Digital Health Week 2018
7 – 12 October 2018
CINNAMON GRAND COLOMBO, SRI LANKA
www.dhw2018.org

PROGRAMME BOOK

Asia Pacific Association for Medical Informatics
## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Message from His Excellency the President of Sri Lanka</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message from the Prime Minister of Sri Lanka</td>
<td>2</td>
</tr>
<tr>
<td>Message from the Minister of Health, Nutrition &amp; Indigenous Medicine</td>
<td>3</td>
</tr>
<tr>
<td>Message from the President of APAMI</td>
<td>4</td>
</tr>
<tr>
<td>Message from the President Elect - APAMI</td>
<td>5</td>
</tr>
<tr>
<td>Programme in Detail</td>
<td>6</td>
</tr>
<tr>
<td>Abstracts – APAMI 2018</td>
<td>16</td>
</tr>
<tr>
<td>Abstracts – Global Telehealth 2018</td>
<td>95</td>
</tr>
<tr>
<td>Southampton Travel Awards Recipients</td>
<td>114</td>
</tr>
<tr>
<td>APAMI Bursary Recipients</td>
<td>115</td>
</tr>
</tbody>
</table>
MESSAGE FROM HIS EXCELLENCY THE PRESIDENT OF SRI LANKA

MESSAGE

I am pleased to send this message on the occasion of the Digital Health Week 2018 which will be held from 07th – 12th October in Colombo, Sri Lanka.

The international conferences to be held during the Digital Health Week on the theme ‘Transforming Healthcare through Digital Health Innovation’ is focused on using ICT in healthcare to improve health care services and patient outcomes.

I have no doubt that the conferences would carry forward the momentum created by the establishment of the Commonwealth Centre for Digital Health in April this year and contribute to the development of Health Systems not only in Sri Lanka but globally. I am pleased to know that over 600 delegates from more than 60 countries are attending this year’s event.

I would like to congratulate Professor Vajira H.W. Dissanayake for bringing honour to Sri Lanka by being appointed President of yet another international organisation, this time the Asia Pacific Association for Medical Informatics.

I wish all the conferences that are part of the Digital Health Week 2018 every success.

Maithripala Sirisena

October 01, 2018
MESSAGE FROM THE HON. PRIME MINISTER

Digital electronics have been able to make most of the functions much more convenient and reduce inefficiencies. In this context, the convergence of digital revolution with health and healthcare is indispensable to ensure a quality and an efficient health service throughout the country.

I am pleased to note that the global event of the Digital Health Week themed ‘Transforming Healthcare through Digital Health Innovation’ is perfectly timed to support such initiatives in Sri Lanka with the aim of improving public health and society through the enhanced healthcare delivery, improved quality and access to healthcare services, reducing costs and many more.

The event organised by the Health Informatics Society of Sri Lanka in collaboration with many other leading institutions in the field will be an opportunity for the digital health professionals from around the world to deliberate on the promotion and development of Digital Health.

I would like to extend a very warm welcome to all the delegates who will take part in the Digital Health Week 2018 in Colombo representing 60 countries and I wish the event every success.

Ranil Wickremesinghe
Prime Minister

September 27th 2018
MESSAGE FROM THE MINISTER OF HEALTH, NUTRITION & INDIGENOUS MEDICINE

Message from the Hon. Minister of Health, Nutrition & Indigenous Medicine

It gives me great pleasure to send this message for Digital Health Week 2018.

In the past three years I have seen the rapid growth of digital health around the world. I recognise the important role that Digital Health would play towards achieving Universal Health Coverage by 2030. Sri Lanka has taken important steps to implement Digital Health to strengthen our health care delivery system that would be showcased at the event. We hope that our lessons would be valuable to others, and we would be able to learn from the experiences of others from around the world.

I am pleased to see that so many international organisations involved in Digital Health from around the world have chosen Colombo, Sri Lanka as the venue to meet this year. I see this as a recognition of the role that Sri Lanka has played in promoting Digital Health around the world since Sri Lanka took the leadership in the Commonwealth Medical Association in 2016.

I understand that over 600 delegates from over 60 countries would be attending Digital Health Week 2018. I wish to welcome all of them to Sri Lanka and wish them a fruitful conference and a pleasant stay in Sri Lanka.

Dr Rajitha Senaratne M.P.
Minister of Health, Nutrition and Indigenous Medicine

October 03rd 2018
MESSAGE FROM THE PRESIDENT OF APAMI

Dear Colleagues,

On behalf of Asia-Pacific Association for Medical Informatics (APAMI), it is our pleasure and Privilege in extending you a cordial invitation to participate at the Conference of APAMI 2018 to be held in Colombo, Sri-Lanka, from 8th October to 12th October 2018.

Sri Lanka, a small island nation, is a fascinating island that we have never met before, with many nicknames such as Serendib, Ceylon, teardrops from India, and pearls from the East. A variety of historical sites, folk culture and unique food, as well as a safari with wildlife, will be a chance to experience a new culture. The venue, the Cinnamon Grand Hotel, is the finest hotel in Colombo located in the largest city of Sri Lanka. It is a place where we can make the best academic program with comfort.

The theme of the conference “Transforming healthcare through innovation in Digital Health” aims to encourage researchers, practitioners, nurses, scientists, healthcare workers and suppliers from across the world to cooperate, share knowledge and experience to use information technology to improve the healthcare status of people.

Apart from the outstanding scientific program, trade fair and social events; the conference will provide an excellent opportunity to forge new relationships with professional colleagues from various nations including the Asia Pacific region. We welcome you to Colombo and to the conference.

With warm regards,

Dr. Kyunghee Cho
President
Asia Pacific Association for Medical Informatics (APAMI)
MESSAGE FROM THE PRESIDENT ELECT-APAMI

The Health Informatics Society of Sri Lanka (HISSL) was founded on 18 November 1998. It was inspired by the establishment of APAMI and the need for Sri Lanka to be represented in the APAMI family through our own Society. I can remember attending the APAMI conference in Hong Kong in 2001 representing HISSL. It gives me great pleasure therefore to welcome all of you, not only from the Asian region but from around the world, to APAMI 2018. It is a pleasure for us to host you all in Colombo.

October 2018 also marks the 25th Anniversary of the Asia Pacific Initiative of the International Medical Informatics Association launched at its General Assembly in October 1993 which lead to the establishment of APAMI. So it is an opportune time for APAMI to reflect on its role for the next 25 years. Biomedical and Health Informatics has graduated from being the pastime of computer savvy doctors to a medical specialization with its own process of board certification. Today physicians can literary ‘prescribe’ Apps to patients. This was not the world that we lived in 25 years ago. In that context it is necessary to consider the broad scope of the academic discipline of biomedical and health informatics and reflect on the role that APAMI should play in promoting the discipline.

Implementation of what we do as academics lies with governments. In that respect, the role that the Asia eHealth Information Network (AeHIN) plays is tremendous. The co-location of the AeHIN Annual General Assembly and APAMI 2018 back to back in Colombo has given us the opportunity to forge links with governments, intergovernmental agencies and international development partners. I hope that this would lead to establishment of a strong partnership between AeHIN and APAMI.

I wish you an enjoyable conference as well as an enjoyable visit to Sri Lanka.

Prof. Vajira H. W. Dissanayake
President-Elect
Asia Pacific Association for Medical Informatics (APAMI)
## PROGRAMME IN DETAIL

### 09TH OCTOBER 2018: INAUGURATION

<table>
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<tr>
<th>Time</th>
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<tr>
<td>6.00 pm</td>
<td>Guests Take Their Seats</td>
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<td>6.15 pm</td>
<td>Arrival of the Chief Guest and Guest of Honour</td>
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<td>6.20 pm</td>
<td>Introduction of the Chief Guest and Guest of Honour to APAMI Executive</td>
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<td>6.30 pm</td>
<td>Procession Enters the Hall</td>
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<td>6.35 pm</td>
<td>National Anthem</td>
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<td>6.40 pm</td>
<td>Traditional Lighting of the Oil Lamp</td>
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</table>
| 6.45 pm | Welcome Address  
*Prof. Vajira H. W. Dissanayake*  
President, HISSL and Chairperson, Specialty Board in Biomedical Informatics, University of Colombo Sri Lanka |
| 6.50 pm | Address by the President of APAMI  
*Dr. K. H. Cho*  
President, Korean Society for Medical Informatics South Korea |
| 7.00 pm | Keynote Address 1  
Clinical Decision Support to Improve the Quality of Care  
*Prof. Christoph Lehmann,*  
Professor of Biomedical Informatics and Pediatrics  
Vanderbilt University Medical Centre, USA  
President, International Medical Informatics Association |
| 7.30 pm | Keynote Address 2  
The World Tomorrow: Technology Clinical Trials and Healthcare?  
*Prof. James Batchelor*  
Professorial Fellow of Clinical Informatics & Healthcare Innovation  
Director, Clinical Informatics Research Unit  
University of Southampton  
UK |
| 8.00 pm | Address by the Guest of Honour |
| 8.10 pm | Address by the Chief Guest |
| 8.20 pm | Presentation of APAMI Bursaries and Southampton-APAMI Travel Awards |
| 8.30 pm | Group Photo  
*Chief Guest, Guest of Honour, APAMI Executive* |
| 8.35 pm | Vote of Thanks  
*Dr. Rohana Marasinghe*  
President Elect, HISSL |
| 8.45 pm | Cultural Show |
| 9.00 pm | Reception |
## 10th October 2018: Conference Day 1

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>APAMI Track 1 (Oak - Main Hall)</th>
<th>APAMI Track 2 (Oak - Hall B)</th>
<th>Global Telehealth 2018 (Cedar Room)</th>
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<tr>
<td>08:00</td>
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<td>08:30</td>
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<td>APAMI/GT Registration</td>
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<tr>
<td>08:30</td>
<td>09:15</td>
<td>Plenary Talk 1: Consumer Health Informatics</td>
<td>Sabine Koch, President Elect, IMIA Strategic Professor of Health Informatics at Karolinska Institutet, Sweden</td>
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<tr>
<td>09:15</td>
<td>10:45</td>
<td>Symposium 1: Connected and Digital Health</td>
<td>Introduction by chair Clive James, Sri Lanka</td>
<td>Introduction by chair Oommen John India</td>
</tr>
<tr>
<td>09:15</td>
<td>10:45</td>
<td>Symposium 2: Health Systems Strengthening</td>
<td>Introduction by chair Sabin Koch, President Elect, IMIA Sweden</td>
<td>Continuity of care for chronic diseases</td>
</tr>
<tr>
<td>09:30</td>
<td>09:50</td>
<td>A pilot project on interoperability between public health information system and EMR/ EHR in China Hui Ge China</td>
<td>09.30-09.50 A pilot project on interoperability between public health information system and EMR/ EHR in China. Hui Ge, China.</td>
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<tr>
<td>09:40</td>
<td>10:00</td>
<td>Virtual Reality for Active Ageing: A feasibility study in Taiwan Shabbir Syed-Abdul Taiwan</td>
<td>09.40-10.00 Virtual Reality for Active Ageing: A feasibility study in Taiwan. Shabbir Syed-Abdul, Taiwan.</td>
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<td>09:50</td>
<td>10:00</td>
<td>Using PHR and PM2.5 Open Data to Build a Web Based Smart Upper Respiratory Disease Alerting System Hsiu An Lee Taiwan</td>
<td>10.00-10.00 Using PHR and PM2.5 Open Data to Build a Web Based Smart Upper Respiratory Disease Alerting System. Hsiu An Lee, Taiwan.</td>
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<td>10:00</td>
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<td>Designing standardized message based on clinical concept models for nation-wide EHR system. Shinji Kabayashi Japan</td>
<td>10.00-10.20 Designing standardized message based on clinical concept models for nation-wide EHR system. Shinji Kabayashi, Japan.</td>
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<td>10:10</td>
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<td>Users perception toward the usefulness of the web-based system for disease surveillance: a qualitative study Lutfan Lazuardi Indonesia</td>
<td>10.10-10.20 Users perception toward the usefulness of the web-based system for disease surveillance: a qualitative study. Lutfan Lazuardi, Indonesia.</td>
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<td>10:30</td>
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<td>Q&amp;A</td>
<td>Q&amp;A</td>
<td>10.40-10.45 Closing Remarks</td>
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<td>10.45</td>
<td>11.00</td>
<td>Tea</td>
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<tr>
<td>Time</td>
<td>Symposium 3: Human, organisational, and social aspects</td>
<td>Symposium 4: Human, organisational, and social aspects</td>
<td>Session GT2 – Keynote Papers</td>
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<tr>
<td>11.00</td>
<td>Introduction by Chair Kyunghee Cho Republic of Korea</td>
<td>Introduction by Chair Pradeep Sylva Sri Lanka</td>
<td>Introduction by Chair Anthony Maeder Australia</td>
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<tr>
<td>11.05</td>
<td>Recent development of medical informatics in Hong Kong Chun Por Wong (HKSMI) Hong Kong</td>
<td>Evaluation of the acceptance of a mobile verbal autopsy App by public health midwives in Sri Lanka Chamika Senanayake Sri Lanka</td>
<td>Invited 1: Methodologies for Improving the Quality and Safety of Telehealth Systems Elizabeth Borycki Canada</td>
<td></td>
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<tr>
<td>11.15</td>
<td>The Fourth Industrial Revolution and medical informatics. Polun Chang – Taiwan, Jack Li (TAMI) – Taiwan</td>
<td>Simplifying the Complex: Mind the Governance, Architecture, Program Management, Standards and Interoperability Alvin Marcelo Philippines</td>
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<tr>
<td>11.25</td>
<td>Emerging Digital Health Ecosystem Vajira Dissanayake Sri Lanka</td>
<td>Understanding User Emotional Expression in Community Question Answering website for the Social Incidents: A Sentiment Analysis of Zhihu.com Yaotan Xie China</td>
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<tr>
<td>11.35</td>
<td>Big Data Project and international collaboration Dai Jin Kim (CUK) Republic of Korea, In Young Choi (KOSMI) Republic of Korea</td>
<td>Health Information Systems Online Course for Public Health Practitioners in Indonesia Ni’mah Hanifah Indonesia</td>
<td>Speaker Q&amp;A</td>
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<tr>
<td>11.45</td>
<td>Digital Health enabling Universal Health Coverage in India: Ayushman Bharat Oommen John (IAMII) India</td>
<td>Perceived improvement of the process of patient care by digitization of primary health care encounters in OPD set-up of a tertiary care hospital through the lens of the health professionals Neranga Liyanaarachchi Sri Lanka</td>
<td>Introduction by Chair</td>
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<tr>
<td>11.55</td>
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<td>11.50-12.20 Highlight 1 Selfie Telemedicine – What Are The Legal and Regulatory Issues? Maurice Mars South Africa</td>
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<tr>
<td>12.05</td>
<td>Q&amp;A</td>
<td>Q&amp;A</td>
<td>12.20-12.30 Speaker Q&amp;A</td>
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<tr>
<td>12.30</td>
<td>Plenary Talk 2: The DHIS2 Open Source eHealth Network in Asia: Collaboration and Synergies. Examples from Sri Lanka, Lao PDR, India and Indonesia Prof Jørn Braa, Senior Professor Department of Informatics, Faculty of mathematics and natural Science, University of Oslo, Norway.</td>
<td>Lunch</td>
<td></td>
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<tr>
<td>Time</td>
<td>Symposium 5: Application of AI in Medicine &amp; Health Care – 1</td>
<td>Symposium 6: Human, organisational, and social aspects – 2</td>
<td>Session GT3 – Keynote Papers</td>
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<tr>
<td>14.00</td>
<td>Introduction by chair Nirmala Cooray Sri Lanka</td>
<td>Introduction by Chair Achala Jayatilleke Sri Lanka</td>
<td>14.00-14.05 Introduction by Chair Maurice Mars South Africa</td>
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<tr>
<td>14.05</td>
<td>Application of Artificial Neural Network to Predict Chronic Kidney Disease Tahmina Nasrin Poly Taiwan</td>
<td>Health Information Literacy and Obstacle in Online Health Information Seeking Among Digital Immigrants Wang Fuzhi China</td>
<td>14.05-14.35 Invited 2: Citizens &amp; Health Data – untapped resource for Telehealth Anne Moen Norway</td>
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<td>14.15</td>
<td>Application of Machine learning to Predict Survival of Hepatocellular Carcinoma Patients Mohaimenul Islam Taiwan</td>
<td>Citizen’s attitudes for handling their healthcare record by IT, 10 years change between 2008 and 2018 Michio Kimura Japan</td>
<td>14.35-14.45 Speaker Q&amp;A</td>
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<tr>
<td>14.25</td>
<td>Accurate detection of fibula malrotation based on 2D-3D registration Yan Li China</td>
<td>Case study: Integrating eHealth into basic training curricula to transform allied health professionals education in government health sector Neranga Liyanaarachchi Sri Lanka</td>
<td>14.45-14.50 Introduction by Chair</td>
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<tr>
<td>14.45</td>
<td>Explore AI assisted imaging tasks Zhi Yang China</td>
<td>Strengthening HIS through social media: Reflection of whatapp use in DHIS2 implementation in Indonesia Guardian Sanjaya Indonesia</td>
<td>15.20-15.30 Speaker Q&amp;A</td>
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<td>14.55</td>
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<td>Key stakeholder perspectives on alignment of digital health initiatives with institutional strategies at a Tertiary Care Hospital in Sri Lanka. Pradeep Sylva Sri Lanka</td>
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<td>15.05</td>
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<td>Preliminary results of health information use promotion using DHIS2 in Indonesia: a realist evaluation approach Jørn Braa Norway</td>
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<tr>
<td>15.15</td>
<td>Q&amp;A</td>
<td>Q&amp;A</td>
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15.30 15.45 Tea
<table>
<thead>
<tr>
<th>Time</th>
<th>Symposium 7: Nursing Informatics</th>
<th>Symposium 8: Health Data Science – 1</th>
<th>Session GT4 – Innovations in Telehealth (Short Talks)</th>
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<tbody>
<tr>
<td>15.45</td>
<td>Introduction by Chair Oommen John</td>
<td>Introduction by chair M H Abusayeed</td>
<td>Introduction by Chair Shashi Gogia</td>
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<tr>
<td></td>
<td>India</td>
<td>Sri Lanka</td>
<td>India</td>
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<tr>
<td>15.50</td>
<td>Nursing interventions improving patient safety</td>
<td>Identifying Important Factors of Falling Accidents in Acute Hospital using Machine-Learning Techniques</td>
<td>The importance of effective communication during conventional face-to-face care delivery, and during telehealth (aka telemedicine) encounters</td>
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<td>Patrick Weber, Vice President, IMIA</td>
<td>Yasunobu Nohara</td>
<td>Eric Gombrich</td>
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<td>Switzerland</td>
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<td>Canada</td>
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<tr>
<td>15.45-15.55</td>
<td>Relationships between Violence and socio-demographic factors a spatial analysis in selected provinces of Sri Lanka.</td>
<td>The Evolution of Telehealth: moving from use-case specific telehealth technology to Unified Telehealth</td>
<td>We don't need new technology in telemedicine we need a new business model</td>
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<td>Rohan Jayasuriya</td>
<td>Eric Gombrich</td>
<td>N Williams</td>
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<td>Australia</td>
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<td>15.10</td>
<td>The Nurses’ Role in Improving Software Quality: How Nurse’s Can Reduce Technology-induced Error and Optimize Healthcare</td>
<td>Using Medications to predict diagnosis codes by multi-label classification</td>
<td>Comprehensive approach to the National Network of Teleaudiology in Word Hearing Center in Kajetany, Poland</td>
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<td></td>
<td>Elizabeth</td>
<td>Chen-Cheng Kuo</td>
<td>P Skarzynski</td>
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<td>Borycki University of Victoria, Canada</td>
<td>Taiwan</td>
<td>Poland</td>
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<td>15.20</td>
<td>Implementation of Nursing Care Plans and International Classification of Nursing Practice nomenclature at the National Hospital of Sri Lanka</td>
<td>Using IBM Watson in quality and safety assessments</td>
<td>The development of a gastric cancer risk prediction model among Koreans based on data collected from National Health Insurance Service</td>
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<td></td>
<td>Kithsiri Mulleryawwa</td>
<td>Petter Hurlen</td>
<td>J Choi</td>
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<td>Norway</td>
<td>Republic of Korea</td>
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<td>15.30</td>
<td>An RCT to assess the effectiveness of nurse-led structured telephonic based heart failure management program – A pilot study.</td>
<td>The association between ehealth literacy and health behaviours in young and midlife adults in Polish population</td>
<td>Health Information System Reforms in Kiribati</td>
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<td>Gopichandran Lakshmanan</td>
<td>Mariusz Duplaga</td>
<td>T Tabunga</td>
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<td>India</td>
<td>Poland</td>
<td>Kiribati</td>
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<td>15.40</td>
<td>End-user Perception and Challenges Encountered in Implementation of mHealth Solution for Public Health Surveillance at field level: A case from Sri Lanka</td>
<td>Defining web based indicators to evaluate disaster shelters</td>
<td>Comparison of work burden on nursing care providers with and without a sensing system: an empirical study</td>
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<td>Pamod Amarakoon</td>
<td>Gumindu Kulatunga</td>
<td>S Itoh</td>
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<td></td>
<td>Sri Lanka</td>
<td>Sri Lanka</td>
<td>Japan</td>
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<tr>
<td>16.45-15.55</td>
<td>Connections For Saving Lives- A Review of different models of tele medicine under National Health Mission in India</td>
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<td>D Agarwal</td>
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<td>India</td>
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<td>Time</td>
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<tr>
<td>16.50</td>
<td>Q&amp;A</td>
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<tr>
<td>17.05-17.15</td>
<td>Healthcare accessibility for North East India: A Nagaland Telemedicine Pilot Project R Adholeya India</td>
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<td>17.15-17.25</td>
<td>Cloud driven application for measurement of wound size S Gogia India</td>
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<td>17.15</td>
<td>Plenary Talk 3: Nursing Informatics – Challenges and Opportunities</td>
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<td></td>
<td>Patrick Weber</td>
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<td>Director of NICE Computing AG, Switzerland</td>
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<td>19.00</td>
<td>21.00</td>
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<td>APAMI GA (By Invitation Only)</td>
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### 11th October 2018: Conference Day 2

