines social media adoption behaviour among international students in the transnational environment in the Wuhan University in China. A survey method was used to collect data and the sample was selected among international students who are studying in Wuhan University. A questionnaire was used as the research instrument to collect primary data. Despite the distribution of 250 questionnaires to international students, only 216 (86.4%) were received from them.

Legal risk, privacy, credibility, convenience, copyright, cost, time and permanency influence adoption behaviour of social media among international students in Wuhan University. These media sites are used by post-graduate students to achieve their educational and entertainment purposes. When considering major study areas, variation in using social media can be observed even among the students in the same major subjects. The usage of social media would be determined by the individual expectations of the international students. Although social media like FaceBook, Twitter, LinkedIn, blogs, wikis, and other virtual communities help create new opportunities to build up diverse relationships with each other, there are many inherent legal risks that everyone has to face unenthusiastically. The university students are more concerned about legal risk, and the frequency with which they use a social media sites decreases. The unique characteristic feature of media usage in China is the restriction applied to popular media sites and the introduction of alternative Chinese native social media sites instead. Therefore learning the native language will be beneficial for approaching social media. Hence, it can be concluded that native social media usage by international students in China is positively affected by Chinese language proficiency.

**Key Words:** Social media, international students, legal risk, credibility, individual expectation, adoption behaviour.



## UNIVERSITY OF COLOMBO, SRI LANKA