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Speakers</th>
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<tbody>
<tr>
<td>08.30</td>
<td></td>
<td>Plenary Talk 4: Innovations for Future-Ready Health Systems: Moving Beyond Pilots and Quick Fixes</td>
<td>Oommen John, Senior Research Fellow, The George Institute for Global Health</td>
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<tr>
<td>09.15</td>
<td>09.45</td>
<td>Symposium 9: Telehealth and mHealth</td>
<td>Introduction by chair Gyan Piyasena, Sri Lanka</td>
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<td>Symphony 10: Knowledge Management – 1</td>
<td>Introduction by chair Anuradha Jayatilake, Sri Lanka</td>
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<tr>
<td>09.15</td>
<td>09.45</td>
<td>The role of telehealth in the provision of culturally appropriate care for Aboriginal Australians</td>
<td>Danette Longbecker, Australia</td>
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<td>Assessment of the Implementation of Standardized Terminology in Community Care by Analyzing Community Clinical Pathways</td>
<td>Ryoma Seto, Japan</td>
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<tr>
<td>09.30</td>
<td>09.40</td>
<td>Developing Theory based Mobile applications: a case study of developing an application for sedentary behaviour in Bangladesh</td>
<td>Rohan Jayasuriya, Australia</td>
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<td>A regional (six country) aggregated DHIS2 health data platform lessons learned</td>
<td>Edwin Monk-Fromont, New Zealand</td>
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<td>09.40</td>
<td>09.50</td>
<td>Test piloting of a mHealth application for Non-Communicable Diseases in Public Primary Care settings in India</td>
<td>Pramod David Jacob, India</td>
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<td>Development of Knowledge Portal for Pharmaceutical Research</td>
<td>Peixiang YANG, China</td>
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<td>Transformation of Environmental, Occupational Health and Food Safety data flow</td>
<td>Prabhadini Godage, Sri Lanka</td>
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<td>09.50</td>
<td>10.00</td>
<td>A mobile application for doctors to improve the recording of Cause of Death: A Sri Lankan study</td>
<td>Rangana Wadugedara, Sri Lanka</td>
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<td>Feasibility of remote vital signs monitoring in frontline military hospitals</td>
<td>Lalan Fernando, Sri Lanka</td>
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<td>Exploring Key Elements for Successful Telehealth Implementation within Severely Under-Resourced Communities: A Case Study in the Pacific Islands</td>
<td>C Higa, USA</td>
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<td>10.00</td>
<td>10.10</td>
<td>Connections For Saving Lives- A Review of different models of telemedicine under National Health Mission in India</td>
<td>Disha Agrawal, India</td>
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<td>Assessment of eRHMIS school health information system usability among users in Kegalle and Anuradhapura Districts</td>
<td>Ashan Dimal, Sri Lanka</td>
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<td>Implementation of a Free and Open Source Picture Archiving and Communication Solution (PACS) for the largest specialized paediatric hospital in South Asia</td>
<td>M U T Perera, Sri Lanka</td>
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<td>10.10</td>
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<td>Cloud-Base Home Environment Health Monitoring Framework</td>
<td>Assessment of eRHMIS school health information system usability among users in Kegalle and Anuradhapura Districts</td>
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## Symposium 11: Application of AI in Medicine and Health Care - 2

<table>
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<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Speaker</th>
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<tr>
<td>11:00</td>
<td>Int 1</td>
<td>Introduction by Chair Anoma Jayaratne Sri Lanka</td>
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<tr>
<td>11:05</td>
<td>Paper 1</td>
<td>Listing differential diagnoses from symptoms of patients with vertigo using knowledge graph</td>
<td>Satoshi Iwai Japan</td>
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<tr>
<td>11:15</td>
<td>Paper 2</td>
<td>Bioinformatics Database Research Platform for Internet Addiction</td>
<td>Sun Jung Lee Republic of Korea</td>
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<td>11:25</td>
<td>Paper 3</td>
<td>Development of visual diagnostic tool in R for precursors of Cervical Cancer</td>
<td>Kumar Dron Shrivastav India</td>
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<tr>
<td>11:35</td>
<td>Paper 4</td>
<td>Automatic and accurate recognition of corneal morphology from OCT images of rabbits</td>
<td>Bo Wu China</td>
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<tr>
<td>11:45</td>
<td>Paper 5</td>
<td>Positioning of optical surgical instruments and acquisition of point cloud data</td>
<td>Nan Zhang China</td>
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<tr>
<td>11:55</td>
<td>Paper 6</td>
<td>Clinical and pathological evaluation of renal cell carcinoma by Radiomics based on machine learning</td>
<td>Zhangshen Shi China</td>
</tr>
<tr>
<td>12:05</td>
<td>Paper 7</td>
<td>Restructuring the Annual Health Bulletin: Incorporating advanced data analytics and visualizations to improve usability</td>
<td>W K D K K Wijayaweera Sri Lanka</td>
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### Session GT6 – Keynote Papers

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>11:00</td>
<td>Paper 8</td>
<td>Introduction by Chair Lasantha Ranwala Sri Lanka</td>
<td></td>
</tr>
<tr>
<td>11:05</td>
<td>Paper 9</td>
<td>Geo-enable health facility list: linking healthcare and public health data</td>
<td>Guardian Yoki Sanjaya Indonesia</td>
</tr>
<tr>
<td>11:15</td>
<td>Paper 10</td>
<td>Using a Machine Learning Approach for Analyzing Standardized Data from the Pulmonary Resection Clinical Pathway</td>
<td>Takanori Yamashita Japan</td>
</tr>
<tr>
<td>11:35</td>
<td>Paper 12</td>
<td>Wearable technologies in clinical trials: An analysis of development trends over the past decade</td>
<td>Ashish Kakkar India</td>
</tr>
<tr>
<td>11:45</td>
<td>Paper 13</td>
<td>The TB Portals: Using data science and informatics to advance TB research through open-access, web-based sharing and analysis of integrated, multi-domain TB patient case data</td>
<td>Jessica Taaffe USA</td>
</tr>
<tr>
<td>12:05</td>
<td>Paper 15</td>
<td>Restructuring the Annual Health Bulletin: Incorporating advanced data analytics and visualizations to improve usability</td>
<td>W K D K K Wijayaweera Sri Lanka</td>
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## Symposium 12: Health Data Science – 2

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<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Speaker</th>
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<tr>
<td>12:15</td>
<td>Q&amp;A</td>
<td>Q&amp;A</td>
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<tr>
<td>12:30</td>
<td>Plenary</td>
<td>Plenary Talk 5: How digital technology can innovate the way NCDs are addressed and accelerate the achievement of UHC</td>
<td>David J. Heard Head of Digital Health Novartis Foundation</td>
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</tbody>
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### Lunch

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<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
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<tr>
<td>13:15</td>
<td>Lunch</td>
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<tr>
<td>Time</td>
<td>Symposium 13: Connected and Digital Health – 2</td>
<td>Symposium 14: Health data science – 3</td>
<td>Session GT7 – Contributed Papers</td>
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<td>14.00</td>
<td>Introduction by Chair Megha Ganewatta Sri Lanka</td>
<td>Introduction by Chair Uditha Perera Sri Lanka</td>
<td>14:00-14:05 Introduction by Chair M Mars South Africa</td>
</tr>
<tr>
<td>14.05</td>
<td>Developing a Web-based Medical Equipment Inventory System Prabath Jayathissa Sri Lanka</td>
<td>Practice patterns and clinical outcomes with advanced and conventional care management in community-based care: a classification and regression tree (CART) analysis Sakiko Itoh Japan</td>
<td>14:05-14:25 Security and Other Ethical Concerns of Instant Messaging in Healthcare M Mars South Africa</td>
</tr>
<tr>
<td>14.15</td>
<td>mHealth for integrated service delivery in the Western Pacific Region: A Systematic Review Myron Anthony Godinho Australia</td>
<td>Electronic Medical Records-based Patient Similarity and Its Application in Building Personalized Predictive Model Ni Wang China</td>
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<td>14.25</td>
<td>Integrated LAN, Wi-Fi and wide area network at AIIMS for healthcare professionals and students of AIIMS. Hari Shanker India</td>
<td>An integrated data analysis in the context of biological network for exploration of distinct breast cancer subtypes Lin Hua China</td>
<td>14:25-14:45 A Patient Agent to Manage Blockchains for Remote Patient Monitoring M Uddin Australia</td>
</tr>
<tr>
<td>14.35</td>
<td>A Study on Health Information Exchange Based on Blockchain Wei-Chen Wu Taiwan</td>
<td>Learning Healthcare System: Spreading Best Practices in Healthcare Madhu Bhatia India</td>
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<td>14.45</td>
<td>Developed Service of Smartphone Overdependence Management Application Mun Joo Choi Republic of Korea</td>
<td>Evaluation of implementation of electronic health record in OPD of gastroenterology department of AIIMS, New Delhi Sushil Meher India</td>
<td>14:45-15:05 Health Information Technology and Telehealth Challenges in the U.S. Affiliated Pacific Islands Region N Okamura Japan</td>
</tr>
<tr>
<td>14.55</td>
<td>Analysis of regional healthcare services using both big data and the Geographic Information System available on Japanese Government websites Yuma Ota Japan</td>
<td>Use of online outpatient appointment system based on overbooking strategy for optimizing hospital resource utilization in a tertiary care public hospital Sanjay Gupta India</td>
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<tr>
<td>15.05</td>
<td></td>
<td>Using Text Mining to Multiple Classification of SOAP Data: Experience from a Hospital of Taiwan Jakir Masud Taiwan</td>
<td>15.05-15:25 Speaker Panel Q&amp;A</td>
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<td>15:25-15:30 Closing Remarks</td>
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<td>Tea</td>
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<tr>
<td>Time</td>
<td>Symposium 15: Knowledge management – 2</td>
<td>Symposium 16: Quality and safety, and patient outcomes</td>
<td>Session GT8 – IMIA Telehealth WG Session</td>
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<td>15.45</td>
<td>Introduction by chair Neranga Liyanaarachchi Sri Lanka</td>
<td>Introduction by chair Kusal Wijayaweera Sri Lanka</td>
<td>15:45-15:50 Introduction by Chair S Gogia India</td>
</tr>
<tr>
<td>15.50</td>
<td>Using KM to facilitate superior care co-ordination Nilmini Wickramasinghe Australia</td>
<td>Development and evaluation of patient safety events prediction models using EHR data and big data analytics Hyeoun-Ae Park Republic of Korea</td>
<td>15:50-16:20 IMIA Telehealth WG scope and projects</td>
</tr>
<tr>
<td>16.00</td>
<td>Diagnostic accuracy and validation of an advanced symptom checker for medical self-care Ananda Perera Sri Lanka</td>
<td>Outcomes and cost analysis of total laparoscopic hysterectomy versus total abdominal hysterectomy Zhao Xiangkun China</td>
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<tr>
<td>16.10</td>
<td>Informatics Knowledge Exchange in eHealth Network in Asia: AeHIN Experiences Boonchai Kijsanayotin Thailand</td>
<td>RFID approach to track clinician activity in the operating theater Raafi Careem New Zealand</td>
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<td>16.20</td>
<td>A Regional Medicines Information Exchange Service for Cross-border Drug Monitoring Alvin Marcelo Philippines</td>
<td>Development and integration models of an in-house built drug-allergy checking system Shuk Man Connie Lau Hong Kong</td>
<td>16:20-16:40 Global Telehealth future plans</td>
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<td>16.30</td>
<td>Low cost, low power e-solution for patient management system using micro controls and embedded technology Gayan Ysanatha Piyasena Sri Lanka</td>
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<td>16.40</td>
<td>Imaging Informatics One-Stop Tool to Improve the Workflow of Modern Radiology Department Zafar Iqbal Qatar</td>
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<td>16:40-16:45 Closing Remarks</td>
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<td>16.50</td>
<td>Q&amp;A</td>
<td>Q&amp;A</td>
<td>16:45-17:15 Telehealth textbook presentation (Closed session for co-authors)</td>
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<td>17.15</td>
<td>Closing Plenary APAMI Beyond 2018 Prof Vajira H. W. Dissanayake Incoming President, Asia Pacific Association for Medical Informatics (APAMI)</td>
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<td>19:00</td>
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<td>APAMI Gala Dinner</td>
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Evaluation of the acceptance of a mobile verbal autopsy App by public health midwives in Sri Lanka

Chamika Hasalanka Senanayake1*, Achala Jayatilleke2, Roshan Hewapathirana3, Mohamed Haniffa Abusayeed1, Rajitha Jayasuriya1, Vindya Kumarapeli2, Lene Mikkelsen4, Aathirayan Sivanantharajah5

1 Ministry of Health Nutrition & Indigenous Medicine, Colombo, Sri Lanka.
2 Postgraduate Institute of Medicine, University of Colombo, Sri Lanka.
3 Department of Informatics, Faculty of Mathematics & Natural Sciences University of Oslo, Norway.
4 Melbourne School of Population and Global Health, University of Melbourne, Australia.
5. Data for Health Initiative, Vital Strategies, USA

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Background: In connection with the potential introduction of automated verbal autopsy in Sri Lanka to determine more reliably the causes of community deaths, a research project was designed to investigate the acceptability of the instrument by the interviewers. Since the quality of the interview determines the outcome, it is important to assess the acceptance of the method and the ability of those applying it. To evaluate the acceptance of an Electronic Solution to facilitate Verbal Autopsy to diagnose cause of death for out-of-hospital deaths in Sri Lanka.

Methods: An interpretive research was carried out from September 2016 to July 2017 in parallel to Phase 1 - of the Smart Verbal Autopsy (VA) implementation programme of the Ministry of Health, Sri Lanka, with technical advice from the University of Melbourne, Health Informatics Society of Sri Lanka, Vital Strategies and the funding from Bloomberg Philanthropies Data for Health Initiative. The research areas covered 7 MOH areas in 3 districts (Colombo, Kurunegala, Matale) in Sri Lanka. A convenience sample of Public Health Midwives (PHM) who had undergone training for verbal autopsy interviews and had conducted at-least one VA interview. After having obtained informed consent a semi-structured interview was conducted with 22 PHMs on their end-user experience and acceptance of the Mobile App at field level. Participatory observations were also done during field and home visits. A self-administered questionnaire comprised of 34 questions on a 4-point likert-scale was administered to 96 PHMs to assess the usability and acceptance of the mobile application (usefulness, ease of use, ease of learning and satisfaction).

Results: Among the participants, 58.3% and 63.5% had an average English language proficiency in reading and writing respectively. Computer literacy was average in 43.8% and low in 24%. Of them 61.5% had poor competencies in mobile usage i.e. only limited to turn on/off and making calls. Majority of PHMs had good knowledge on smart phone safety features but demonstrated poor knowledge in Android systems i.e. basic experience with, navigation with touch system and autocorrect features. The usability and acceptance of the mobile application had a mean score of 3.09 (SD = 0.3621). The semi-structured interviews further revealed that most of their public health interventions are being based on the number and quality of the social network links that they have established in the community. As the core duties of PHMs are related to Maternal and Child Healthcare (MCH) activities, migration to the unfamiliar territory of medical symptomatology through VA implementation was new to them as reflected by the average score of 51%. Participatory observations during field and home visits revealed that all PHMs planned well their interviews and had good interaction with the informant. However, some weakness in symptom analysis of the history given by the informant was observed. All informants were cooperative and no one refused to answer the VA questions. All PHMs managed to handle the mobile app for data entry and were able to finalize & submit the interview to a central server without any assistance.

Conclusion: This electronic solution was well received by the PHMs and it can be used to conduct verbal autopsy to diagnose out-of-hospital deaths in Sri Lanka. This solution is acceptable to PHMs and does not demand any high familiarity with technology.

KEYWORDS: Verbal Autopsy, CRVS, ODK, SmartVA, Sri Lanka
Using KM to Facilitate Superior Care Co-ordination

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Epworth HealthCare & Deakin University, Melbourne, Australia

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**Background:** To design superior care co-ordination systems by incorporating the principles, tools and techniques of knowledge management. Care co-ordination is a relatively novel concept in the US healthcare system to promote the efficient sharing and coordination of care processes between caregivers and care providers and has the potential to support and enable value-based patient centric care to ensue. The care coordination processes include the timely, safe, efficient, and appropriate delivery of care services to the patient with the collaboration of all players. Care coordination refers to the process that ensures that patients’ health services and information sharing requirements are met in the most effective manner. It is therefore a critical component that emphasizes on continuity and accountability on the part of the caregivers. Moreover, care coordination calls for effective collaboration between the various organizations and stakeholders taking care of each individual patient.

**Methods:** Using a case study example of knee arthroplasty with a mixed method study design the proposed solution is examined in both a not-for-profit tertiary hospital in Australia and a not-for-profit healthcare organisation in the US. As case study methodology is a mature method to investigate contemporary phenomena in their context (Runeson & Höst, 2009), in this research we applied the single case study approach, referred to general definitions of the term case study according to Robson (Robson 2002), Yin (Yin, 2009) and Benbasat (Benbasat, Goldstein, & Mead, 1987). The solution combines Boyd’s OODA thinking with the intelligence continuum to ensure that all times pertinent information and germane knowledge permeate. Further, the care co-ordination approach is informed by a robust care co-ordination framework developed and tested by Gibbings.

**Results:** The proposed solution has been found to provide a superior state of care co-ordination based on data from surveys and focus groups discussions.

**Conclusions:** In general, total hip and total knee replacement surgeries are successful and are performed frequently, especially for people experiencing pain associated with degenerative joints (Katz et al., 2004). However, types of partial hip and knee replacements are complex and involve with many post-operative risk factors. Since, these risk factors can attribute to a decrease in the patient’s quality of life (Dijkman, Kooistra, Ferguson, & Bhandari, 2008), the continuous assessment and regular monitoring are of significant importance for post hip and knee replacements. Additionally, hip and knee implants are undergoing a rapid rate of innovation and improved technology with unknown outcomes that should be monitored effectively (Wickramasinghe, Bali, Choi, & Schaffer, 2009). As long term and continuous monitoring and assessment of these risk factors in the hospital are cost effective and time consuming for senior patients as well as care providers, in this study a home monitoring solution is proposed to monitor post-operative these risk factors real time and more efficient. By applying the tools and techniques of knowledge management including OODA thinking and the intelligence continuum, superior care co-ordination can be realised. This is illustrated in the context of orthopaedics. The findings highlight benefits for providing high value patient-centred care enabled through knowledge management.

**KEYWORDS:** Care co-ordination, knowledge management, patient centric, OODA thinking, intelligence continuum
Practice patterns and clinical outcomes with advanced and conventional care management in community-based care: a classification and regression tree (CART) analysis

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1 Nursing Career Pathway Center, Department of Gerontological Nursing and Care System Development, Graduate School of Health Care Sciences, Tokyo Medical and Dental University, Tokyo, Japan
2 Health Services Research and Development Center Tsukuba, University of Tsukuba, Tsukuba, Japan
3 Department of Global Health Policy, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan
4 Department of Epidemiology and Biostatistics, School of Public Health, Imperial College London, London, United Kingdom
5 Department of Clinical Epidemiology & Health Economics, School of Public Health, The University of Tokyo, Tokyo, Japan

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Background: The Long-Term Care Insurance (LTCI) system was introduced in 2000 to provide healthcare and welfare services for the elderly in Japan. Especially for community-based care, there are a variety of care services handled by care managers. In our previous study, we found that the risk of progression of care need levels among long-term care recipients with advanced care management was significantly lower than the group with conventional care management. However, it remains unclear the difference of practice patterns of care managers between advanced and conventional care management. In this study, we aimed to compare the LTCI services use between advanced and conventional care management and to identify patterns of LTCI service use that influence progression of care need levels of recipients.

Methods: The study design was a retrospective observational study. We used a nationally representative survey (Survey of Long-term Care Benefit Expenditures) for 2009 through 2014. Our target population was elderly persons who were eligible for the LTCI services. First, we compared the LTCI services use with Pearson’s chi-squared test and Wilcoxon rank sum test. Second, we identified patterns of LTCI service use that influence progression of care need levels with a survival classification and regression tree (survival CART) analysis.

Results: We identified 45,330 eligible recipients during the study period. Recipients with and without advanced care management were 12,903 (28.5%) and 32,427 (71.5%), respectively. As for the comparison of LTCI service use, the utilization rates of visiting nurse (15.6% vs 13.8%, \( p < .001 \)) and short-stay respite care (12.4% vs 11.0%, \( p < .001 \)) in the group of advanced care management were significantly higher compared to the group of conventional care management. On the other hand, the utilization rate of home help service in the group of advanced care management was significantly lower than the group of conventional care management (43.2% vs 46.8%, \( p < .001 \)). Regarding patterns of LTCI service use that influence progression of care need levels, short-stay respite care was the most influential factor for the risk of progression of care need levels in the group of advanced care management. As for conventional care management, house-visiting bathing and short-stay respite care were the most influential factors for the risk of progression of care need levels.

Conclusion: The results demonstrated different patterns of LTCI service use between advanced and conventional care management. The patterns of LTCI service use in the group of advanced care management might be effective to improve the patient outcomes in the group of conventional care management.

KEYWORDS: Long-term care, Patient care management, Housing for the elderly
Simplifying the Complex: Mind the Governance, Architecture, Program Management, Standards and Interoperability for Successful eHealth Implementation

Alvin B. Marcelo1*, Fazilah Shaik Allaudin2, Jai Ganesh3, Boonchai Kijsanayotin4

1 Medical Informatics Unit (University of the Philippines Manila, Philippines)
2 Ministry of Health, Malaysia
3 Sri Sathya Sai Trust, Karnataka, India
4 Thai Health Information Development Centre (Health Systems Research Institute, Bangkok, Thailand)

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Background: List a sequence of activities to help governments with their national eHealth implementation

Methods: While starting eHealth projects are easy, countries are still challenged with sustaining their eHealth programs. The Mind the GAPS framework helps countries systematically build capacity to create and maintain complex systems like eHealth.

Results: With clear governance structures and management systems, a shared enterprise architecture, good program management, standards for interoperability, countries will be better able to navigate the complex landscape of national eHealth systems and create useful health information systems.

Conclusion: By adopting the Mind the GAPS framework, countries can create functional national scale health information systems.

KEYWORDS: Governance, program management, standards, governance, architecture
Application of Artificial Neural Network to Predict Chronic Kidney Disease

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2 International Center for Health Information Technology (ICHIT), Taipei Medical University, Taipei, Taiwan.
3 Department of Dermatology, Wan Fang Hospital, Taipei, Taiwan.
4 TMU Research Center of Cancer Translational Medicine.

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Background: Chronic kidney disease (CKD) is the leading cause of morbidity and mortality in worldwide. It is characterized by progressive loss of kidney function and estimated to affect 15% adults in the USA. However, established approaches to CKD risk assessment, and predict future risk of CKD based on well-established risk factors such as diabetes, high blood pressure, heart disease, obesity and a family history of CKD. Current approaches to predict CKD risk fail to identify many patients who would benefits from preventive treatment, while others receive unnecessary tests and treatments. Machine learning offers immense opportunity to improve the accuracy for identifying correct patients. We, therefore construct artificial neural network machine learning models to predict CKD.

Methods: A total of 25 clinical variables were retrieved from 400 patients, and data were collected from UCI machine learning repository database. Entire machine learning process was divided into four steps such as data preprocessing, variables selection, model building and cross validation. Variable contains more than 50 percent missing value was excluded from our analysis, and synthetic minority over sampling method was used to generate synthesis samples for the minority class to balance the positive and negative values. Information gain ratio was used to select potential variable to improve model performance. Artificial neural network model was used to predict CKD. As the data size is not large, therefore 10-fold cross validation was used to reduce root mean squared error. Finally, area under receiver operating curve, sensitivity, and specificity were used to evaluate the performance of each model. R software (Version 3.4.2) used to clean and analyze data; Weka 3.9 was used to construct a model and draw ROC curve. Weka contains a collection of visualization tools and graphical user interface for easily performing algorithms. Additionally, MedCalc’s software was used to calculate 95% confidence interval of accuracy, sensitivity and specificity. All statistical tests were two-tailed and p<0.05 was considered significant.

Results: The mean age of 400 patients was 52.64±15.33 years. Albumin, serum creatinine, hemoglobin, packed cell volume, red blood cell count, sodium, hypertension and diabetes mellitus were highly correlate variables. The area under ROC for ANN was 0.995. The accuracy, sensitivity and specificity were 96.50 (95% CI:94.20-98.07), 98.76 (95%CI: 96.42-99.74), 93.04 (95%CI: 87.88-96.47) respectively.

Conclusion: In our current study, artificial neural network model showed the higher prediction accuracy of CKD. This method may lead to greater insight and help to accurately identify increase the number of patients who could benefit from preventive treatment, while avoiding unnecessary treatment of others.

KEYWORDS: Chronic kidney disease, artificial neural network, machine learning, heart disease, obesity
Application of Machine learning to Predict Survival of Hepatocellular Carcinoma Patients

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Background: Hepatocellular carcinoma (HCC) is one of the world’s most common malignancies, and second cause of cancer related deaths worldwide. Current approaches to predict HCC survival always fail to identify many patients who would benefit from preventive treatment, while others receive unnecessary tests and treatments. Recently, machine learning offers immense opportunity to improve the accuracy for identifying correct patients. We, therefore, constructed classification machine learning models to predict survival of HCC patients.

Methods: Patients data was collected from Coimbra’s Hospital and University Center (CHUC) in Portugal. This dataset contains demographic, risk factors, laboratory and overall survival features of 165 patients who diagnosed with HCC. The entire machine learning process was divided into four steps such as data preprocessing, variables selection, model building and cross validation. If the variable contains more than 50 percent missing value, was excluded from final analysis. Mean imputation method was used to handle the missing data, and synthetic minority over sampling method was also used to generate synthesis samples for the minority class to balance the positive and negative values. To improve prediction accuracy, information gain ratio method was applied to select potential variables. Different classification models (Random forest, support vector machine, Naïve based, logistic regression, and artificial neural network) were evaluated to predict one-year survival of hepatocellular carcinoma. Finally, 10-folds cross validation was applied to reduce root mean squared errors. The performance of each model was compared by area under receiver operating curve, sensitivity, and specificity. In the data cleaning and visualization of data, R software (Version 3.4.2) was used. Additionally, Weka 3.9 was used to construct a model and draw ROC curve. Weka contains a collection of visualization tools and graphical user interface for easily performing algorithms. Furthermore, MedCalc’s software was used to calculate 95% confidence interval of accuracy, sensitivity and specificity. All statistical tests were two-tailed and p<0.05 was considered significant.

Results: A total of 49 variables were collected from 165 HCC patients. There were 133 (80.60%) male and 33 (19.40%) female patients with HCC. Overall, 102 (61.81%) patients survived one year and 63 (38.19%) patients were died. However, Alpha-Fetoprotein, performance status, alkaline phosphate, albumin, hemoglobin, ascites, symptom, liver metastasis, encephalopathy were highly correlate variables. The area under ROC for RF, LR, NB, SVM, and ANN was 0.80, 0.76, 0.73, 0.73 and 0.70. The accuracy, sensitivity and specificity of RF [73.94 (95% CI:66.54-80.45), 77.57 (95%CI: 68.49-85.07), 67.24 (95%CI: 53.66-78.99)], LR [69.70 (95% CI:62.07-76.60), 72.81 (95%CI: 63.67-80.72), 62.75 (95%CI: 48.08-75.87)], NB [66.67 (95% CI:58.92-74.36), 56.72 (95%CI: 44.04-68.78), 55.26 (95%CI: 43.41-66.69)], SVM [67.27(95% CI:59.55-74.36), 74.49 (95%CI: 64.69-82.76), 56.72 (95%CI: 44.04-68.78), and ANN [66.06 (95% CI:58.29-73.24), 72.55 (95%CI: 62.82-80.92), 55.56 (95%CI: 42.49-68.08).

Conclusion: Machine learning classification models, especially random forest model showed the higher prediction accuracy of HCC survival. This method may lead to greater insight and help to accurately identify increase the number of patients who could benefit from preventive treatment, while avoiding unnecessary treatment of others.

KEYWORDS: Hepatic carcinoma, machine learning, prediction model, random forest, artificial neural network
OpenMRS: A revolution in eHealth in Low and Middle-Income Countries (LMIC)

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Background: This paper aligns with the theme of Public-Private Partnerships towards UHC and the SDGs. It summarises the evolution of the Electronic Medical Record [EMR], OpenMRS. OpenMRS was founded on the success of an EMR project, in Eldoret Kenya in 2004 which confirmed that effective eHealth information management tools could be implemented in Low and Middle-Income Countries [LMIC]. Its success demanded the building of a whole new EMR system called OpenMRS.

Methods: This section describes the evolution of OpenMRS and also the lessons from its implementations. [https://www.ncbi.nlm.nih.gov/pubmed/15992493]. The successes of the project are centered on the following fundamentals.
Collaboration-This involves not only the EMR system designers and developers (https://talk.openmrs.org/) but end users, funders, researchers and governments. OpenMRS is part a of the WHO charter in the Universal Health Coverage [UHC] and the Sustainable Development Goals [SDGs] http://www.iddri.org/Publications/Translating-the-Sustainable-Development-Goals-into-action-A-participatory-backcasting-approach-for-developing-national-agriculture]. To manage millions of patients and all disease entities OpenMRS demonstrates Scalability, Sustainability and Flexibility to adapt to the clinical interfaces of care and data capture [CPOE]. This allows rapid form designs to meet the varying care data capture needs. The system adheres to health care Standards, so data is Interoperable to evaluate the total care processes, resource utilization, research and healthcare management. OpenMRS uses HL7, FHIR, SNOMED, LOINC, ICD, etc., for data capture and interoperability. The system is founded upon a well-designed Modular structure and an adaptable Concept dictionary. These permit system enhancement and the addition of new modules without loss of functionality. Modern and affordable technologies allow Communications to be web-based and with intermittent connectivity for remote data capture. Being free and Open Source, it has become Cost-effective for LMIC. In 2017 there were almost 30,000 online community interactions documented across 64 countries around the globe.

OpenMRS has been integrated into many other distributed platforms e.g. Bhamni, KenyaEMR (AMPATH) and is a core element of nationwide DHIS2 systems [Philippines and Bangladesh] [https://www.facebook.com/openmrsphilippines/]and[http://health.bmz.de/ghpc/casetudies/A_Quiet_Revolution/index.html]. The most critical implementation element is that OpenMRS is Clinically Useful. It delivers feedback to providers and caregivers and if not, it will not be used.[https://healthmarketinnovations.org/program/open-medical-record-system-openmrs]

Results: OpenMRS is evaluated by regular research publications.[https://openmrs.org/wp-content/uploads/2018/03/2017-OpenMRS-Annual-Report.pdf]. The number of implementation sites (3,037) and active patients [8.7 million]. It was adapted to manage the Ebola crisis in Sierra Leone [https://openmrs.org/2017/08/openmrs-ebola-electronic-health-record-system-used-in-sierra-leone/]

Conclusion: A 2009 review of OpenMRS described it as "Talkin' about a revolution” where “HIV/AIDS programs are not only in place but some of them, (partnerships) ...are openly speaking of bringing the pandemic to its knees over the next 5 years through widespread screening and effective treatment and prevention of HIV and other diseases.”

KEYWORDS: LMIC, Open Source, OpenMRS, eHealth implementations
Electronic Medical Records-based Patient Similarity and Its Application in Building Personalized Predictive Model

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Background: To propose a set of patient similarity measures and to assess the impact of the patient similarity-based selection of training samples on the prediction performance of machine learning models.

Methods: The proposed patient similarity was estimated at the combination of four sub-similarities calculated by using patients’ age, gender, multiple laboratory items and multiple disease diagnoses (presented by the International Classification of Diseases, 10th revision [ICD-10] code), respectively. The sub-similarity of patients’ age was set as the ratio of the minimum to the maximum of two ages, and the gender similarity was defined as 1 if the two patients have the same gender and 0 otherwise. For continuous values of all lab items, they were first standardized to N (0,1) item by item, and were then used to define the sub-similarity of patients’ lab tests as one minus their Euclidean distance. The sub-similarity of patients’ disease diagnosis was defined as the average of distance between the ICD code only belonging to one patient and all the ICD codes belonging to the other patient, where the distance between two ICD codes in the ICD code system (a hierarchical tree with 4 levels from the root) was calculated using the level of their nearest common ancestor over the number of levels in the ICD hierarchy. The weighted sum of the above sub-similarities was considered as the single measure of patient similarity.

We applied the multi-dimensional similarity assessment on a diabetes dataset derived from an electronic medical records system collected between 2014 and 2016 in a tertiary hospital in Beijing, China. 5,000 patients with any of the diabetes diagnoses (ICD-10 codes E10-E14) and 5,000 patients without any diabetes diagnosis were selected randomly from the dataset, comprising a study cohort of 10,000 samples. For an index (test) patient, a personalized predictive model was built on its most similar patients out of the training samples, then was tested on the index patient. Machine learning models employed in this study included k-nearest neighbor (kNN) with k=50 as default, logistic regression (LR) model and random forest (RF) with 50 trees as default. We used a hold-out method to validate the predictive models, where the study cohort was split randomly into a test set of 1000 samples and a training set of 9000 samples. The predictive performance was evaluated by the area under the ROC curve (AUC).

Results: When selecting 1% to 100% with the increment of 1% of the training samples, there were consistently higher performances for kNN, LR and RF built on similar samples than for those on randomly selected samples, with means±standard deviations of AUC of 0.63±0.03, 0.89±0.05 and 0.90±0.01, and 0.57±0.02, 0.88±0.05 and 0.90±0.02, respectively (all P values <0.001).

When using top m similar training samples for building predictive models, the performance of kNN declined linearly from an AUC of 0.70 to 0.58 as m increased from 1% to 100%. By contrast, performance for LR and RF improved steadily from an initial AUC of 0.54 and 0.85 (P<0.001) to the saturated AUC of 0.90 (m=27% and 11%, respectively). RF showed a significantly higher performance than kNN and LR when using no more than top 8% of similar training samples.

Conclusion: Using a selective training samples based on the patient similarity, personalized predictive models outperformed those built on randomly selected samples, and the performances varied upon the machine learning models.

Keywords: Electronic medical records, patient similarity, predictive model, training sample, diabetes
Understanding User Emotional Expression in Community Question Answering website for the Social Incidents: A Sentiment Analysis of Zhihu.com

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Background: On 31 August 2017, a 26-year-old woman, surnamed Ma, jumped from a hospital window in Yulin, north of Shanxi province, because of the dispute with her husband and mother in law about which way to give birth to their baby. This social incident raised intense discussions in Chinese social media. Nowadays, based on the environment of web 2.0 featured by the interactive communication of information, Community Question Answering websites (CQA) is more directivity, problem-oriented, and emphasizes the social interactions of its members. In CQA users can ask question and then answer what they know. Therefore, for some social issues, CQA can be a main platform for subject of series of talks. The users of typical CQA website, Zhihu.com, have already spontaneously organized the topic covering all the discussions about this social incident, known as maternal fell death in Yulin. What’s more these discussions under the topic both include opinion communication and emotional expression. Understanding the concerns of different users in the CQA website, how they think about this social incident and their sentiment tendencies toward the incident are a meaningful work. Therefore, we aimed to using a comprehensive framework supported by text mining techniques to know what users in Zhihu.com focus on with respect to the incident and understand the sentiment tendencies characteristics of those users according to the difference of their background.

Methods: Supported by self-development software, we collected 5458 answers about how people think about the incident of Ma’s death under the topic in Zhihu.com, known as maternal fell death in Yulin. Then, according to open-access information in users' host page, we obtain the background of users who wrote these answers, such as gender, occupation, and address. Next, we applied Chinese word segmentation techniques, keyword abstraction and clustering, and sentiment calculation supported by sentiment lexicon to processing of the text content of these answers. Finally, combined with users’ background, we analyzed these data from the angles of users’ gender, occupation, and address.

Results: We identified 5 significantly different topics from the answers written by the users of Zhihu.com: emotional support, legal right, incident description, hospital duties, and family relationships. The ratio of negative sentiment to positive sentiment in users’ answers is 2.18:1. For male users, the ratio is 1.98:1, while for female users, the ratio is 2.02. Comparing with male, female users are more likely to convey their concerns, sorrow and other negative mood in their writes. With respect to occupation distribution, the ratios in accounting group (1.05:1), IT & computer group (1.97:1), education group (2.13:1), media group (2.29:1), finance group (2.38:1), medicine & Health group (3:1) and public management group (3.42:1) indicates that the two-pole emotional distribution between each group is out-of-proportion. In address distribution, the ratios in oversea group (1.77:1), IT & eastern China group (2.19:1), north China group (2.69:1), western China group (2.81:1), and central China group (3.74:1) indicates that the two-pole emotion distribution of users from inland areas is more skewed than those from coastal area.

Conclusions: These findings identified the focused topics of community users in Zhihu.com about the social incident, Ma’s death in the hospital of Yulin and the emotional tendencies of these users. It helps us better understand the opinion and sentiment expression of these users and the differences of emotional expression at all kinds of users’ background.

KEYWORDS: social incident; Community Question Answering websites; topic analysis; sentiment analysis
Diagnostic Accuracy and Validation of an Advanced Symptom Checker for Medical Selfcare

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Background: To determine the diagnostic accuracy and the validity of an Advanced Symptom Checker CAMEOS (Computer Assisted Medical Evaluation of Symptoms) – P.

Methods: Diagnostic accuracy will be determined by sensitivity, specificity, positive and negative predictive value and positive likelihood ratio. Validity is to be determined by calculating the Cohen's kappa statistic for interrater agreement corrected for chance agreement between the program and a Board Certified Specialist in Family Medicine.

Results: FP (Family Physician) and CAMEOS agreed on the diagnosis in 84% (n=100) cases and agreed as to the absence of any diagnosis in 9% (n=100) of the cases. There were 3% (n=100) cases where the FP made a diagnosis and the CAMEOS could not make a diagnosis or made a diagnosis of very low probability. There were 4% (n=100) of the cases where FP could not make a diagnosis but the CAMEOS made a diagnosis. The kappa value for the 2 x 2 table in the Fig 1 is 0.68. Using Landis and Koch criteria a kappa value of 0.68 is substantial agreement corrected for chance.

The diagnostic accuracy study yielded the following results: sensitivity was 96%, specificity 69%, positive predictive value 95%, negative predictive value 75% and the positive likelihood ratio of 3.13. Random item selection test yielded no positive diagnosis whatsoever suggesting the integrity of the knowledge base particularly the discriminative power of the disease knowledge programmed into the knowledge base.

Conclusion: On the basis of these results it is reasonable to conclude that CAMEOS-P has acceptable diagnostic accuracy and validity. This data cannot be compared directly realistically with that in the current literature on the subject due to differences in the sample selection, underlying knowledge base, inferential algorithm, study design. But implications of some of these studies are relevant. The diagnostic accuracy estimated for multiple symptoms checkers is in the range of 34% - 68% (67% for DocResponse, 68% AskMD and 69% for Isabel symptom checker) (9,11). The diagnostic accuracy of the CAMEOS-P is well above these limits and the reasons are obvious - focusing on the common diseases, triage is on selfcare, gold standard is specialist in Family Medicine and the study undertaken by the developer himself.
Development and evaluation of patient safety events prediction models using EHR data and big data analytics

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Background: The purpose of this study is to develop and evaluate patient safety event prediction models for fall, pressure ulcer, and unplanned extubation using EHR data and big data analytics in a tertiary hospital in South Korea.

Methods: For fall and pressure ulcer, 15,482 patients admitted to neurology or hemato-oncology departments from January 1, 2015 to May 31, 2016 were included as study subjects. Fallers were defined as patients with fall incident reports or with any fall-related narratives in nurses’ progress notes. Patients with pressure ulcer were defined as patients with pressure ulcer incident reports. In total, 310 and 202 cases were classified as fallers and patients with pressure ulcer, respectively.

For unplanned extubation, 5,412 patients with intubation and extubation times of endotracheal tube stayed in ICU between July 1, 2013, and June 30, 2016 were included. Unplanned extubation cases were defined as patients with unplanned extubation-related narratives in nurses’ progress notes. In total, 60 cases were identified.

A list of features related to occurrence of fall, pressure ulcer and unplanned extubation were identified by literature reviews. Then data on features were extracted from multiple data sources in EHR system. Data sources include nurses’ progress notes, admission-discharge-transfer records, critical care flow sheet, and APACHE scoring system. Since features were documented at multiple times with various types in more than one sources, we used different criteria for data integration such as currency, granularity, and coverage.

Fall and pressure ulcer prediction models were developed using logistic regression, Cox proportional hazards regression, and decision tree. Unplanned extubation prediction models were developed using logistic models with three different sets of features measured at different points of time. The predictive validity of models was compared with area under the ROC curve (AUC), sensitivity, specificity, positive and negative predictive values.

Results: For fall and pressure ulcer, logistic regression model was the best model. The predictive validity indicators of logistic model for fall prediction were 0.86 for AUC, 79.03 for sensitivity, 79.43 for specificity, 7.28 for PPV, and 99.46 for NPV. The corresponding values of logistic model for pressure ulcer prediction were 0.98, 92.70, 92.67, 15.52, and 99.89, respectively. For unplanned extubation, logistic model with the features of highest effect size and recording frequency was the best model (0.90 for AUC, 56.10 for sensitivity, 92.74 for specificity, 9.54 for PPV, and 99.36 for NPV).

Conclusion: This study showed that it is possible to predict a patient safety event using EHR data and big data analytics. The patient safety prediction models developed in this study will be implemented in a clinical decision support system (CDSS). This system will predict the risk for patient safety events and provide tailored recommendations based on the predicted risk. The clinical effectiveness of the CDSS will be studied in the near future.

KEYWORDS: Patient safety, big data analytics, fall, pressure ulcer, unplanned extubation
Virtual Reality for Active Ageing: A feasibility study in Taiwan

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Background: Physical inactivity (PI) has been a major problem among elderly population. PI has been noted to cause sleep-wake disturbances, cognitive impairment, and worsen chronic diseases. Chronic PI tends to burden older population by problems such as functional disability and the need for institutional care. Virtual reality (VR) intervention have been seen to significantly promote physical activity of elderly with sedentary life, but the perceived usefulness and acceptance of the VR among elderly never been studied before. The aim of this study is to explore the acceptance of the VR among elderly for mitigating the problems while ageing.

Methods: The pilot study was conducted on 30 elderly people (both male and female) who were voluntarily included as participants, between March to May 2018. They were asked to use VR for 15 minutes twice a week for 6 weeks. The questionnaire based on the Technology Acceptance Model was developed, to evaluate the acceptance of VR technology. Discussion was also conducted with participant to understand if they are willing to use VR for mitigating the problems while aging such as dementia, depression and for motivation of physical activities. Cronbach’s Alpha was computed to examine the reliability of the questionnaire and the Sustainable Usability Scale (SUS) for the analysis of usability of VR in elderly participants. Pearson’s correlation coefficient was computed to determine the correlation between the variables.

Result: A total of six male and twenty-four female Participants aged between 55-95 years old agreed to participate in the study. The content validity of the adapted TAM questionnaire was justified as the Cronbach’s alpha (α) value was 0.948. The Pearson’s correlation coefficient established a statistically significant correlation between perceived usefulness, perceived ease of use, curiosity and enjoyment, subjective norm, user experience and intention to use. The SUS score for the study was 90, depicting a good usability score. 77.77 % of the participants agreed with the usefulness of the device and around 80% of the users intended to use VR in future.

Discussion: Through this study, we have managed to conduct feasibility study of VR in ageing. The older population are seen to have a wide acceptance towards the VR. VR technology can subjectively bring about positive effects to the lifestyle and rehabilitation among the older population. The device also motivates the elderly users to increase their activity and alleviate their mental conditions. Based on the acceptance and intention to use, VR technology could be introduced as one of the device that can help elderly to cope with their ageing problems.

KEYWORDS: virtual reality, ageing, elderly, technology acceptance model, physical inactivity
Listing differential diagnoses from symptoms of patients with vertigo using knowledge graph

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Background: Many studies have examined systems that support physicians in differentiating diagnoses. Such systems, called diagnostic support systems, usually have an associated medical knowledge database. However, it has been difficult to handle knowledge bases because no common disease database exists among all physicians. We propose a method to use fundamental knowledge of anatomical structures and functions for inferring possible sets of differential diagnoses from patient symptoms.

Methods: We constructed the knowledge in the form of a graph. We defined nodes of two types and one relation to express knowledge of anatomical structures and functions: anatomical functional nodes (AFN), symptom nodes (SN), and suggestion relations. AFN is defined as an anatomical structure that has one or more functions. SN is defined as a symptom that is readily apparent in a patient. Suggestion relations are of two patterns: AFN abnormality to another AFN’s abnormality and SN to AFN abnormality, which are used to trace functional dependencies. For example, vessels have the functions to nourish their every distal part of the body. These functions of peripheral vessels depend on the central vessel functions. Peripheral vessel abnormalities such as interruption of blood flow suggest abnormalities in the central vessel. A patient claiming numbness of his face implies some abnormality of the facial nerves. SN “facial numbness” suggests the abnormality of AFN “facial nerves.” If the AFN abnormality suggests no other AFN abnormality, then it is called a “Cause” node; one or more “Cause” nodes are related to a specific disease. By traversing this knowledge graph, we can seek an AFN abnormality that can be reached from a specific symptom. Then we can review a list of possible diseases. By traversing backward from the listed diseases, we can ascertain which AFNs or SNs can be reached similarly. As a result, possible symptoms are obtainable. The importance of possible symptoms can be ranked by their information entropies, which are calculated from the count of diseases that have those symptoms. To evaluate the model, we implemented this knowledge graph for diseases that cause vertigo.

Results: We traversed the graph from SN “tinnitus.” As a result, we compiled a list of 16 possible diseases. After reviewing the possible diseases, we traversed backward in the graph to ascertain possible symptoms that a putative disease might cause. The review revealed 10 symptoms that the possible diseases might cause. By calculating information entropies, we can infer three particularly important symptoms to differentiate diseases.

Conclusion: Using this model, we can infer possible diseases from symptoms and what symptoms physicians should expect to observe next. Some relations in anatomical structures can be regarded as suggestion relations in this model. In future work, some medical ontologies that contain anatomical structural knowledge are expected to be useful to extract these relations.

KEYWORDS: Anatomic models, Clinical decision support system, Differential diagnosis, Expert systems, Knowledge bases
Outcomes and cost analysis of total laparoscopic hysterectomy versus total abdominal hysterectomy

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Background: The aim of the study was to assess outcomes and cost of total laparoscopic hysterectomy (TLH) versus total abdominal hysterectomy (TAH). A retrospective analysis was performed for 535 patients with hysterectomy from outpatient and emergency department at Capital Medical University Xuanwu Hospital, Beijing, China between January 2014 and November 2016.

Methods: The analysis was based on two cohorts: women treated with TLH (n = 204) or with TAH (n = 331). All the information of patients including age, ASA, operation time, length of stay, discharge prognosis, incision healing grade, total cost and 30-day antibiotics cost after discharge were analyzed in detail. Mann-Whitney U test was performed for abnormal distribution numerical variables and ordinal variables, Chi-square test with Yates correction and Fisher exact test for nominal variables.

Results: The length of stay and the length of stay after operation of TLH group were less than TAH group and the differences were statistically significant (p=0.003, p=0.002). When compares the median operation time, the TLH group was higher than TAH group for 8 minutes, and the difference was statistically significant (p=0.004). With respect to the median amount of bleeding, the TLH was less than TAH for 50 ml, and the difference was statistically significant (p<0.0001) too. The differences of discharge prognosis and the incision healing grade between TLH and TAH were not significant (p=0.15, p=0.09). There was no significant difference for the 30-day antibiotics cost after discharge in outpatient department (p=0.76). With regard to total cost, the median of TLH was 15412.41 (Inter quartile range: 4506.94) RMB, which was higher than that of TAH 13817.98 (Inter quartile range: 3324.81) RMB, and the difference was significant (p<0.0001). The surgery fees, disposable materials fee for surgery and disposable material fee for treatment of TLH were higher than those of TAH and the sum of the three differences accounts for 18% of total cost.

Conclusion: TLH was a safe and effective method of hysterectomy. There was shorter length of stay and less amount of bleeding of TLH than TAH. The TLH was associated with higher total hospital cost and 30-day antibiotics cost after discharge. These differences may have resulted from surgery fees, disposable materials fee for surgery and disposable material fee for treatment.

KEYWORDS: Total laparoscopic hysterectomy, Total abdominal hysterectomy, Hospital costs, Operation time, Length of stay
An RCT to assess the effectiveness of nurse-led structured telephonic based heart failure management program – A pilot study

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Background: The aim of this study is to assess the effectiveness of nurse-led structured telephonic based heart failure management program (NL-STHFMP) on QOL and drug compliance

Methods: This randomized controlled trial was conducted among 24 outpatient heart failure (HF) patients visiting a tertiary care hospital. The control group received usual routine care, whereas the experimental group received NL-STHFMP which include formal health teaching, a HF checklist (Hriday card), telemonitoring of vital parameters (blood pressure, heart rate, and weight) weekly through a mobile application named as “Dhadkan version-2” and telephonic follow-up for 3 months. The outcome measures were QOL and drug compliance. Kansas City Cardiomyopathy Questionnaire (KCCQ), adherence to refills medications scale were used to assess QOL and drug adherence, respectively, in the study patients. Descriptive and inferential statistical methods were applied to find out the results.

Results: At baseline, the demographic, QOL and drug compliance scores of both groups were comparable. After intervention, the QOL domain score of KCCQ as well as drug compliance was significantly better in experimental group as compared to control group (P < 0.001, P < 0.001), respectively.

Conclusion: There was significantly better QOL and drug compliance in HF patients who received nurse-led structured telephonic based heart failure management program (NL-MAHFMP).

KEYWORDS: Drug compliance, heart failure, nurse-led structured telephonic based heart failure management program, quality of life
Learning Healthcare System: Spreading Best Practices in Healthcare

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Background: Health care systems are facing many challenges in growing health care delivery infrastructure, increasing healthcare cost, constrained budgets, missed opportunities, waste, rising level of illness, and need to pace up with rapid technology. The complexity in many health conditions due to adverse drugs reactions, lack of genomic knowledge and lack of evidence for clinical utility often seen in current healthcare. Reorganizing healthcare and changing practices for better and improved healthcare requires transformation in current health systems. The Learning health system provides a conceptual platform to spur such transformation-continuous learning to improve health care and drawing knowledge from real world to promote better health. Learning health system (LHS) describes an approach of improved patient care by using continuous knowledge, quality improvement strategies and integrating a range of scientific methodologies. The LHS also promises personalized medicine by understanding learning for what, why and for whom it works and applying that knowledge for improved patient care. The LHS aims to accelerate the generation and uptake of knowledge to ensure innovation, quality, safety and cost effective healthcare that improves patient outcome. The inclusion of pharmacogenomic in a knowledge generating learning health care system is one promising way to provide best practice, better care quality and patient safety.

This paper describes an evolving learning health system at Wanfang hospital, Taiwan characterizing knowledge approach, and clinical assessment for improving genetic screening to reduce adverse drugs reactions. The aim is to realize its full potential for knowledge generation and application and evaluating the impact on current medical practices. This paper presents a positive view on integrating pharmacogenomics into Learning Healthcare Systems through Clinical Decision Support Systems for promoting continuous improvement of clinical issues in hospital.

Methodology: This study is conducted at Wanfang Hospital, Taiwan aimed to explore the implications of learning health system. This study has been approved by the Ethical Committee of Taipei Medical University-Joint Institutional Review Board (TMU-JIRB) under the number N201705069. The project has been grouped under four integrated subprojects. Firstly, the creation of knowledge base for disease diagnosis codes and analyzes the differences in the accuracy before and after. Secondly, the creation of knowledge library from data by using big data analytics infrastructure. Thirdly, information infrastructure of LHS to support other integrated subprojects. Fourth is the clinical assessment model for learning health system-to conduct pilot research and clinical trials. Our study is focused on fourth subproject. There are two main programs such as to conduct clinical trials and assessments for increasing the accuracy of diagnosis codes and to decrease the adverse drug event by examining gene. An adverse drug reaction is an unexpected reaction which is caused by taking medicines. Sometimes the severity of ADR is low, but sometimes it could be a life-threatening situation. Genetic screening would have high utility for commonly occurring severe conditions associated with genetic markers that shows high sensitivity and specificity. The learning health system in Wanfang hospital is intended to merge genomic and other data of individuals to identify drivers of health that might support personalized healthcare decision making.

Conclusion: The learning health system implemented in Wanfang hospital will spread best practices in healthcare. It will help the clinical investigators and medical institutions to review and revise the current quality of information, understand pros and cons of medical quality leading to improved clinical practice, care quality, patient safety and medical behavior.

KEYWORDS: Learning health system, knowledge grid, knowledge object, pharmacogenomics in LHS, adverse drugs reaction, clinical decision support system.
Assessing the Security Vulnerabilities of IoT Adoption in Healthcare

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Background: The number of research on the information security is growing, not many studies have concentrated on investigating healthcare information security and vulnerabilities. Therefore, the need arises to investigate and assess the security and privacy risks of Internet of Things (IoT) technology and to have an in-depth understanding of IoT adoption and its vulnerabilities in the healthcare context.

Methods: In identifying IoT system vulnerabilities in the healthcare system, a secondary research method of critically reviewing peer-reviewed scholarly publications was adopted.

Results: A review of vulnerabilities in IoT devices is classified based on the IoT structure and the types of security.

i. Perception Layer: Since IoT devices can be placed in a patient’s environment without any additional protection or attendance. Physical or device tampering can be serious in the healthcare since IoT devices in the healthcare are designed and programmed to capture, store and protect patients’ healthcare information. To address this, IoT node authentication is an essential first step to identify any malicious attack nodes.

ii. Network Layer: This layer is exposed to different types of network attacks due to the variation of supported network types, protocols, communication medium and technologies in IoT. Attacks in this layer include: DoS attacks, network resources exhaustion, interference with IoT health devices. These attacks could have devastating impact on patients and the healthcare system.

iii. Application Layer: The variety of healthcare IoT applications may generate security issues in IoT systems. Embedded software constraints and difficulty in installing dynamic security patches are two common causes of security issues in the application layer. This is due to the thin network protocol and the security module, and the difficulty in dynamically updating program patches on IoT devices from remote locations. Since IoT devices are limited in storage capacity, memory, CPU, and battery power, installing updates limits the ability to perform this functionality.

Conclusion: Utilizing IoT in healthcare may raise several security/privacy issues due to its automatic data collection and monitoring features. Since in healthcare, privacy and security vulnerabilities are a serious concern, a comprehensive security framework is required to consider the entire strata of the IoT system. This way, the IoT privacy threats and security vulnerabilities can be identified while the issues identified can help technology developers, and service providers in healthcare address the deficiencies in order to deliver a secure IoT healthcare system.

KEYWORDS: Healthcare; IoT; Vulnerabilities; Security issues; Privacy
The role of telehealth in the provision of culturally appropriate care for Aboriginal Australians

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Background: To explore how telehealth facilitates the provision of culturally appropriate care for Aboriginal Australians, from the perspective of healthcare workers at a rural Aboriginal Community Controlled Health Service (ACCHS).

Methods: An exploratory qualitative study was undertaken with staff involved in healthcare provision at the ACCHS in a remote town in Queensland, Australia (population <2000 residents). Semi-structured interviews asking about their experiences with telehealth and how telehealth might facilitate or impede culturally appropriate care, were conducted with ACCHS staff during four site visits made to set up telehealth facilities with the intention of increasing access to specialist care. Thematic analysis of verbatim-transcribed audiorecordings of interviews was conducted with three researchers independently coding the data and agreeing a coding structure, and comparing and contrasting emerging themes.

Results: All nine ACCHS staff with roles in management, health promotion, liaison and support, and clinical care, participated in interviews. Seven participants identified as Indigenous, all had received training in telehealth, and most had supported community members to participate in specialist telehealth consultations. The central theme identified was ‘Care provided in a supportive environment’, reflecting participants’ views that culturally appropriate care was about both personal interactions between healthcare providers and the Aboriginal person and the environment in which interactions occurred. Three sub-themes underpinning the central theme were: telehealth facilitating accessible, available and affordable care (by reducing the time, distance, frequency and stress of travel and improving access to specialist care); telehealth accommodating the presence of Indigenous Health Workers (who could explain information and support and advocate for the patient); and telehealth supporting a holistic view of health and connection to community (enabling the presence of extended family members).

Conclusion: Although telehealth is commonly seen as a way of improving access to care, it may also increase engagement with the health system and uptake of specialist care for Aboriginal Australians, by facilitating the provision of culturally appropriate care. Further research is needed to understand the views of community members and specialists providing care via outreach and telehealth, to identify potential strategies to enhance care for remote communities.

KEYWORDS: telehealth, Indigenous health, remote health, culturally appropriate care
Informatics Knowledge Exchange in eHealth Network in Asia: AeHIN Experiences

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Background: Countries have been realizing the benefits of information and communications technology in making healthcare more efficient. The merging of health and IT offers numerous benefits but also poses several difficulties and challenges because of the complexity of healthcare process which involve many stakeholders. The Asia eHealth Information Network (AeHIN), created by the World Health Organization (WHO) in 2011, is the network of health IT professionals, who are working together to realize the benefit of digital technology in health. One of the AeHIN’s strategies is to strengthening health IT capacity in country by enhancing knowledge exchange and resource sharing among their members. There are many knowledge exchange platforms provided by AeHIN such as webinars, mailing list, conferences and the customized informatics training workshop with site visits in accordance to learning needs of the requested country.

To describe the organizing process and the result of the knowledge sharing training workshop of two requested countries, the Ministry of Health (MOH) officers from North Korea and Myanmar, to the host country, Thai Health Information Standards Development Center (THIS), Ministry of Public Health, Thailand.

Method: To describe how knowledge exchange organized and the workshop evaluation by the participants.

Results: The process of organizing the workshop with site visits divided into three phases. The first phase is the preparation phase before the country visited, which includes 1) the expression of the training needs accordance with the knowledge gaps of the requested country with the capacity and readiness of country that can provide the training (host), 2) establish a host country organizer, 3) draft a concept note including the training schedule by two countries, and 4) acquire funding source. The second phase starts when the funding is secured, the detail of the workshop and visiting sites schedule are planned, including logistic management (e.g. official invitational letter to speakers), venue and accommodation, and collaboration with the visiting site. The final phase is conducting and evaluation of the knowledge sharing event. The evaluations are conducted during and at the end of the event. The final evaluation questions are learning skill and knowledge gained from the courses, the site visits and the satisfactory level of the participants. The knowledge exchange events between Democratic People's Republic of Korea (North Korea) and Thailand (6 participants, 8 weeks in 2016) and between Myanmar and Thailand (15 participants, one week in 2017) were evaluated with high satisfaction with the average Likert score 4.38 and 4.88 points, respectively (whereas 5 = very satisfied and 1 = very unsatisfied).

Conclusion: High satisfaction level of participants indicates that the model is useful for knowledge exchange between countries. These knowledge exchange model can be used as a guideline for any countries that are interested to conduct similar knowledge exchange workshop.

KEYWORDS: Knowledge Exchange, eHealth, AeHIN, Capacity Building
Designing standardized message based on clinical concept models for nation-wide EHR system

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**Background:** To collect clinical data from various resources of healthcare providers, we designed standardized messaging format by community agreed concept models for a nation-wide EHR (Electronic Health Records) system. We had developed Medical Markup Language (MML), XML (eXtensible Markup Language)-based message standard for Japanese EHR, but it was not flexible to catch up clinical/technical requests. Therefore, we decided to re-design MML to improve its interoperability.

**Methods:** Data models were based on a subset of ISO 13606, which is consisted with two layers of reference models and concept models. At first, equivalent data schemas were designed for JSON (JavaScript Object Notification) and XML as a container of concept models by JSON Schema version 0.6 and XML Schema 1.0. And the second, target concept models were identified from existing messages and documents on our EHR system, such as MML version 4, HL7 FHIR resources, and openEHR clinical knowledge manager. Finally, message templates were designed from the reference models with the concept models.

**Results:** The reference models were defined by UML (Unified Modeling Language) on figure 1. Three message templates were defined for instances, such as allergy, medication, laboratory tests with eight concept models, experimentally. These models can be converted to HL7 FHIR messages, MML, and ISO13606/openEHR in both XML and JSON. Other models, equivalent to other MML modules are under development for other clinical use cases as upcoming MML version 5.

**Conclusion:** We designed new interoperable messaging formats to incorporate various concept models on basal reference models. These models were based on two layers models by ISO13606 and interoperable with multiple standards.

**KEYWORDS:** Clinical concept model, ISO13606, openEHR, MML
Application of information technology to medical equipment management in the Solomon Islands

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Background: In this research, the author addresses the application of medical equipment management in developing countries. Even in core hospitals in developing countries like the Solomon Islands, it was found that there were various problems of medical equipment management from the author’s experience of working at a local hospital. Gizo Hospital is a core hospital with the second biggest size of the Solomon Islands for neighboring islanders with a population of 80,000 people. In the beginning, when the author worked there, electrical engineers had worked only for disconnection and electric repairs. For medical equipment management, it was cleared that management of safe medical equipment was not possible because of the contaminated situation of equipment and interview with nurses also handling their medical equipment. As a result of interviewing from an electric engineer about the management status of the medical equipment, the hospital staff who use medical equipment did not know how to manage them. To solve the problem, first, thought that it had to manage the equipment what should be done the grasp equipment quantity and the situation of them.

Methods: Since hospitals have a large number of medical devices and only some of them have equipment information at the time of purchase on the page, first create an electronic ledger of the medical equipment in the hospital and select the type, name, model, manufacturer, installation location, serial number, equipment status are listed in Excel file. As a result, it was found that among 115 medical devices to be managed, there are 5 unused devices, 4 devices corresponding to discards, and 9 units requiring repair. Also, almost all equipment required cleaning. By using the information of the listed medical devices, it became possible to conduct periodic inspections to improve the quality of medical device management. Therefore, by recording the inspection result and the serial number of the equipment in correspondence, we created an access database that can obtain information of equipment efficiently.

Results: With the created access database, it became possible to efficiently manage and use medical equipment smoothly. From the start of management, the contamination situation of 95% medical equipment was improved, it became safe to use, the quality of medical equipment management improved clearly. Also, through data management, we discovered that there are many devices and contaminated devices that are not used in a specific department. Therefore, we investigated the cause and found out the opportunity for the staff to obtain usage and management knowledge as a result, and the factor that no teaching person was present.

Conclusion: This research is expected to improve the quality of medical care by use of such database information even in remote areas such as the Solomon Islands and areas with educational disparities with urban areas. In the future research, by constructing an extended database, it will be useful for improving management ability of medical equipment manager, education for hospital staff, human resource development. The database to be constructed includes learning support contents combining visual images, quizzes, and e-learning, making it more effective and possible to learn repeatedly.

KEYWORDS: ICT, Medical equipment management, Developing country, Database, Skill up
A Regional Medicine Information Exchange Service for Cross-border Drug Monitoring

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Background: establish the governance and management of an online information service for comparable medicines across various countries in Asia

Methods: There is benefit for countries to compare medicines across borders (examples are antimicrobial resistance, registration, and pricing) but because medicines are labeled differently in countries, this comparison is difficult if not impossible. This project describes how a regional information exchange can be built using free and open source software together with the creation and governance of a network of authorized data sources. This paper is descriptive.

Results: With clear governance structures and management systems, a regional medicine information exchange can be built and maintained. This resource can then be used to compare drugs across borders such as but not limited to antimicrobial exchange, registration, and pricing.

Conclusion: In order to maximize the benefits of comparing medicines between countries, a regional information exchange is a fundamental requirement.

KEYWORDS: Medicine, information exchange, governance, management
Using a Machine Learning Approach for Analyzing Standardized Data from the Pulmonary Resection Clinical Pathway


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Background: A critical path developed in the American industry in the 1950’s approached to medical treatment as a clinical pathway and entered the Japanese medical field in the 1990’s. The clinical pathway tool helps standardize medical treatment processes, improve patient services, secure medical safety, and improve medical management by offering continuous analyses and feedback. The Japanese Society for Clinical Pathways has recommended an outcome-oriented clinical pathway that establishes the management of medical treatment processes relative to a series of goals (outcomes). The Society developed a standard basic outcome master (BOM) to help quantify patients’ daily functional outcomes and establish treatment outcome goals. The BOM features 317 defined outcomes and is in the process of being domestically standardized. BOM promotes secondary data use because outcomes are structured the patient condition and medical treatment. This study aimed to analyze and compare data from two hospitals using an outcome-oriented electronic clinical pathway. We analyzed factors contributing to prolonged hospitalization, for both hospitals, along the pulmonary resection clinical pathway.

Methods: Each outcome is associated with some assessment item (e.g., laboratory result, measurement value, and clinical finding). When at least one of assessment is not achieved, the variance is recorded in an outcome layer. For each patient, achievement or variance accumulates as data for each outcome set during hospitalization. In this study, we analyzed the outcomes of 701 cases within the pulmonary resection clinical pathways of the two hospitals from 2015 to 2016. We created a temporal data set of variance from the target outcome for each patient based on the operation date. We then applied the gradient boosting decision tree (GBDT) to predict prolonged hospitalization from the outcomes. These consisted of 357 explanatory variables of “operation day/outcome.” We visualized the data over time via a directed graph with the Jaccard index.

Results: Common outcomes for both hospitals were respiration, wound, pain control, dietary intake, circulation, and ambulation. Variance occurred frequently on the day of the operation or on postoperative day 1 (POD1) for pain, wound, respiration, and circulation. POD1 respiration, POD3 dietary intake, POD1 drain state, POD3 wound, and POD1 urination exhibited higher features by GBDT. Directed graphing of the top 50 features showed circulation, respiration during POD0–POD1, and wound during POD1–POD4.

Conclusion: Clinical pathways allowed direct comparison of outcomes and analyses of outcome variances between different hospitals. We were able to extract early postoperative, and later, patient-specific factors that related to prolonged hospitalization for pulmonary resection. By revising outcome settings and increasing common outcomes between the two hospitals, we may be able to achieve more accurate analyses. Moving forward, we plan to expand our analytical approach by identifying an increasing number of target hospitals.

KEYWORDS: clinical pathway, pulmonary resection, basic outcome master, gradient boosting decision tree.
Developing a Web-based Medical Equipment Inventory System

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Background: A medical equipment inventory system is a centralized index of all medical equipment in a health care system. This medical equipment inventory system is composed of a unique identifier for each equipment category that link to its locational data and clinical uses in relevant institution. A medical equipment inventory system is essential to ensure the availability of functional and useful equipment identification for the ministry of health. This project focused on developing medical equipment inventory system for General Hospital Kalutara with the view to implementing and scaling up at national level.

General Objective was to develop web based medical equipment inventory module. Specific Objectives were, identify the key requirement of medical inventory system, develop a searching criteria and unique medical equipment category identifier for medical equipment for a health care institute and to develop web based programme using PHP and MySQL.

Methods: This project consisted of 3 phases. Phase 1: requirement analysis using focus group discussions (FGD) with medical equipment inventory handler’s and medical administrators. Phase 2: identification of the suitable web-based dashboard for the user. Phase 3: development of the medical equipment inventory system.

Results: FGD were conducted in 3 healthcare institutes. There were 31 interviewers (Male -6, and female - 25). They highlighted the key requirements for the medical equipment inventory system. Which were the different searching criteria of medical equipment and how to categorize them. Using this information, the requirements specification for medical equipment inventory system was developed. Using web-based programming language (PHP) and database language (MySQL) is used for the development. As searching criteria, the unique medical equipment category identifier and health institution number(HIN) were used. This medical equipment inventory system prototype is developed and piloted in General hospital Kalutara.

Conclusions: Development and implementation of medical equipment inventory system has facilitated the long due need for medical equipment inventory information of health institutions in Sri Lanka.

KEYWORDS: Medical equipment inventory system, Medical equipment, Medical equipment category identifier, HIN, PHP,& MySQL
Miniature low power-driven and low-cost workstation with embedded Patient Management Software (PMS) for specialized clinics: Innovative technology incorporation to the Central Leprosy Clinic at National Hospital of Sri Lanka

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Background: Innovate raspberry pi 3 modules with embedded into a LED monitor composing to a mini workstation for use as computer in Patient Management Software (PMS) in Central Leprosy Clinic at National Hospital of Sri Lanka

Methods: Currently used patient management system in leprosy clinic is a paper-based system and it has all the drawbacks of paper-based system such as high cost, losses and misplacement of documents, inability to share, storage problems, slow access and security issues which may affects the optimal care for patient management. Compared to other fields such as banking, marketing etc., incorporation of electronic information systems in local healthcare industry lags behind due to various factors including the changing dynamics, complexity of the health services and cost of acquiring optimum services. Furthermore, this situation is of no more difference in other developing countries.

In the other hand providing standard laptop or desktop computers to all health staff member will be high in initial capital adding further cost via high power consumption and higher maintenance cost. Which is not be feasible and has been failed to spend on large amount of allocated money to buy and maintenances such equipment’s. Therefor search and invest for miniature low-cost solution rather spent lot of money on bulky desktop computers acquisition of digital health is more feasible. For this quest credit card sized single board computer such as Raspberry Pi can inserted to regular LED monitor is the sustainable approach.

In a small, less busy health unit such a clinic at central leprosy clinic at national hospital the proposed approach is driven. As shown in picture patient registered in one place and go to doctors then blood sample taken and sent them to laboratory. However Patient management system is a vital component of any clinical care setting to deliver patient centered care. This is the basic set up in most of the clinic and small units the health workers are do more or less same type of routine work. Therefor using bulky desktop computers in every place is very expensive. As proposed solution the working software is embedded into the system is much cost effective. Other advantage such as less opportunity to misuse internet connection since system allows only the do intended work and less chance of virus attacks. In other aspects of advantage unauthorized software installations are avoided as system does not provide full user access to system structure. As per the miniature hardware resources are very small in size (of Ram size of 128mb and CPU of 800Mhz) power consumption is trivial compared to bulky desktop computers. Above all other advantages mentioned, system OS embedded on miniature hardware workstations are Linux kernel where one of the worlds stable OS where more robust on long run without failures which more mission critical on health domain. In summary assembling a miniature fully functional, online self-operative workstation equipped with low cost and low power consumed monitors capable of processing data as a high end bulky workstation form micro controller hardware and embed the digitalized existing paper-based health records in to it. Widely used Open source software is customizing to digitalized patient management system which is then interoperable used with other existing electronic health integration systems. The data gathering process involves gathering observations, encounters, notes, and other data from the healthcare system and presentation of those in summaries, reports, and data views that is accessible to connected system.

Results: Miniature workstations and digitalized patient management system which is fully functional Online self-operative, low power consumed monitors which capable of processing data. These workstations save space needs, low initial capital, low maintenance cost and virtually no virus attacks.

Conclusion: Low cost, low energy, highly secure, centrally control digitalized patient management system which is embedded to workstation that can be scale up other health care system with minimal cost

KEYWORDS: Raspberry pi , Patient management system , Embedded computers
Using PHR and PM2.5 Open Data to Build a Web Based Smart Upper Respiratory Disease Alerting System

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Background: The science, technology and machinery industry has been developed rapidly, but has also brought negative effects, such as environmental destruction, air pollution, etc. According to the statistics of the World Health Organization, the global air quality is rapidly deteriorating, causing serious air pollution. Among them, air pollution has the most direct impact on human life. In particular, changes in the concentration of PM2.5 in the air have been of continuous concern. Air pollution may trigger allergies, asthma, colds, influenza, nasopharyngitis, tonsillitis, laryngitis and COPD, etc. The influence of the body's respiratory system is an important issue of our concern. In recent years, hospitals have successively developed electronic medical records for effectively achieving public health record management and data exchange in Taiwan. Following that, the Health Insurance Department also launches My Health Bankbook (personal health record, PHR) containing all the personal medical information of health insurance for the past three years in order to provide individuals to manage their personal health and promote secondary value-added applications. Since upper respiratory disease increases dramatically due to air pollution, this study thus attempts to combine PHR with open data of PM2.5 and establishes an algorithm to infer if the patient is under the risk of upper respiratory disease. Through real-time calculation, it provides not only an air pollution emergency alert but also effectively prevent discomfort caused by respiratory diseases.

Methods: This study employs the personal health records of respiratory disease (Obstructive lung diseases, Restrictive lung diseases, Infectious lung diseases, Interstitial lung diseases, Vascular lung diseases and Respiratory tumors; ICD-9 coded 460-518) to develop an air pollution impact coefficient algorithm. The factors of algorithm include date of illness, type of disease, air pollution impact value, risk factor, etc. The type of disease is defined by the physician which is divided into long-term, chronic or acute; the impact of air pollution can be adjusted based on the patient's respiratory disease and the risk factor is the index of the life-threatening disease of the patient. By combining the real-time data of air pollution into impact coefficient algorithm, air assessment of the activity area analysis and some alert suggestions are proposed for users. The advantage is to avoid visiting areas that may affect personal respiratory systems and soothing patient’s recurrence with upper respiratory diseases.

Results: In conclusion, this study based on the date of illness, the type of disease, the air pollution impact value, and the risk factor that air pollution impact coefficient developed an algorithm of air pollution impact. The algorithm was constructed by integrating with the personal health record management system to form a smart platform which can automatically capture real-time air pollution indicators and perform algorithm calculations with the user's personal health record. The following information can be obtained through this platform:
1. Real time air pollution indicators.
2. Personalized environmental impact coefficient.
3. Activity area warning.
In short, the system will automatically recommend the user's most suitable activity area according to his/her personal health status and help him/her prevent air pollution.

Conclusion: The air pollution derived from industrial development have a seriously negative impact on human beings. However, the integration of existing resources across different areas can effectively achieve the goal of prevention over treatment. In this study, we employed Taiwan’s air pollution open data and personal health records to identify the air pollution impact coefficient for individuals with diseases related to the upper respiratory system. The impact coefficient was calculated in real-time which help individuals prevent air pollution injuries and achieve the ultimate goal of effective personal health management.

KEYWORDS: PHR, Air Pollution, Upper Respiratory Disease Alerting, Web Based Smart System, Open Data
Geo-enable health facility list: linking healthcare and public health data

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Background: The objectives of this study were to identify to what extent health facility list in Indonesia geo-enable to support data integration and being used in the ministry of health.

Methods: This study was a descriptive qualitative that emphasizes the availability of nationwide health facility list and potential of healthcare and program-based data integration in Indonesia. The research involves 6 different departments in Ministry of Health where data was collected through 2 stage focus group discussion and observation of available health facility list.

Results: Healthcare and health program services used health facility as unique identifiers to manage patient and public health information. It was seen in numerous health activity such as patient care (inpatient and outpatient), infectious disease control, logistics management and human resource management. The Ministry of Health collect health facility data through registration and generate a unique code for a health facility. There were 2.750 hospitals, 9.767 primary health centers, 1.427 clinics, 566 clinical laboratory and 28.906 pharmaceutical facility. Unfortunately, there were multiple health facility registration systems at the national level where health facility metadata was growing and overlapping. Metadata analysis from 6 different health facility list showed that that health facility can be categorized into 2 main groups: healthcare facility that provides direct care to the patient and non-healthcare facility that does not directly perform services to patients. More content of health facility list was needed as means collection of administrative, service and health facility resources that becomes a complex identifier. Data integration and interoperability required standardized health facility codification with spatial data included. Individual data need to be exchanged between healthcare providers to enable continuing patient care while integration of aggregate data by facility level may occur where the unique code of the health facility becomes the linkage. Spatial information included coordinate and the catchment area where health programs indicators are frequently displayed as polygons layer.

Conclusion: The study found that there was no complete health facility list covering all different types of health facilities in Indonesia. The existing health facility code was limited to primary health centers and hospitals and it was managed separately. Given these findings, the Ministry of Health gives priority to the development of master health facility list (MHFL) by optimizing the existing registration system. Data integration and interoperability become possible using a unique code that generated from MHFL where spatial data also available. In consequence, several strategies such as regulation and health facility survey are needed to complete information health facility list by involving various stakeholders at different administrative levels.

KEYWORDS: Health facility list, geo-enable health information systems, health data integration
Feasibility of remote vital signs monitoring in frontline military hospitals

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Background: Frontline military hospitals provide health care facilities to wounded soldiers, civilians and sometimes, enemy personnel. These hospitals often need to manage large numbers of complex casualties in a short period of time with limited equipment and personnel. (Van Gent et al., 2018) has shown that video conference telemedicine linking intensivists with remote ICU facilities can increase outcomes, establishing reliable video conference links at the frontline is difficult. The continuous, remote monitoring of patient’s vital signs in frontline military hospitals may be feasible and lead to improved outcomes. Although (Liu, Holcomb, Wade, & Salinas, 2017) demonstrate that vital signs are not predictive of survival, continuous monitoring of patients vital signs has been shown to be effective in raising alarms for early intervention and reduced death(Weller, Foard, & Harwood, 2017). A recent survey by (Downey, Chapman, Randell, Brown, & Jayne, 2018) found that continuous monitoring of vital signs outside intensive care units was feasible. However, (Ruppel et al., 2018) has shown that continuous patient monitoring results in so many false alarms that health care professionals report that alarms interfere with the provision of care.

The aim of this study is to examine the extent to which remote, continuous monitoring of patient’s vital signs in a frontline military hospital could be feasible and effective in improving outcomes.

Methods: An observational and descriptive study was conducted in some selected hospitals where war casualties were managed. In depth interviews were conducted with commanding officers and medical consultants with extensive experience with front line military hospitals was conducted to identify main challenges for continuous, remote patient monitoring in the field. Interviews were transcribed and analyzed qualitatively using thematic analysis.

Results: Scarcity of experienced skilled man power, especially clinical experts (consultants, medical officers and nurses) is the main problem identified. Shortage of space, especially receiving a large number of casualties in a short period of time and transporting the casualties after the primary care to provide secondary care are the other problems known. Casualty identification, registration and prompt and accurate triaging were critical. The observation of priority one and two casualties, surgery and post-operative care are the functional care points where remote vital signs patient monitoring can be applied to improve the quality of casualty care. However, for remote vital signs monitoring to be useful in frontline hospitals, monitor alarms must be accurate and false alarms kept to a minimum.

Conclusion: Scarcity of trained specialist manpower is the main problem faced by frontline military hospitals. Casualty identification and registration, triaging, observation after triaging, acute management and post-operative care are the functional points where remote vital signs monitoring can help to improve medical care. Further research in the field is required to examine the extent to which the feasibility and benefits might be actually realized.

KEYWORDS: remote patient monitoring, military hospital, telemedicine, casualties
Automatic and accurate recognition of corneal morphology from OCT images of rabbits

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Background: The changes of corneal refractive power can greatly affect the overall refractive state of the human eyes. The corneal morphological data can be applied to early diagnosis of corneal dilatation, keratoconus and other diseases. And it can also be applied to evaluate the efficacy of certain clinical treatments, such as corneal refractive surgery and corneal cross-linking therapy, prediction of corneal structure and function before and after corneal refractive surgery. It has been widely used to perform experiments on rabbit eyes due to restrictions for experimenting on human beings. Optical coherence tomography (OCT) is a noncontact imaging technique with high axial resolution, which allows precise delineation of the different layers of the cornea. In this paper, it’s proposed to accurately measure the corneal morphological parameters from rabbit eyes’ OCT images. Because the rabbit can’t gaze at the mark on the OCT equipment and the morphological measurement program of OCT device was designed for human eyes, the accurate morphological parameters of rabbit cornea cannot be obtained directly by the measurement program on OCT device. Therefore, it is of great significance to study the automatic and accurate recognition algorithm for measuring the rabbit corneal morphological parameters based on the OCT images.

Methods: In this paper, based on the rabbit eyes OCT image, the precise corneal morphological parameters were automatically obtained by the proposed algorithm. First, the morphological denoising algorithm was used to extract the edges in the OCT image of rabbit cornea. The isolated noise was removed and the weak pseudo edge was suppressed effectively. Then, the corneal edges were extracted by Canny operator. Third, the extracted corneal edges were fitted by a general equation of quadratic curve. The central corneal thickness (CCT) and the radii of curvature of the posterior and the anterior surface of the cornea were calculated. These automatically obtained parameters were consistent with those obtained by manually annotated methods. At last, to verify the reliability of the proposed algorithm, the parameters of curvature radius and CCT were automatically recognized by our algorithm for human eye OCT images. And these results were compared with those measured by OCT devices.

Results: A general equation of quadratic curve gave a good fit to corneal edge curve. The CCT and corneal curvature radii which obtained by the proposed algorithm were verified by consistency test, and a high consistency was achieved. It was proved that these parameters of rabbit cornea were consistent with those obtained by manual annotation method (Cronbach's Alpha=0.983, p<0.05). For human eye OCT images, the CCT and corneal curvature radii automatically obtained by our algorithm and OCT devices were examined by consistency test, and a high consistency is achieved (Cronbach's Alpha=0.991, p<0.05). Therefore, the accurate recognition of corneal morphology parameters based on human eye OCT images was validated. And the reliability of the proposed algorithm was verified in the application of rabbit corneal morphological recognition.

Conclusion: The reliability of the proposed algorithm was verified in the application of rabbit corneal morphological recognition. An automatic morphology parameters recognition algorithm for OCT images of rabbit eyes have been developed, which is expected to be applied to other automatic and accurate recognition of high-noise, low-contrast image boundaries.

KEYWORDS: Corneal morphology; OCT image; Edge detection; Curve fitting; Curvature radius
Positioning of optical surgical instruments and acquisition of point cloud data

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Background: Surgical navigation systems are increasingly applied in surgery. The application of navigation systems has played an important role in relieving patients' pain, shortening the duration of the operation, and increasing the success rate of an operation. And optical tracking systems with infrared emitting diodes or reflective spheres are widely adopted because of its sub-millimeter accuracy. However, the disadvantage of the optical system is that the markers must be accurately tracked by the camera and some successful commercial systems are very expensive. In this paper, an optical tracking system based on stereo vision is designed with high-accuracy and low cost. And then using this positioning algorithm can obtain the point cloud data of the intraoperative body in real-time that is to facilitate the registration of preoperative CT or MRI data for accurate intraoperative positioning.

Methods: In the proposed system, the optical infrared LEDs installed on the surgical instrument are used as markers and near-infrared filters are added in front of the Bumblebee2 stereo camera lens to eliminate the interference of ambient light. The algorithm based on the region growing method is applied to extract the pixel coordinates of markers, and the gray centroid method is used to solve the pixel coordinate of the marker’s center. Then, the marker’s matching algorithm and three-dimensional coordinates' reconstruction are applied to calculate the coordinates of the surgical instrument tip in the world coordinate system.

Results: In the simulation, the stability, accuracy and rotation tests were carried out for a simulated surgical instrument that is produced by the project team. In order to test the stability of the proposed system, 10 different position points are selected randomly and surgical instrument is kept still in each position. For each position, 100 samples are used for repeating and the standard deviations (SD) of X-, Y-, and Z-directions are calculated. The tracking accuracy of the system is evaluated by comparing the distance calculated by the algorithm proposed with the actual measured distance using a grating ruler. Twelve angle groups are measured from 5 degree to 60 degree. Each angle is measured 100 times, and then averaged. And the same time, human spine Computed Tomography (CT) data is used as 3D model and printed by a 3D printer. Then, the point cloud data of the spine is obtained by scanning the surface of the printed 3D spine model with a calibrated surgical instrument. Namely, the stereo camera constantly grabs images of the active markers on the surgical instrument, and the processor calculates coordinates of the tip of the surgical instrument in real-time which forms the point cloud data of spine. The obtained coordinates of these point cloud data are used in 3D reconstruction and registration with the 3D CT data.

Conclusion: The simulation results show that the proposed optical tracking system has high accuracy and stability. In the future, it can achieve the registration between preoperative CT data and intraoperative point cloud data of joints and meets the requirements of surgical navigation.

KEYWORDS: Optical positioning; Surgical instruments; Optical markers; 3D reconstruction; Point cloud data
Transformation of Environmental, Occupational Health and Food Safety data flow


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Background: Public Health Inspector (PHI)’s monthly report is an important component of the primary healthcare system to have a clear idea about the environmental, occupational health and food safety (EOFS) health in a given Medical Officer of Health (MOH) area. However, it was identified that the data formats have not been revised for a long period resulting in poor data quality, relatively high possibility of data inaccuracy, no proper data approval flow and no proper mechanism to find completeness and timeliness of reports at national level. Thus, data generated at the grassroot level have minimal use for policy planning or monitoring of the Environment, Occupational health and Food safety. Electronic public health information management systems are emerging and they have proven to improve the efficiency, quality, completeness, timeliness and the cost of health care. District Health Information Software version 2 (DHIS2) is a web-based free and open source platform which is widely implemented in over 60 countries providing a wide range of possibilities for building information systems for a range of public health issues. Objective of this study is to transform paper based environmental, occupational health and food safety data flow into electronic data flow using DHIS2.

Methods: Focus group discussions were carried out with all stakeholders in several occasions. Existing data elements and data flow were thoroughly investigated and by considering all suggestions, data entry forms were revised. We decided to use DHIS2, which is a generic public health information system to address the identified problems in current system. The system was developed and tested by entering 20 newly revised PHI monthly returns after piloting the newly built system in Northern Province.

Results: Generic DHIS2 platform was flexible enough to be customized to revised PHI monthly report. The inherited features in DHIS2 platform, such as data validation, indicator formation, data backup, setting up data approval work flow, locking data set on time and handling missing information were used when developing the system and verified by testing. Further, it allowed changing data and process needs without major rework. Thereport dashboard has detailed visualizations where Environmental, Occupational health and Food safety information could be analyzed in different tabular and graphical representations.

Conclusion: The electronic system will provide accurate, complete and real time, Environmental, Occupational Health and Food Safety data which play an important role in primary health care service for policy making at national level and for the implementation, monitoring and evaluation. This system could also be used for further revision of the EOFS information system to include more quality data elements.

KEYWORDS: Environmental, Occupational Health, Food Safety, District Health Information Software version2
Development of visual diagnostic tool in R for precursors of Cervical Cancer

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Background: Cervical cancer is responsible for increased rates of morbidity and mortality among women all over the world, which if detected early could significantly alleviate the clinical prognosis of patients. Cytology based screening for cervical cancer gives uneven diagnosis which has a statutory impact on the clinical prognosis of patients. The current gold standard for cervical cancer diagnosis is exhaustive and time consuming because it relies heavily on the subjective knowledge of the onco-pathologists which leads to substandard diagnosis and false positives. To reduce time and complexities associated with early diagnosis, we propose a robust and interactive cervical cancer image analysis and diagnostic tool, which can categorically process colposcopic digital cervigrams, histopathological and cytopathological images to identify abnormal features and anomalies as compared to healthy state in least amount of time and settings with minimum resources.

Methods: Incorporation of a set of specific parameters that are clinically referred to for identification of abnormal cells with the help of open source software -R-version 3.5.1 is one of the major highlights of the tool.

Results: The software has the ability to automatically identify and quantify the morphological features, colour intensity, sensitivity and other parameters digitally to identify and delineate malignant lesions, which will improve and accelerate screening and early diagnosis.

Conclusion: We require an interactive diagnostic tool for early detection particularly in developing countries where cervical cancer incidence and related mortality is high. Incorporation of digital pathology in place of manual pathology for cervical cancer screening and diagnosis can increase the precision and strongly reduce the chances of error in a time specific manner.

KEYWORDS: Cervical Cancer, Early Detection, Digital Pathology, Screening
Tupaia – mapping health systems in Asia-Pacific: Overlaying HIS, LMIS and facility assessment data across 6 countries on a single, regional data platform

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Background: We implemented a regional project to map health systems in PICs, incorporating measures of infrastructure, disaster preparedness, staff, equipment, medicines availability, service provision and opening hours. The system is designed to allow health staff to plan improvements more efficiently and target limited resources more effectively – it also allows patients to see the location of facilities and available services. Tupaia uses DHIS2 as an aggregation server for a variety of data sources. The information is presented on a customized, public-facing web portal. A new open-source, mobile LMIS (mSupply Mobile) was released and implemented in a number of countries, offering end-to-end stock visibility.

Primary objective: Improve health service provision via the overlay of HIS and LMIS data in an integrated, regional eHealth architecture.

Secondary objective: Improve the availability of essential medicines in each participating country.

Secondary objective: Link information on the availability of medicines and supplies to other data relevant to the health system, including cold chain, service provision, staff, training, infrastructure and equipment to support overall health system strengthening.

Case study: Kiribati, a Pacific Island Country (PIC) of 114,000 implemented Tupaia in 2017, along with the roll-out of mobile electronic inventory (mSupply Mobile) across 30 facilities. Kiribati had the most comprehensive national roll-out of the new mobile LMIS of all the countries involved in Tupaia.

Methods: A longitudinal cohort study across 600 facilities in the Pacific Island Countries. All facilities in all six countries were included in the design. Coverage (facilities that received baseline mapping) exceeded 90%. Tupaia was rolled out across six PICs; Kiribati, Solomon Islands, Vanuatu, Tonga, Cook Islands and Tokelau. The primary focus of this case study is Kiribati. In Kiribati, mobile electronic inventory was installed in all health centres. Medicines availability was measured using a basket of goods, according to the HAI/WHO methodology for measuring medicines availability at the primary healthcare level. The % is defined as the number of medicines available on the day of visitation, divided by the total number of medicines in the basket of goods, taken as an average from across all facilities.

Results: 91 facilities in Kiribati were mapped using our app, representing >90% of facilities in the country. Mobile electronic inventory was installed in 30 health centres. Medicines availability increased from 66% to 81% (p<0.05) from October 2017 – April 2018. Measures of user acceptability have been positive, with >80% of daily data entry requirements being met. Other health system metrics are displayed across all facilities.

Conclusion: Aggregating data from multiple sources has the potential to improve medicines availability, whilst contributing to rational use of medicines and geospatial epidemiology. Aggregating this data across multiple countries can enhance disease-outbreak and disaster response, particularly in the Pacific.

This is believed to be one of the first large-scale projects of its kind, overlaying HIS and LMIS in near real-time across an entire country – it is also one of the first-ever projects to aggregate real-time LMIS data across multiple countries. This is also one of the largest longitudinal studies of medicines availability at the primary healthcare level ever conducted, using the HAI/WHO methodology.

KEYWORDS: Essential Medicines, LMIS, HIS, health data aggregation, access to medicines
Accurate detection of fibula malrotation based on 2D-3D registration

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Background: Fractured fibula accounts for a significant amount in ankle fractures. Recent researches demonstrated that substantial cases of poor functional outcomes are evoked by fibular malrotation which is hard to be detected using conventional fluoroscopy [1-3]. Up to now, postoperative CT scans have been thought the best approach to assess distal fibula internal rotation (IR) and external rotation (ER) accurately [4]. Therefore, intraoperative assessment of degree and direction of fibula rotation depends on qualified surgeons’ experiences. We proposed a novel approach to detect intraoperative distal fibular malrotation based on 2D-3D registration, which means that registration between intraoperative fluoroscopy in 2D and preoperative object CT plan in 3D could assists surgeons to reset fibula accurately. There are two benefits of our method. One is that quantization of fibula has more accurate guide compare to surgeons’ experiences which are beneficial to ankle functional outcome. The other is that it could notably decrease the costs of postoperative CT scans and extra X-ray radiation.

Methods: In order to test proposed method, we take a single simulated fibula as research subject and simulated 12 real-time intraoperative sets of data including ER and IR gestures using translation and rotation tools in Mimics software. The gold standards are the 3D-3D registration results of reconstructed intraoperative 3D simulation data and preoperative 3D simulation data. Three orthogonal fluoroscopies could compensate the insensitive projection axis in 2D-3D registration. The important step of 2D-3D registration is to form a 2D digitally reconstructed radiographs (DRRs) from 3D volume, which unifies the dimensions between real intraoperative fluoroscopies and registered object.

Results: The average angular (translational) errors in registration on x axis, y axis and z axis are respectively 0.56° (0.90mm), 0.14° (0.39mm) and 0.41° (0.30mm) for 12 sets. The corresponding standard deviations are 0.34° (0.61mm), 0.11° (0.31mm) and 0.15° (0.26mm). Overall, the maximum errors in cartesian coordinate system are 1.12° (2.25mm), 0.31° (0.86mm) and 0.64° (0.83mm) respectively.

Conclusions: Stroh D A et al. found that distal fibular external rotation beyond 5° or internal rotation more than 10° would result in striking change of contact pressure in talofibular articulation, therefore the clinical maximum tolerance of distal fibular rotation error is less than 5°. Proposed method can satisfy the requirement as the maximum errors are well below the limit. Besides, it also demonstrated the robustness of the registration algorithm as all of the angular standard deviations are less than 0.4°. Furthermore, registration results show that detection of rotation is more sensitive than translation, which is suitable to detect fibula malrotation. In conclusion, our method provides a feasible and accurate way to detect fibular malrotation.

KEYWORDS: Ankle fractures, Distal fibula malrotation, 2D-3D registration
Analysis of regional healthcare services using both big data and the Geographic Information System available on Japanese Government websites

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Background: Japan has become a super-aged society ahead of many other countries. It has become necessary to implement the most efficient and effective placement of healthcare resources in the Japanese healthcare management field. The Ministry of Health, Labor and Welfare (MHLW) of Japan has accumulated data on all clinical practices of each patient from all medical institutions as a “National Database (NDB).” Portions of these data have been published on their website starting from 2017. Also, MHLW has accumulated data as to how beds of all hospitals and clinics with beds were occupied by patients across the country. MHLW has released the data on their website since 2017 as “Sickbed Function Reports (SFR),” which contain the number of cases treated at each medical facility. In addition, the Ministry of Internal Affairs and Communications has developed a Geographic Information System named “jSTAT MAP (GIS),” which can provide population data from the census for each town or village as geographical data on the website. When we combine the data of the census with the big data of NDB and SFR, it enables us to estimate the number of occurrences of medical treatments in each local area, and to know how beds can accommodate patients in each area. By using these big data, medical institutions can know the standing of their own institution in their local area and it enables them to make plans for cooperation with other healthcare providers within a same area. In this research, we propose a method to estimate the occurrence of age-specific medical practices in any local region by utilizing these forms of big data and GIS. We show the actual way of analyzing the data of medical treatments in one local town as an example.

Methods: The subject region is Sera town in Hiroshima prefecture, Japan. The census, NDB and SFR are used as original data materials. GIS and Business Intelligence System are used as data visualization tools. By comparing the population composition data of Japan and Sera town, it is possible to estimate the number of treatments which occur in Sera town using data from NDB. Then, we compared the number of surgeries which is estimated by data from NDB and the actual number of surgeries which have been carried out by each medical institution obtained from data of SFR.

Results: From the data of NDB and the regional census data which is contained in GIS, the estimated number of all surgical cases occurring in the region of Sera town was 2285 cases (ophthalmic; 526, dermatological; 428, abdominal; 362, orthopedic; 345, cardiovascular; 205, genitourinary; 175, thoracic; 12, others; 12) in a year. From the data of SFR, a private eye clinic in Sera town performed 672 cases (128 %) of ophthalmic surgery, approx. 140 cases might be from outside of Sera town. On the other hand, the municipal hospital in Sera town performed 264 cases (76.4 %) of orthopedic surgery and 240 cases (66.3 %) of abdominal surgery. The rest of the cases were presumed to be performed at the other hospitals.

Conclusion: NDB or SFR have been published on government websites beginning in 2017. By using these data combined with GIS, which contains regional census data, we can estimate the number of medical care actions that occur in each local area in Japan. It became possible to ascertain the number of practices of medical treatments. By utilizing such data in this way, we believe that each medical treatment facility will be able to formulate a more efficient and effective medical strategy for their local region in the future.

KEYWORDS: big data, NDB, healthcare management, GIS, Japan
Heath Information Literacy and Obstacle in Online Health Information Seeking Among Digital Immigrants

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Background: To evaluate the health information literacy (HIL) among digital immigrants in China, and explore the possible obstacles in online health information seeking.

Methods: A self-assessment questionnaire and a semi-structured interview were designed to measure the HIL of digital immigrants and their ability to seek online health information. We investigated 2117 digital immigrants aged 45-65 in China, 45 of them were invited to take part in the interview. Non-parametric test was used to assess the impacts of social demographic factors on the digital immigrants’ health information literacy. Multiple linear regression (MLR) analyses were adopted to explain the influencing factors.

Results: Explore factor analysis showed four independent dimensions: consciousness, seeking, evaluation, and application. Cronbach’s α of four dimensions were between 0.526 and 0.749. Significant differences of HIL were found in different demographic backgrounds. Respondents with a higher education level and skilled internet using experience were more confident in evaluating health information quality, and seeking and applying health information. The result of MLR indicated that the age ($\beta$=-0.228, p<0.001), education level ($\beta$=0.257, p<0.001) and internet usage time ($\beta$=0.193, p<0.001) were main affecting factors. Main obstacle for digital immigrants to obtain health information through internet was the low information skills. In addition, the poor quality and readability of online health information was also a hindrance.

Conclusion: The situation of HIL in digital immigrants is not optimistic. Although, they recognized the positive effects of HIL on their health promotion, but their ability to seek, evaluate or apply health information is weak. Digital immigrants are adept at accessing information resources on the Internet, but they are less likely to visit health sites and are unfamiliar with the browser usage. Chinese government should incorporate information literacy education into the national health literacy promotion program, and strengthen legislative oversight on the health information pushed from internet search engine.

KEYWORDS: Digital immigrants, Health information literacy, Online health information, Semi-structured interview
Implementation of Nursing Care Plans and International Classification of Nursing Practice nomenclature at the National Hospital of Sri Lanka

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Background: To implement the Nursing Care Plans and the practice of International Classification of Nursing Practice (ICPN) at the National Hospital of Sri Lanka (NHSL) and evaluate the challenges faced when trying to implement Nursing Care Plans at the NHSL. The second phase intends to quantify the Nursing interventions practiced under selected scenarios, at the NHSL.

Methods: Standardized Nursing Care plans were introduced to selected surgical wards at the NHSL. The Nursing staff were trained on standardized documentation and their corporation was obtained for the project. Care plans were documented over a period of 6 weeks for all surgical patients treated more than 24 hours. 110 care plans were obtained through the selected wards. The care plans were then coded according to the North American Nursing Diagnosis Association (NANDA) Taxonomy 1, Nursing Interventions Classification (NIC), and Nursing Outcomes Classifications (NOC) by trained nurses. In depth interviews were carried out amongst 10 nurses who implemented the care plans and 3 nurses who conducted the coding. The challenges during implementation and the challenges in coding care plans documented by different individuals were evaluated.

Results: The challenges in implementing the care plans mainly included the constraints due to the heavy work load and the lack of time. Though the Nurses received a basic training (revision of the training received at the Nurses Training Schools), it was mentioned that they often forgot the standard process/ nomenclature and had to refer. This was mainly because those were not a part of their regular practices. Another major factor mentioned was that the Nursing care was provided in a linear manner where one nurse carry out the same procedure for all patients rather than a patient centered manner like in the case of a care plan. This made the documentation different from the regular practice. Lack of time to carryout the documented care plan was also mentioned. This is due to differences in Medical management of the patients.

The challenges in coding included mainly the lack of uniformity in documenting Nursing diagnosis, interventions or outcomes. Most consistency was seen in interventions where as least was in diagnosis. To a lesser degree, inaccurate and erroneous documentations were noted. Incomplete documentation however was minimal.

Conclusion: More training and establishment of standard practice of Nursing process, use of care plans and use of standard nomenclature is needed. These aspects should be made formalized and incorporated in to routine practices well before a computerized nursing informatics system is implemented at the NHSL. The second phase of the study intends to evaluate the nurses workload through the classified data.

KEYWORDS: Nursing Informatics, ICNP, Nursing Care Plans, NIC NOC NANDA, Nursing Process
The association between digital health literacy and health behaviours in young and midlife adults in Polish population

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Background: The ability to find, access, assess and apply health information available through digital resources is one of key skills required in modern world. The main objective of the study was the assessment of the impact of digital health literacy (DHL) on health behaviours in representative sample of young and midlife adults from Polish population. Furthermore, the predictors of DHL in this group were analysed.

Methods: The survey was carried out in a nationally representative sample (n=1000) of adult population in Poland, and was based on the computer-assisted telephone interviewing technique. It was based on the questionnaire including the eHealth Literacy Scale (eHEALS), a short version of the European Health Literacy Survey questionnaire (HLS-EU-Q16), the cluster of items assessing health behaviours and views on key public health issues as well as sociodemographic variables. In this paper, the results related to DHL in early and midlife adults (below 40 years old) declaring the use of Internet are presented.

Results: The analysis was carried out on the data of 397 respondents. In this group, women made 49.9% (n=198), married persons – 38.5% (n=153), residents of rural areas – 20.9% (n=83) and cities with higher population than 100 000 – 46.6% (n=185), persons with master’s degree – 31.0% (n=123) and licenciate degree – 25.2% (n=100). Mean eHEALS score (eHS) in the study group (mean±standard deviation) was 29.0±5.5. eHS depended on place of residence (higher scores among respondents from the cities with the population at least 100000, 29.2±5.3 vs. residents of smaller cities, 29.0±6.0, and of rural areas, 28.5±5.3, Kruskall-Wallis test, p=0.010), the level of education (higher scores in the highest education category in comparison to two other categories; 30.0±5.4 vs. 29.2±5.8 and 28.5±5.4, p<0.001) and the marital status (married vs. unmarried, 29.7±5.7 vs. 28.5±5.3, U Mann-Whitney test, p=0.012). eHS was higher among respondents showing higher physical activity (29.4±5.9 vs. 28.6±5.1, p=0.028) and higher consumption of fruits and vegetables (29.5±5.6 vs. 28.3±5.3, p=0.005). There was no differences of eHS depending on tobacco smoking status, consumption of alcohol and of fast food products. The respondents in favour of higher health insurance rates for tobacco smokers and those who were convinced about effectiveness of health-related social campaigns revealed higher levels of eHS than opponents or undecided (p=0.002 in both cases).

Conclusion: The level of DHL in early and midlife adults depends on socio-demographic variables with confirmed impact on the use and acceptance of information technologies. Furthermore, there is a clear association between higher DHL and selected positive health behaviours in this group. The level of DHL may be also perceived as a revealer of proactive attitudes to public health issues

KEYWORDS: digital health literacy, ehealth literacy scale, health behaviours
Using Medications to predict diagnosis codes by multi-label classification

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Background: Assigning diagnosis codes to electronic medical records is essential in healthcare facilities. However, it takes time for physicians to choose appropriate codes. Physicians either need to search disease codes on Internet or memorize them. Recently there are rapid development on Artificial Intelligence, especially on text classification. In this research we used text classification for assigning diagnosis codes.

Methods: The data we used is outpatients’ medical records from one hospital. We used prescribed medicines as input, and ICD-10-CM as predicted label. In this research, we referred to the approach proposed by Yoon Kim in 2014 research. We used word2vec to generate vector according to the context information of each medication, and used convolutional neural network for text classification. Due to the coding variances between doctors, we built a prediction model from one doctor dataset and to capture the more general concept of ICD-10-CM, the predicted level of diagnosis codes is categorical level. We divided this doctor dataset into training and testing dataset. Testing dataset included date on 10, 20, 30 of each month in 2016. Training dataset excluded date on 10, 20, 30 of each month in 2016. We used micro-averaged precision, recall and F-measure as evaluation.

Results: The dataset we used is a doctor from the division of Endocrinology and Metabolism. After adjusting the level of codes to categorical level, we had 197 diagnosis codes been predicted. The precision, recall and F-measure of this model separately are 0.68, 0.89 and 0.77.

Conclusion: This model showed its ability on automatically suggesting the most related diagnosis codes. From the result, we found that recall performed well meaning that the prediction of this model can cover about 90% answers coded by doctor. In some manually reviewed cases, we also found that this model is helpful to improve the completeness of disease coding.

KEYWORDS: Medications, Diagnosis codes
Explore AI assisted imaging tasks

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Background: With advancement of the computing infrastructure both in hardware and software, artificial intelligence (AI) assisted technologies attracted more and more attentions. For medical imaging tasks, it has demonstrated great potentials in the process of detection, enhancing, classification/recognition, and decision-making.

Methods: For computed tomography, awareness of the radiation risk has pushed the radiation dose to as low as possible levels while, to assure high quality image, sufficient dose has to be used for enough signal-to-noise ratio. Advanced techniques, such as iterative reconstruction (IR), was developed to handle more data noise, therefore helped lowering the radiation dose further. However, after years of development, it seems that IR has met its limit both in dose level and processing speed. In recent studies, researchers began to look for the opportunities in AI. The key task is to identify noise and signal in low dose data, then process the data more effectively. Image quality assessment measures whether an imaging technology or system can produce images with qualities acceptable to the diagnostic standards. It is an important procedure in qualifying an imaging product prior to its arrival to the market or verifying the functionalities during maintenance. One of the main tasks is to construct a model observer (MO) that reflects the human observer behaviors to assess low contrast detectability of an imaging system. An AI approach fits the role intrinsically.

Diabetic Retinopathy (DR) screening and diagnosis have been a favored field for AI related developments. We have seen encouraging reports in the literatures. However, the results are generally based on high quality images and focused only on feature extraction/classification. DR patient care should be a complete operative chain from the image acquisition (often in remote rural areas) to the end services. AI enabled techniques are useful at each stage, such as identify “bad” acquisitions at the very beginning, perform CAD and suggest CAD-driven services later.

Robotic surgery is another important direction that requires close-loop processing of detection, analyzing, and decision-making which fits exactly in the AI’s principle. It needs to register the surgical plan and operation/intervention spatially and procedurally. As an example, a surgical plan was made from a prior image by marking the image. During the surgery, the marked prior image needs to register to the real patient in order to identify the surgical site, then, a proper decision can be made to direct the robotic mechanism to perform the surgery accurately. With the help of AI technologies, minimal invasive surgery may be achieved.

Results: At low dose, CT imaging achieved reasonable quality using advanced algorithms. A 3D image quality assessment technique was developed to assess the efficacy of the imaging techniques. In DR screening and diagnosis, we developed techniques that improves reliability of the image acquisitions and helped CAD outcomes. For robotic surgery development, accurate alignment of surgical plan with the patient in surgery becomes possible.

Conclusion: AI related computing technologies showed great potential in a variety of medical imaging tasks. On the other hand, researchers are also questing the border of the AI capabilities. In the development of CT image quality improvement and assessment, diabetic retinopathy screening and diagnosis, and image guidance in robotic surgery, we are investigating potential AI solutions and understanding its strength.

KEYWORDS: Image tasks, image quality, image registration, AI
Developed Service of Smartphone Overdependence Management Application

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Background: Smartphone offers varied convenience and entertainments in modern lifestyle. Due to its convenience, people are easily led to overdependence in smartphone use. We developed a smartphone application, purpose to prevent overuse of smartphones. By using the smartphone application, it will be easier to access in behavior changes. This study proposed the development of the smartphone application service, which designed to promote smartphone overdependence prevention based on Self Determination Theory (SDT).

Methods: We developed the research intervention based on SDT, which has been widely used in self-directed behavior change. SDT arises from the satisfaction of three basic psychological well-being: Autonomy, Competence, Relatedness. In this study, those three factors were used as foundation factors of constructing intervention functions. Our application uses Microsoft SQL Server and its storage interface and functionalities were developed based on node.js.

Results: The 12-week intervention research protocol is shown in Figure 1. At the baseline, participants are enrolled and have 1 to 8 weeks as the intervention period after conducting a pre-questionnaire. After intervention period terminated, we do follow up till 12 weeks as a recurrence prevention period. Application functionalities were developed based on the self-directed system. During 8 weeks of intervention, we provide preventive services through application functions. Developed functions are as follows. (1) Autonomy: Arises autonomy through ‘set weekly usage target’, ‘last usage target achievement’, ‘check daily report’, ‘daily graphs’, ‘today usages’ functions. (2) Competence: Arises competence through ‘0, 4, 8, 12 weeks questionnaires’, ‘check questionnaire results’, ‘information about smartphone overuse’, ‘weekly informative massage’ functions. (3) Relatedness: Arises autonomy through ‘question and answer’, ‘consultation center guide’, ‘Admin messages’.

Conclusion: Since this is a pilot study to demonstrate protocol of developed smartphone overdependence management application, we expect meaningful results obtained, if we proceed according to our intervention protocol.

KEYWORDS: Behavior change, mHealth, Mobile application, Self-Determination Theory, Smartphone Overdependence
Prediction of biochemical recurrence for prostate cancer patients after operation treatment using random survival forest

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Background: Electronic health record (EHR) in clinical data warehouse system contains a broad range of information for patients, but it has incomplete and sparse values compared with randomized clinical trial dataset. The random forest approach can work better for this data than conventional method such as Cox proportional hazard (PH) regression. Thus, we will use the random forest to predict biochemical recurrence (BCR) after radical prostatectomy (RP) using EHR.

Methods: We developed observational prostate cancer patient database called as Smart Prostate Cancer Database, whose data were extracted from clinical data warehouse system. This database included 380 variables with 2,300 patients. Among them, included are variables having missing values less than 50% and patients treated with RP whose follow-up records are available. 93 predictive variables with 548 patients having total 25% of missing values are selected to develop prediction model. The variables include demographics, diagnosis results from biopsy, pathology, MRI findings, CT findings, TRUS, laboratory results of prostate-specific antigen, and operation notes.

Two preprocessing methods were applied to address the missing values, imputation and selection, and two prediction algorithms, random forest and Cox PH regression, were also employed. The random forest was incorporated with the form of random survival forest which is an extension of random forest for censored survival data. Variables that were not log-linear to the hazard rate were transformed using restricted cubic splines (RCS). Accordingly, eight models were constructed by combining each of the two preprocessing methods and each of the two prediction algorithms with applying and not applying RCS. It was validated using cross-validation with 1000 bootstrap samples. The error was measured by Harrell’s C index.

Results: While Cox PH regression fails to predict BCR due to the monotone likelihood problem due to sparsity of BCR both in selected and imputed dataset, RSF predicts BCR successfully with high accuracy. When RSF combines with RCS on imputed data, it shows best performance with error rate of 0.1638.

Conclusion: We developed a prediction model based on small samples and incomplete but large predictor variables of EHR. The model shows significantly higher accuracy than the cox PH regression.
Bioinformatics Database Research Platform for Internet Addiction

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Background: Biomarker is measurable indicator to predict the presence or severity of a disease state. Examples of biomarkers include levels of protein in the blood or patterns of activity in the brain. This study designs an IABioDB (Internet Addiction Bioinformatics Database), which is an integrated database for Biomarker research concerning an internet game group, a smart phone addiction group and their control group. The process of biomarker discovery provides opportunities for more sophisticated approaches to integrating purely statistical and expert knowledge-based approaches.

Methods: The IABioDB stored 482 research subject data of genomics and proteomics information. The research subject data is related to the internet game and smart phone addiction. The IABioDB uses Microsoft SQL Server and its storage interface and the statistical analysis functionalities were developed based on Java and R language.

Results: The IABioDB has genetic information of miRNA Array and miRNA qPCR. Using through HeatMap library, we visualized analysis status of miRNA Array genetic information and miRNA qPCR information analysis. Protein data are visualized with a box plot chart to distinguish normal group and addiction group. By visualization of bar chart, able to comparing all the objects of each group.

Conclusion: The IABioDB enables the efficient management of information regarding subjects, genomics and proteomics information. The IABioDB is significant to share research results between researchers in each field. In future, functional MRI data also will be integrated.

KEYWORDS: Internet Addiction, Biomarker, Bioinformatics, Genomics
Developing Theory based Mobile applications: a case study of developing an application for sedentary behaviour in Bangladesh

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Background: Despite the plethora of mobile applications (mApps) for health, most are not based on behaviour change theory and even more rare is such development in low and middle income countries (LMIC). From a systems design perspective, the issues and challenges to incorporate behavior change theories and frameworks are rarely discussed. The objective of the study was to evaluate the process of a theory based development of a mApp and a working prototype in a LMIC environment.

Methods: Three stages of a “person based” approach— a user centric digital intervention development—used by Yardley et al. (2015) was followed in an iterative way. In the first planning stage we collected data from participants, employees in organizations who were identified to have sedentary behaviour in the workplace using surveys, focus group discussions and key informant interviews. Targeted behaviours and behaviour change techniques were identified using the Behaviour Change Wheel (BCW) and validated through an expert group consultation. The design stage required us to elicit guiding principles (Yardley et al., 2015) comprising key intervention design objectives and the features of the intervention. The design team interacted with the development team using paper prototypes in several iterations. The process encountered in the development and initial test of the mApp was documented by the researchers.

Results: A survey of sedentary employees in three workplaces in Dhaka, Bangladesh found the prevalence on sedentary time during work was 284 minutes a day and the frequency of breaks over one hour was identified among 64% of the employees. Interviews with managers confirmed the need for breaks in sitting time during working hours. Based on literature and focus group discussions a list of targeted behaviour and behaviour change techniques were elicited. The issues and challenges faced in developing the mApp prototypes based on communications between the design and development team will be presented. Further process evaluation of the app development will be collected and reported.

Conclusion: The person based approach provides a scaffolding to the development to theory based approach to mApp development using agile framework. Limitations in resources and communication issues are faced in following a rigorous process and teams need to develop pragmatic approaches to overcome them. There are many external factors that impedes development and implementation of mApps in resource poor settings.

KEYWORDS: mApp development, Theory based, sedentary behaviour
A regional (six country) aggregated DHIS2 health data platform incorporating HIS and LMIS – lessons learned

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Background: We implemented a regional project to map health systems in six Pacific Island Countries, incorporating measures of infrastructure, disaster preparedness, staff, equipment, medicines availability, service provision and opening hours. The system is viewable by health workers, senior health staff and patients, with password-protected, tiered access. DHIS2 is used as the aggregation server, wrapped by a microservices architecture using NodeJS servers backed by PostgreSQL. Data is collected via a mobile data collection app (React Native, with a Realm database) and via mSupply (4D database), mSupply Mobile (React Native, Realm) and local DHIS2 instances. The data is presented on a React frontend.

Primary objective: Map health services across multiple countries in near real-time using passive and active data collection methods, to address regional health security issues, including disaster response, medicines availability and quality and resourcing.

Secondary objective: To eventually present regional geospatial epidemiology on a single platform.

Methods: Observational, longitudinal study
Baseline mapping across 600 facilities in 6 countries using a React Native mobile app (released for free). Pilot countries were Kiribati, Solomon Islands, Vanuatu, Tonga, Cook Islands and Tokelau. Stock data is pushed daily from mSupply servers in country, with follow-up data collected via crowd-sourcing.

Results: 600 health facilities were mapped across 6 countries. 7000 surveys were completed, with 300 registered data collectors. In total 500,000 data points have been collected and are being displayed (via password-protected, tiered access) at www.tupaia.org. The platform has already been used for disaster response (incl. Tonga), supply chain mapping (with a focus on medicines availability) and assessing service provision through a traffic light tool. In Tonga, the platform was successfully used for rapid data entry and dissemination following Cyclone Gita, proving robust and useful. It helped to identify that damage to health facilities was limited and that resources should be directed towards communities, saving money and speeding up the response. Several lessons learned on data collection methods and building an integrated system will be presented.

Conclusion: Regional health system mapping across multiple countries has the potential to address regional health security issues, including disaster response, antimicrobial resistance, medicines quality and disease outbreaks. It may also assist in accelerating progress towards universal health coverage. Aggregating data across multiple countries is practical and achievable in the Pacific Island Countries – this is especially useful for multi-lateral donors and senior health planners in participating countries. This is believed to be one of the first large-scale projects of its kind, overlaying HIS and LMIS in near real-time across entire countries – it is also one of the first-ever projects to aggregate real-time LMIS data across multiple countries.

KEYWORDS: Regional health security, Universal Health Coverage, HIS, health data aggregation, access to medicines
Identifying Important Factors of Falling Accidents in Acute Hospital using Machine-Learning Techniques

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**Background:** Falling accidents in hospitals is an important problem that affects the quality of life of patients, and the number of the accidents is increasing with the age of the patients. Identifying important predictive indicators of accidents helps account for the accidents and may reduce the number of accidents. In this study, we have extracted important factors of falling accidents from structured electronic health record (EHR) data using machine-learning techniques and discussed how to adopt preventive measures.

**Methods:** We used EHR data of all inpatients of our acute hospital from April 2014 to March 2016. The EHR data included 677,028 patient-days records and basic patient information, discharge summary of diagnosis procedure combination (DPC) system, evaluation items of daily nursing care level, and risk assessments of falling accident. The number of accidents was 875 and we predicted whether a patient cause an accident at each day. Since one of the purposes of this analysis was to identify high-risk patients in advance, we used 632 variables obtained from the day before the studied day as explanatory variables. We then constructed a predictor of accidents using gradient boosting decision tree (GBDT) and calculated the feature importance of each explanatory variable. Feature importance determines the variables that are important for prediction; however, they do not predict whether the effects of factors are positive or negative; therefore, we used partial dependence plot to demonstrate the effects of important factors for outcome. We also calculated the disease risk score (DRS) as a confounding variable summary using GBDT and estimated the causal effect of each important factor.

**Results:** The cross-validation AUC of the predictor was 0.735. The extracted top 20 important factors included not only well-known factors, such as risk scores of falling accidents (first place) and the history of accidents (second place), but also new factors, such as the number of cigarettes smoked per day (14th place). Partial dependence plot revealed that patients who smoked >20 cigarettes per day (smoking habit) were at high risk for accident. We stratified patients according to DRS and found that, for low-risk group whose DRS was <0.3%, smoking habit significantly increases the risk of accidents at an odds ratio of 2.32 (p = 0.001, 95% confidence interval: 1.37–3.76).

**Conclusion:** Our result revealed that the number of cigarettes smoked per day correlated well with falling accidents. Since smoking index was included in the discharge summary of the DPC system, we could extract smoking habit as an important factor without previous knowledge. Correlation does not indicate a causal association, and unobservable confounding variables, such as irritability, may produce spurious correlation; however, smoking habit is still an important factor of accident. Therefore, smoking habit must be considered for risk assessment to identify high-risk patients.

**KEYWORDS:** Falling Accident, Electronic Health Record, Machine Learning, Disease Risk Score
Using Text Mining to Multiple Classification of SOAP Data: Experience from a Hospital of Taiwan

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Background: Text mining is proving to be increasingly important and powerful techniques for hospital data. Patient’s progress note that is known as subject, object, assessment, and plan (SOAP) consists a lot of information that needs to be structured for better use of information. The copy and paste redundancy is an important issue for hospital data and the clinicians naturally copy and paste information from previous notes. Text mining can be useful tool for minimization the problem for SOAP data. Furthermore, the multi-label classification is a challenging issue to achieve better accuracy in a timely manner. We explored the multi-label classification to achieve better accuracy in a timely manner. The aim of our study was to assess the performance of a text classification system for hospital SOAP data against selected set of international classification of diseases (ICDs) 10 code.

Methods: We used hospital data from department of Wangfang Hospital, Taiwan for SOAP analysis for diagnosis ICD 10 code. The data had 1037 instances and it was from January 2016. We used multi-label classification for our study. Convolutional neural network was used for text classification in our study. The results were evaluated using accuracy, hamming loss and micro F-Measure of dataset. Higher values of accuracy and F measure show better performance and smaller value of hamming loss show better performance. First, we checked the data and preprocessed it. We used SAS EG 7.1 for data cleaning and preprocessing. Finally, we used MEKA (a multi-label extension to Weka) software version 1.9.0 to evaluate our data. We resampled our data to adjust imbalance data. For evaluating data, we explored the standard multi-label classification methods such as Binary Relevance (BR), Classifier Chains (CC), Pruned Sets (PS), and Bayesian Classifier Chain (BCC).

Results: After evaluating all methods, we found acceptable results. We checked accuracy, hamming loss and F measure for all four (4) methods respectively and those were for BR: 73%, 0.01 and 82%; for CC, 78%, 0.01, 86%; for PS, 84%, 0.01, 85% and for BCC, 79%, 0.01, 87%. The predicting model able to predict correctly and show acceptable accuracy, hamming loss and F measure.

Conclusion: We measured all the four methods for evaluating best performance and found acceptable findings. PS method showed the highest performances among the all methods for text classification. This finding is helpful for decision system. However, we only used one department. In the future, we will explore more data from different departments and alternative approaches to handling the data skewness and perform further experiments with other ICD-10 codes.

KEYWORDS: Multi-label classification, text mining, progress note, SOAP
Test piloting of a mHealth application for Non-Communicable Diseases in Public Primary Care settings in India

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Background: Non-Communicable Diseases (NCD) such as Diabetes and Hypertension are among the leading causes of early mortality in India. Technology, especially mHealth point of care applications with Clinical Decision Support have the potential to play a big role in controlling and improving outcomes from these diseases in public primary care settings. This presentation will detail the development and test piloting of such a mHealth application in Indian Public Primary Care settings and lessons learnt.

Methods: The application was developed by 1. Identifying the gaps through review of publications and study of present usual care in the primary care settings. 2. Identified components of interventions needed through interactions and recommendations by experts 3. Developed the mHealth application with the algorithms for clinical decision support embedded in it 4. Evaluated usability, acceptability and adaptation of the application to the clinical workflows of the end users through pilot testing in 5 Community Health Centres across 2 states in India.

Results: The application is built with Python using django web framework, android mobile application is driven by an XML application configuration layer with JavaRosa at the core and database is Couch DB. It is standards compliant to standards such as ICD 10 for diagnosis, LOINC for lab results, HL7 for messaging and CCD for interoperability. It has modules for nurses and doctors with the ability to store and integrate longitudinal health records electronically; provide automated guideline-recommended treatment plan and life style advices tailored to individual patient clinical profiles; enables monitoring and alerts to the need for changes in management and sends out automatic short-messaging services (SMS) reminders and alerts to patients. Usual care before the mhealth application, had lack of standardized evidence based systematic management guidelines which this application facilitated in bringing about. The 4-month pilot was done in 5 Community Health Centres (CHC) in 2 states of India. Deploying the application necessitated changes in the processes, workflows and patient flows. Adaptations had to be made during the test pilot, for example it was realized that the doctors would just not use the application for confirming or changing the recommended intervention and so a switch to print outs to get their sign offs had to be incorporated. There was resistance to follow the recommended processes and workflows using the application, which was overcome with focused and sustained onsite training, orientation programs, adaptations after feedback from end users and support covering all the concerned health care team members in each of the CHC’s.

Conclusion: While point of care mhealth applications with clinical decision support have the potential to play a big role in improving outcomes in NCDs even in public primary care settings, it is very important to work on the change management in processes and workflows these digital innovations bring about. If deploying these applications necessitates changing the processes and work flows, time and effort needs to be spent in working out and charting the best feasible processes and workflows, training end users, taking feedback, adapting and supporting them when going live, till end users and patients are comfortable with these changes.

KEYWORDS: Processes, Workflows, Change Management, mHealth
Defining digitally compatible indicators to evaluate disaster shelters

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Background: According to the current practices, Disaster Preparedness & Response Division (DPRD) receives information manually from displacement shelter camps via focal points appointed by DPRD under approval of local Regional Director of Health Services (RDHS). Medical officer of Health (MOH) will automatically enrolled to the disaster information system under a disaster a circumstance. Currently, there is no definite identified approved list of shelter indicators and an electronic process to observe real-time changes to the indicator values. Generation of timely information from shelter camps will monitor camp status, primary facilities and communicable diseases to improve the living conditions in line with Strategic Plan for Health Sector Disaster/Emergency Preparedness, Disaster Management Act No. 13 of 2005 and Sustainable Development Goals.

To identify the health-related primary web-based indicators for monitoring temporary shelters following natural or manmade disasters and then to design an electronic information system to receive the information on the indicators.

Methods: Interdisciplinary social networking process with brainstorming and focus group discussions were made on identifying health-related primary indicators for disaster shelters and selecting a cost-effective methodology for receiving that information effectively to DPRD for decision making.

Results: Indicators were developed (Annexure 01) through consultative meetings incorporating several specialties following several discussions sessions. Three categories of indicator levels were identified which are essential for proper functioning of shelter camps. There were 31 indicators related to shelter camp consistency, 10 indicators from nearby hospitals in the area of the shelter camp receiving casualties related to disasters and 11 indicators from RDHS highlighting the urgent needs for the shelter camps in the region. Some important indicators identified were, location/contact details of shelter camps, demographic patterns of shelter habitants, visits to the shelter by health staff, morbidity and mortality patterns, urgent manpower and material needed for the shelters and local hospital admissions related to the disaster etc.

Existing Disaster management Health Information system (DMHIS) organization structure developed by DPRD was selected to incorporate shelter indicator details. This information system is made in line with the United Nations Sendai Framework for Disaster Risk Reduction and Sri Lanka Disaster Management Act (No. 13 of 2005). This DMHIS is based on DHIS 2 which is a free and open-source health information management platform with a wide area of capabilities, reliability, and accuracy was modified and will be customized to receive above indicator information.

Conclusion: Receiving shelter information in a time of in periphery remains a challenge. Identification of the proper list of indicators will assist in the evaluation of the current situation and assist in effectively prioritizing distribution of resources. Electronic information system formats represent a cost-effective, convenient option which produces more results. DHIS 2 based system was decided to be a user-friendly, cost-effective and acceptable system which gathers information much quicker compared to the paper-based system in managing disaster health indicator information from shelter camps in Sri Lanka.

KEYWORDS: disaster, shelter, DHIS2, information system, indicators
Using IBM Watson in quality and safety assessments

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Background: The objective of the project was in part to identify the rate of positive findings in CT examinations in hospital child care, in part to gain practical experience from using the IBM Watson toolset. CT scans can provide vital information for the care of a patient, but the exposure to radiation is potentially harmful, and should be restricted. The rate of positive findings may be one several indicators when assessing the overall use of CT in a hospital.

Methods: In total, 5,242 free text radiology reports from CT scans of children between 0 and 20 years were retrieved from the hospital electronic patient record, de-identified, and subsequently categorized and analyzed using IBM Content Classification. The system was trained in sessions where 100 preliminary classifications were assessed and corrected. In all, nine training sessions were performed before achieving a stable state. The study was approved by the hospital patient privacy board and performed in the hospital safe zone.

Results: 42.7% of the reports described positive findings. The method was assessed by randomly selecting and manually classifying 200 reports and compare these to the automatic classification. The IBM Watson assessment of each report was not known to the evaluator. The accuracy was estimated to 98% (95%-99% using credibility interval of 95%).

Conclusion: The level of positive CT scans was slightly higher than what is reported in the literature for similar patient groups, indicating a somewhat more restrictive use of CT scans in our hospital. As each referral is assessed individually according to existing protocols, the results did in themselves not require a change of practice. Use of radiation should always be restricted, and the exposure should be proportionate to the clinical outcome. Tools like IBM Watson can in our experience be used to extract knowledge and experience from free text in the EPRs for quality assurance purposes.

KEYWORDS: Electronic health records, quality indicators, natural language processing
Wearable technologies in clinical trials: An analysis of development trends over the past decade

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Background: The development of innovative ‘wearable technologies’ - better known as ‘wearables’, that capture continuous personal health and activity data from patients have generated significant interest as new means of patient-centric data generation in healthcare as well as in clinical trials. The present study aimed to analyze the trends in clinical development of ‘wearable’ devices over the past decade.

Methods: We utilized the National Library of Medicine (NLM) at the National Institutes of Health (NIH) database, clinicaltrials.gov to search for clinical studies with keywords and combinations including - ‘wearable device’, ‘wearable technology’, ‘wearable’ and ‘wearable electronic device’ to generate a list of eligible studies over the period 2008-2017. The studies that had an ‘unknown status’ were excluded from the current analysis. These studies were further analyzed to ascertain their recruitment status, study type, study phase, funding mechanisms, therapeutic areas and geographical locations.

Results: We found 358 clinical studies satisfying our eligibility criteria. Out of these, nearly 49% (175) studies were active, recruiting or enrolling by invitation. 75% of the ongoing studies were intervention studies while the remaining 25% were observational studies. 17% of studies were investigating the utility of wearable devices in central nervous system disorders, 12% in heart disorders, 8% in obesity and 7% in endocrine diseases. Out of the eligible studies, 10 were classified as early Phase I/Phase I study and 11 were Phase II studies. Nearly 1/3 of the studies were found to be enrolling healthy volunteers as well. Only 10% of the clinical development programs were funded by NIH of other federal agency, 26% were industry sponsored while the remaining were supported by individuals, academia or organizations. 61% (217) of the study centers were located in North America, followed by 21% (74) in Europe with only 9 study centers located in Asia and Pacifica. Number of clinical trials using wearable technologies increased by an average of 77% (Range: 54% - 133%) per year over the period 2014-2017.

Conclusions: Conclusions: Clinical trials of wearable device technology have seen a significant increase over the past decade with significant growth seen especially in the last 5 years. As expected, most of the studies focused on cardiovascular and neurosciences therapeutic area. Majority of the studies are limited to the western hemisphere. Multiple reasons could be ascribed including regulatory, ethical, legal, infrastructure, and security challenges. Even though the arena is full of enthusiasm, more data are needed from well-designed large-scale studies to achieve analytical and clinical validation of wearable technologies.

KEYWORDS: Wearables, wearable devices, wireless, mHealth, clinical trials
Sharing experiences of development, implementation and maintenance of Hospital Information Management System (HIMS) to government hospitals in Sri Lanka

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Background: Introduction of electronic systems to government healthcare institutions in Sri Lanka was a long felt need, and it was delayed due to many factors including, non-availability of infrastructure, lack of human resource and resistance to change. The primary objective of the project is to introduce electronic Hospital Information Management System (HIMS) to government hospitals to ensure the effectiveness & efficiency of information management while being financially & operatively feasible.

Methods: The project was carried out as action research. Preparation for the introduction of an electronic Hospital Information Management System for government healthcare facilities started in 2012. Lengthy discussions held with the participation of university academics & group of health informaticians on design & development of the system. All possible pieces of different scenarios modelled to identify workable implementation strategies which can consider as one of the critical features to ensure stakeholder buy-in. Agile method of system development helped to achieve the maximum flexibility, thus making all stakeholders active partners in the development process.

Empowering end users in healthcare institutions to meet the challenges with confidence & authority in an information technology blended atmosphere achieved by establishing training facilities located within hospitals to improve IT literacy. Furthermore, collaboration with Technical Universities established to train hardware & network maintenance teams. Ready access to system managers for help & respectful responsiveness to all relevant suggestions ensured hospital-wide acceptance.

Achieving a significant milestone in Sri Lankan electronic information system integration HIMS established a working data transfer mechanism with electronic Indoor Morbidity & Mortality Report (e-IMMR) of the Ministry of Health, Sri Lanka, for information sharing.

Results: Constant engagement with policymakers & hospital administrators ensured implementation of HIMS in 10 tertiary care facilities around the country & a growing number of hospitals expressing a willingness to collaborate. Key benefits of the projects include Development of a Hospital Information Management System which is owned by the Ministry of Health, which can be replicated at any government hospital without significant software cost. Continuous support to the institutions through the development centre at National Cancer Institute, Maharagama is delivered while the institutional capacity was built through hardware, network, necessary computing training. Implementations were carried out with the change management, and it has resulted in increased buy-in from the stakeholders.

Conclusion: Implementation of HIMS has brought about a significant change in information management in all implemented hospitals without adding a substantial financial burden to hospitals. Stakeholder buy-in for the system has been a considerable factor in the success of HIMS. Development and improvement of the HIMS is a continuous process transformed into a comprehensive Electronic Medical Record (EMR).

KEYWORDS: Hospital Information Management System, HIMS, Hospital Information System Implementation, Hospital Administration
Preliminary results of health information use promotion using DHIS2 in Indonesia: a realist evaluation approach

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Background: This research studies how differences in context and approaches in District Health Information Software 2 (DHIS2) (www.dhis2.org) implementation in 10 districts in Indonesia affect facility level system adoption and health data use. Understanding the underlying mechanisms for generating data use culture and system adoption is crucial when developing DHIS2 implementation strategies countrywide across the different contexts.

Methods: We apply a realist approach to achieve above objectives. Repeated field visits to all districts, FGDs and surveys were used to collect data, identify and formulate program theories, mechanisms, outcomes and how this related to the variety of contexts. Based on this we came up with a set of context-mechanism-outcome (CMO) configurations, which is central to realist evaluation (Pawson R, Tilley N, Realist Evaluation, London, SAGE, 1997). The configurations and the elements were tested, refined and improved during 3 repeated field visits to the 10 districts over 16 months period.

Results: We identified a number of mechanisms and CMO configurations and tested program theories at different abstraction levels. Here we illustrate by testing an overall program theory: “If DHIS2 (external context) is introduced to a District Health Office (DHO) and, provided Technical Assistance (TA) by a local consultant (internal context), the district decides to adopt the platform (internal context), the health office will promote and expand the use of DHIS2 (mechanism) and transfer the knowledge (mechanism) to its health facilities where they will use DHIS2 dashboards with their own data (outcome)”. This theory is tested by asking “How is the data use and system adoption with and without the local TA and/or local commitments? What caused these situations? In what internal and external contexts did these occur?”

Political supports and TA may represent contexts or mechanisms depending on district situations. DHO commitment to prioritize other system development makes DHO support a context. While in District C, the Mayor support is a mechanism resulted from DHO advocacy, which finally produced faster HIS adoption and health data use. Consultant backgrounds and TA approaches may act as mechanisms. For example, while District G consultant focused on establishing strong technical foundation, District J consultant chose more practical approach and resulted in faster expansion beyond funded facilities.

Conclusions: Here we only present a few examples that we will explore further in the paper. This study finds that the mechanism of local commitment and ownership are the most important factor in generating good system adoption and health data use. Additionally, 1) technical support from HIS consultant with balanced skills between health data management and ICT, 2) operationalization of data use and sharing through local policies, and 3) demand for data both at district and facility level serve as contextual features that enhance data use.

KEYWORDS: DHIS2, realist evaluation, health data use, health IT adoption
Integrated LAN, Wi-Fi and Wide Area Network at AIIMS for healthcare professionals and students of AIIMS

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**Background:** All India Institute of Medical Sciences is a premier medical institution of India having more than 2000 beds and more than 55 disciplines of healthcare. Daily visit of patients approximately 20,000. LAN environment in AIIMS, New Delhi has grown from coaxial cabling to Cat3, Cat5 and Cat6. From 1988 to 2018 it has grown from a mere 50 nodes to 9000 nodes catering to e-Hospital, e-Office and internet applications. The network infrastructure consists of 2 core switches, 20. distribution switches and 500 access switches in the wired LAN. As part wireless of network including hospital area, library area and hostel area consisting of 1150 access points and a DHCP server for dynamic allocation of IP address for wireless users.

The objective of the network design for implementation at AIIMS is reliable, versatile and secure network. Also, with the objective of providing online journal access for faculty, scientists and students of AIIMS. Also, to provide online telemedicine healthcare for remote area patients.

**Methods:** Star topology for LAN implementation using core, distribution, access switches for wired network and for wireless network using DHCP server and access points was adapted. VPN for online journal access from outside institute was implemented. MAC based authentication for wireless users given. Implementation of IPSec tunnel among AIIMS and its centers to access e-Hospital software done. SOPHOS firewall at gateway level security implemented. Implemented VLANs for various group of users. National Knowledge Network (NKN) lease line(1Gbps) for WAN connectivity was used.

**Results:** The implementation of wired and wireless LAN at AIIMS as resulted in - Faculty, Scientists and students of AIIMS to freely access online information. It has also resulted in publishing over 600 research publications using the online journal access. It is also helped in collaborative research and telemedicine.

**Conclusion:** The implementation of the above said network has helped the institute in Reduce inequalities in healthcare, facilitate high quality health research, Telemedicine for remote healthcare, help to improve the quality & efficiency of health services, policy and guidelines, Professional development and knowledge exchange.

**KEYWORDS:** Network, LAN, WiFi, WAN, online Journal, online information retrieval, telemedicine
Strengthening HIS through social media: Reflection of Whatsapp use in DHIS2 implementation in Indonesia

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Background: The use of social media (such as WhatsApp messenger) as a means of communication and coordination is ubiquitous, including in working environment. This study seeks to understand the role social media-based support group plays in supporting the adoption and implementation of District Health Information Software 2 (DHIS 2) in Indonesia. Insights from the study will enable a richer understanding to Health Information Systems (HIS) strengthening in a spread out setting such as Indonesia.

Methods: This study is part of a larger action research program Health Information System Programme (HISP) engaged in strengthening HIS in Indonesia. All authors are member of at least one group of Whatapp messenger created to support DHIS2 implementation in Indonesia. Participant observations and interviews were used to gather data for the study. Classification and analysis of 30 Whatsapp group messages going back from November 2017 was done to provide a richer understanding of the role of social media support group have among group members. The emerging concepts and ideas were studied and analyzed by the authors through formal and informal discussions.

Results: The study identified more than 30 HIS-related Whatsapp groups encompassing members engaged in DHIS2 implementation in Indonesia; representing Ministry of Health, provincial and district health offices, academics, and HIS consultants. The largest group comprised of around 100 stakeholders created as far back as February 2017 while others were newly formed in late 2017 to 2018. The Whatapp groups provided an opportunity for communication and collaboration among members. Latest DHIS2 implementation updates and supportive messages could be shared and discussed within groups, incorporating feedback from members far apart. This enabled a closed loop communication placing members on board with the ongoing activities. Furthermore, the group allowed flattening of the hierarchy among members, for example, district people could discuss straight with provincial representatives. This presented a new way of organizing communication and different programs in the respective Whatsapp group member levels. Interviews revealed that reported progress and supportive texts motivate participants. They admitted to look forward to making and documenting progress, including to innovating, thus able to share it with the group, including the participants from late-starter districts, although many choose to lurk and respond to questions or topics in private. On the other hand, some participants reported that they do not read all the messages due to practical constraints, like time or mobile device capacity.

Conclusions: Social media-based support group may encourage different mechanisms such as healthy competition, hierarchy flattening, and event organization. We encourage further research on how to optimize the utilization of social media-based support group to improve the level of HIS adoption and use.

KEYWORDS: Social media-based support group, Whatsapp group, DHIS2, HIS strengthening, large scale health IT project management
Assessment of the Implementation of Standardized Terminology in Community Care by Analyzing Community Clinical Pathways

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Background: In the rapidly aging society, the Japanese government has promoted interested community care (ICC). Community clinical pathways (CCPs) are standardized care plan and health records with interoperability between acute hospitals and long-term care (LTC) facilities, which is a crucial solution for ICC. Some CCPs are also operated in electronic health records. This study assessed the implementation of standardized terminology in community care by analyzing CCPs.

Methods: In 2001, the Japanese government started a website for sharing contents of critical pathways as one of the healthcare IT promotion policies. As of May 2018, the website offers 20 CCPs (including for cancer, stroke, and fracture) from 10 acute-care hospitals, which we analyzed using text mining methods and cluster analysis. Next, we elucidated the major nouns that expressed human actions from those CCPs using Jaccard score. Further, we checked the elucidated words, i.e., whether they were registered in nursing standardized terminologies masters because nursing terminologies primarily cover LTC. This study was supported by JSPS Grants 16K12222.

Results: The research revealed that 20 CCPs comprised 57,052 words of 2,865 kinds. Major 76 words were classified into nine clusters as follows: activities of daily living (ADL; 9 words), healthcare providers’ assessment (7 words), healthcare providers’ comments (4 words), patients’ outcome (5 words), rehabilitation (11 words), admission/discharge (11 words), medical procedure (13 words), patients’ education (5 words), and header of pathways (11 words). In ADL terms, the representative word “support,” exhibited a deep connection with 42 words (Jaccard score, 0.42–0.10); of 42 words, 20 matched the master of standardized nursing terminologies (match rate, 47.6%). In patient’ education terms, the representative word “explanation,” exhibited a deep connection with 59 words (Jaccard score, 0.37–0.10); of 59 words, 21 matched the master (match rate, 35.6%). In rehabilitation terms, the representative word “training,” exhibited a deep connection with 22 words (Jaccard, 0.19–0.10); of 22 words, 9 matched the master (match rate, 40.1%). Per text mining, standardized nursing terminologies concerned with LTC comprised 35.5%–47.6% of major terms in CCPs because, in ADL terms, CCPs were frequently used popular terms (not only scientific/legal term; e.g., look over patients activities).

Conclusion: Standardized nursing terminologies could effectively express most terms in CCPs, whereas in rehabilitation and patient education terms, it was recommended that more terms used in LTC, including CCPs, should be registered in standardized nursing terminologies (e.g., medicines brought to hospitals by inpatients). Overall, standardized nursing terminologies are meaningful to electronic CCPs; therefore they should be enhanced in patient education and rehabilitation.

KEYWORDS: Long-Term Care, Community Clinical Pathways, Electronic Health Records, Nursing Informatics, Standardized Terminologies Masters
mHealth for integrated service delivery in the Western Pacific: A Systematic Review

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Background: This systematic review examined: i) how mHealth is being used in integrated service delivery in the Western Pacific Region (WPR); and ii) the lessons learnt to guide the implementation of mHealth-based interventions in the WPR.

Methods: This review was conducted in 2 phases: i) a systematic review of published reviews and ii) a systematic review of original research papers. Medline, PubMed, EMBASE, Cochrane, CINAHL, Global Health, SCOPUS and Web of Science databases were searched. Standard systematic review protocols were employed, involving two independent reviewers for screening (titles/abstract, and then full-text screening stages), critical appraisal and data extraction. Data was extracted from eligible studies using a piloted data extraction sheet based on the Integrated People-Centered Health Services (IPCHS) framework. Findings were thematically analyzed, and then used to guide the development of an assessment framework, to assist nations or their agencies with the development, implementation and evaluation of mHealth programs for integrated service delivery.

Results: We identified 40 studies, predominantly from Australia, China, Malaysia, & New Zealand. WPR countries not represented were Philippines, Mongolia, Brunei Darussalam, Laos, Japan, and Pacific island nations. mHealth tools were used in integrated service delivery i) to push and pull information as part of interactive decision support systems; and ii) providing feedback and guidance to the individual as well as the actor network of providers (e.g. clinicians, coaches), patients, carers, and families. This was achieved through person-to-person audio or video calls, and through automated and structured telephone support. Automated text messaging (SMS or MMS) have been applied to act as reminders (daily/weekly/monthly), motivators, counsellors/advisors, health coaches, and exercise facilitators. The evidence base is limited but generally the perceptions on the utility of mHealth were optimistic and positive impacts were found.

We found that many IPHCS strategies were addressed using mHealth. IPCHS Strategy 1 to engage and empower people and communities is being addressed through mHealth self-service tools which allow citizens and communities to bypass unnecessary gatekeepers and access health services directly. IPCHS Strategy 2 to strengthen governance and accountability is facilitated by mHealth tools to support medication management and health worker adherence. IPCHS Strategy 3 to reorient the model of care is supported by mHealth enabling ambulatory, community-based care and self-management in primary care-based systems. IPCHS Strategy 4 to coordinate services within and across sectors is facilitated by mHealth tools to share information, promote health literacy and assist with scheduling and navigation. IPCHS Strategy 5 to create an enabling environment is supported by mHealth tools to facilitate the use of data collected in routine care for continuous safety and quality monitoring and improvement, to strengthen health systems. We also found that mHealth tools can support needs assessment and contribute to the knowledge base.

Conclusion: Although our review found that mHealth can enable the shift of services from disease-centered to people-centered integrated service delivery and models of care in WPR, systemic factors such as supply and demand, usability and workflow issues associated with the implementation of mHealth programs play a vital role.

KEYWORDS: mHealth; integrated care; person-centered care, service delivery; systematic review
Health Information Systems Online Course for Public Health Practitioners in Indonesia

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Background: Since 2017, The Ministry of Health Republic of Indonesia has been piloting DHIS2 (District Health Information Software Version 2) in 10 districts and will scaling up in another 50 districts (out of 514 districts) in Indonesia. It was perceived capacity building of HIS in Indonesia still challenging where face-to-face training was budget limited, thus only limited participants could be involved in the conventional training. The purpose of this study was to design health information systems (HIS) online course for public health practitioners in Indonesia to improve their knowledge and skills on health management information system, particularly using DHIS2.

Methods: This study used instructional design models to develop the HIS online course where DHIS2 was used as a tool to understand the role of information technology for data and information management. Training data were taken from retrospective data of various health programs from district and health facilities level. The development process involved several organizations part of the DHIS2 Indonesia implementation namely Center for Data and Information Ministry of Health, Universitas Gadjah Mada, University of Oslo, and WHO Country Office Indonesia.

Results: The online training targeted health information system (HIS) staff and health program managers in Province and District Health Offices and Primary Health Center in Indonesia. Online course on DHIS2 was developed as an alternative tool for professional development among public health practitioners in the health offices. The designed goals and curriculum of the online course were tailored to the in-class training curriculum. The online training was adopted DHIS2 Fundamental Online Academy established by University of Oslo. To meet the needs of DHIS2 implementation in Indonesia, there were several additional topics related to DHIS2 Indonesia focusing on information systems management and implementation strategy. Number of videos, assignments and quizzes were made to help participants achieve the expected competencies. A pre-test and post-test questionnaire were created to evaluate the participants knowledge while acceptance of online course was evaluated using a feedback survey.

Conclusion: This study has introduced a potential tool supporting The Ministry of Health efforts in implementing DHIS2 in order to strengthen national health information system. It is expected that online course on DHIS2 becomes one of the most efficient methods to improve the capacity of public health practitioners in utilizing DHIS2 at The Ministry of Health, Province and District Health Offices, and Primary Health Centers across Indonesia.

KEYWORDS: Online Course, Health Information System, Distance Learning, DHIS2
RFID Approach to Track Clinician Activity in The Operating Theater

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Background: Patient safety is at the center of an efficient healthcare system. Medical errors are a threat to patient safety. It is relatively common in hospitals and is a serious public health problem. Therefore, it is of importance to have efficient activity detection systems in hospitals to detect clinician activities in order to keep mistakes at a minimum. This research focuses on designing a system model which allows a computer to automatically identify the physical actions of an anesthetist in the operating theater in order to detect and correct his/her clinical errors. It involves finding suitable technologies to identify activities in the operating theater and designing a prototype system to detect an aspect of clinical work. This paper discusses our attempt to use Radio Frequency Identification (RFID) technology to capture anesthetist activities in a simulated operating theater.

The objective of this paper is to answer whether RFID system could be used to detect an anesthetist’s clinical activities in an operating theater.

Methods: An experimental study was set up to use active RFID equipment to detect the activities of an anesthetist in an operating theater. The experimental set up used the active RFID system of AURA Lab of the Auckland University of Technology. The experiments were conducted with clinical trainee staffs at the Simulation Centre for Patient Safety (SCPS) at the University of Auckland, New Zealand. An appropriate simulation suite was set up exactly like a clinical operating theater with clinical trainee staff. A mannequin was used as a patient and the room is provided video and sound recording facilities. Different operating room stories took place with five personnel in the room, an anesthetist, a surgeon, two nurses and an anesthetic technician. As we were tracking the anesthetist’s activities only, he wore tags on his parts of body.

Results: For each of the trials the RFID tag’s position on each part of the body, forehead, back of head, front of body, back of body, and wrists was recorded for analysis. Based on the data, the distance traveled by each tag was calculated to measure the movements of anesthetist’s body parts.

Conclusion: This paper presents a trial using an RFID tracking system to detect anesthetist activity during anesthesia, in order to investigate whether the radio frequency identification system can be used to detect an anesthetist’s clinical activities in an operating theater. The experiments were organized to detect the anesthetist’s activities in a realistic operating theater environment with clinical trainee staffs and a mannequin in a simulated operating theater. Several operating room scenarios were run to obtain the RFID data. However, we noticed that the RFID data we collected were noisy and incomplete. Because the RFID readings were influenced by the effect of multi-path reflection and attenuation due to the large amount of metal surfaces presented in the operating room. This study demonstrates that the RFID sensor system could be used to detect some characteristics such as total distance traveled by the anesthetist and his/her rotational movements during the operations. This is because the data was not completely captured by RFID system in the operating theater environment due to multi-path reflection and attenuation issues. Therefore, the further investigation is required to use active RFID sensor system to detect anesthetist activities in the operating theater.

KEYWORDS: Anesthesia, Clinical activity detection system, Clinical errors, RFID sensors
**Development of Knowledge Portal for Pharmaceutical Research**

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**Background:** With the competition for science and technology getting more and more fierce, pharmaceutical research has become increasingly complex, and knowledge has been accumulated at an increasing rate. Establishing the knowledge portal based on Web has become a trend. Objectives were to develop a knowledge portal for pharmaceutical research based on the needs of pharmaceutical research institute, to realize the comprehensive integration, effective utilization and knowledge service of pharmaceutical information resources.

**Methods:** Based on the information classification principle, the pharmaceutical knowledge resources accumulated by the institute have been divided into 7 types: journal articles, project documents, experimental records, video resources, chemical compounds, patents, experts and scholars. Using metadata storage, full-text retrieval, data mining, video-on-demand technology, the knowledge portal for pharmaceutical research has been established by adopting the J2EE technology based on the Browser/Server architecture. Windows 2008 Server (64 bits), JDK1.7, Tomcat7.0 and MySqI5.6 were employed as the developmental platform to realize the system functions. Users can access the system through the browser, using a dedicated account.

**Results:** Integrating all kinds of knowledge resources, applications and services together, the pharmaceutical research knowledge portal can exercise overall management. (1) Resource processing and indexing. The processing of pharmaceutical information resources, indexing, storage and other operations. (2) Information storage management. Add, deletion, and modification the information stored in the database. (3) Information query and retrieval. The information stored in the database can be general query and full-text retrieval. The molecular structure information of compounds can also be browsed and queried. (4) Visual mining analysis. Construction of pharmaceutical information network, based on keywords, experts, relevant literature to provide knowledge discovery. (5) Collaboration in scientific research. Using E-mail, bulletin boards, online forums, etc., to provide a platform for project team to coordinate research. (6) Video on demand. It provides online broadcast, query and download of pharmaceutical multimedia videos. (7) Statistical analysis of data. Through multi-dimensional statistical analysis, the sources and utilization of the information can be analyzed and displayed in a variety of graphics. (8) Integrated management of the system. Including data synchronization, interaction, backup and recovery, also includes user rights management, providing security guarantee for information release and use.

**Conclusion:** We have successfully put the pharmaceutical research knowledge portal into use since 2016, after 2 years of operation, it has accumulated nearly 10 thousand data records. The system is characterized by the friendly interface, diversified retrieval methods, rapid response and complete output. As an attempt of the pharmaceutical research institute, the knowledge portal has significantly promoted the institute’s information construction, improved the quality and efficiency of drug research and development, and achieved knowledge sharing and innovation.

**KEYWORDS:** Pharmaceutical Information; Knowledge Management; Knowledge Portal
Perceived improvement of the process of patient care by digitalization of primary health care encounters in OPD set-up of a tertiary care hospital through the lenses of the health professionals

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Background: The primary healthcare encounters in government health sector reached 50 million per year and it shows an increasing trend. However, the morbidity patterns of such encounters have not been documented in adequate details to make data-driven decisions. On the other hand, digitalization of primary health settings has proven to improve the data capturing and assist clinical care. The Castle Street Hospital for Women primary care setting (Out Patient Department - OPD) was digitized using a Hospital Information System. The objective of the study was to evaluate the perceived improvement of the process of patient care by the digitalization of primary healthcare encounters of the OPD setup in the lenses of the health professionals.

Methods: A qualitative study in the form of in-depth interviews was carried out among the healthcare professionals, who are the primary users of the OPD system, 10 weeks after the implementation. A purposive sample of nine healthcare professionals was interviewed for their opinion on process improvement, perceived benefits, comparison of paper and electronic systems, individual reaction to change, further improvement required in the system and the support they received during the transformation from paper to electronic. The interview was done by the principal investigators in English language given the expected profiles of the participants. The transcripts were coded line-by-line, and then developed into themes by grouping.

Results: All the participants had completed more than 20 years of service and average primary care experience was 7 years. Out of all the participants only 2 had formal ICT training while others were trained through in-service programmes. All have used a laptop or a desktop for some purpose. General ICT proficiency was beginner to intermediate. Average difference in perceived rating of the clinical care process (1-10 scale) was +2.1 after digitalization. Overall, the respondents perceived improvement in the clinical care process by means of access to past encounters, access to basic patient clinical information, online order entry process, automated admission process, potential to visualize the investigation reports and positive finding recording. Furthermore, one of the key perceived benefits was improving the accountability of the caring medical officer through logs and signature on admission sheets printed through the system. Top of the mind analysis revealed the best value addition to the care process was the ability to retrieve the relevant past events and core decisions taken in each encounter. On the other hand, the diagnosis coding and reason for encounter coding need to be contextualized. They were neutral on the patient response about the process change.

Conclusion: Overall rating of the care process improvement was positive, and the best value addition was the ability to retrieve the relevant past events and core decisions taken in each encounter. However, the diagnosis and reason for encounter coding need to be contextualized. The patient perceived benefits should be assessed separately.

KEYWORDS: Digitalization, primary healthcare, encounters, health professionals, perceived improvements
End-user Perception and Challenges Encountered in Implementation of mHealth Solution for Public Health Surveillance at field level: A case from Sri Lanka

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Background: Use of mobile devices for field level public health surveillance is an unexplored avenue in public health in Sri Lankan context. A mobile app was designed to collect data and to identify and follow-up children under age of 5 with malnutrition or having risk-factors for undernutrition. The mobile app was implemented in 3 districts of Sri Lanka by training public health midwives (PHMs) who are the field level public health workers and the key end users of the mobile app. The objective of this study was to assess the acceptance of the solution by end users and to identify challenges of implementation of mHealth solutions at field level in Sri Lanka.

Methods: A qualitative approach was followed to observer 18 months of field implementation of the mobile solution in the three districts. Focus group discussions were conducted with the participating PHMs of 30 medical officer of health areas (comparable to health districts) to assess their perception on use of mHealth on public health surveillance and the challenges encountered during the transition. Responses were analyzed on thematic areas. Participant observations were performed at field weighing centres and field clinics on how the PHMs were using the mobile application during the clinical assessment of the nutritional status of the children. The data captured using the mobile application was also analyzed to assess the geographical distribution of the cases and the competency of PHMs in using the mobile app accurately.

Results: Focus group discussions with the end users revealed that PHMs in general prefer the mobile based data collection as opposed to the traditional paper-based data flow. They believed that it would enhance efficiency of data flow and the mobile technology has a lesser learning curve. Offline data entry, access to data and help to follow up children, portable devices, interactive interfaces with embedded nutrition concepts were identified as features promoting the adoption of the solution at the end user level. PHMs believed that the use of mobile technology was a value addition to the traditional field level public health workers. They highlighted the need of a mechanism to cover the costs of mobile data and insufficient support for hardware maintenance during and after the warranty period of the device, which were new challenges in a traditional public health setting. The lack of interest/motivation by supervisory public health staff and administrators were felt as a barrier to introduce mobile solutions by PHMs in certain areas. Participant observations at weighing centers revealed that only some PHMs were using the application for real time data entry after measurement of weight while others preferred to document in paper forms and bulk data entry at conclusion of clinic. It was interesting to find that most of the PHMs who participated in the study had used the mobile application to refer nutritional status of individual children when inquired by a mother or a supervisor instead of using the paper-based system. Coverage of children at-risk for malnutrition was over 80% with the mobile application in the three districts during the period.

Conclusion: End user preference for a mobile solution for field level data collection and data use was encouraging. The users felt they had easier access to their data than in the paper-based system. The solution has contributed to build trust on use of technology at end user level. It was essential to provide sufficient resources and support and to advocate for support from local management for the sustainability of the solution at field level. Further studies are required to assess the individual variation in adopting mHealth for routine work and competency exhibited by end users.

KEYWORDS: mHealth, Public Health
Users’ perception toward the usefulness of the web-based system for disease surveillance:
 a qualitative study

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Background: Disease surveillance activities in Indonesia were suffering a poor management of information since many reporting mechanisms rely on paper-based approach. To improve the situation, the use of information technology has been implemented. Since early 2016, the web-based system for vaccine preventable disease have been introduced.

Objective of the study was to explore the perception toward the function and usefulness of the web-based system for disease surveillance using qualitative method.

Methods: Ten surveillance officers from different primary health centers in Yogyakarta District were interviewed. The key informants have been selected purposively based on their role as surveillance officers for vaccine preventable diseases and already used the web-based surveillance system. Each informant was interviewed individually during the period of November-December 2016. All interviews were recorded and data were transcribed verbatim and analyzed qualitatively.

Results: Surveillance is not only about data collection, but also a whole cycle that after data has been collected, need to be analyzed, disseminated and used for public health action. The situation in our context is challenging since before the implementation of the web-based system, it is always a hard task to process the data where the data is in paper-based form. With this ICT based system, data analysis can be facilitated easier. Based on the in-depth interview, essential features of the web-based surveillance system have been identified i.e: 1. Disease notification; 2. Data Integration; 3. Information dashboard and data analysis. This feature is important to support the disease surveillance.

Conclusion: This qualitative study concludes that the web-based system perceived to be useful to facilitate a complete cycle of disease surveillance from disease notification, data integration, analysis and use of information.

KEYWORDS: Vaccine preventable diseases, disease surveillance, web-based
Restructuring the Annual Health Bulletin: Incorporating advanced data analytics and visualizations to improve usability

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Background: Annual Health Bulletin (AHB) of Sri Lanka is the main annual publication of the Ministry of Health. However, concerns have been raised on the usability of the Annual Health Bulletin as the main reference document for informed decision making by top-level policy makers and decision makers in the health sector. Therefore, this study intended to identify the role of advanced data analytics and visualizations to improve the usability of AHB for strategic decision making in the health sector.

Methods: A qualitative action research methodology was employed, and the study was conducted in three stages. Stage one was conducted among 12 data producers and users of AHB selected via a purposive sampling method. Semi-structured interviews were conducted among them to explore the role of advanced data analytics and visualization to enhance the use of AHB. Three focused group discussions were conducted during the stage two of the study among officers directly involved in formulating the AHB, to identify the reasons for the poor use of advanced data analytics and visualization techniques in the AHB and potential solutions. During the final stage of the study, two workshops on advanced data analytics and visualization were conducted, to train the officers directly involved in formulating the AHB. Interviews and focus group discussions conducted during the first two phases of the study were recorded by the principal investigator as detailed notes, highlighting the key points and thematically analyzed.

Results: Among the themes which emerged from interview data, poor data visualization, and poor use of advanced analytics was identified to be critical towards the low use of AHB by potential users. Poor visualization of data made it difficult for users to interpret complex tables and graphs. Poor use of advanced analytics resulted in minimal disaggregation, unavailability of information on health inequities, minimal information on predictions and forecasting making it ineffective as an aid for strategic decision making.

As revealed by focus group discussions, lack of knowledge on advanced data analytics and visualization techniques, unavailability of disaggregation in primary data, poor quality data and low motivation to do advanced analysis and proper visualization contributed towards the poor use of these techniques during the formulation of AHB. However, unavailability of analytics tools, visualization tools or other relevant resources were not a contributory reason for its poor adoption.

Following the two hands-on workshops on advanced data analytics and visualization, 23 (85%) institutions submitted write-ups, using at least one of the data visualization and advanced analytics techniques suggested during workshops. However, many institutions did not have good quality primary data to do the necessary advanced analytics.

Conclusion: Poor usage of data analytics and visualization has contributed considerably towards the low usability of AHB among intended users. Use of advanced analytic techniques and improved data visualization is central in improving the usability of AHB for strategic decision making in the health sector. However, improving the quality of primary data is of paramount importance in achieving this and demands urgent attention.

KEYWORDS: AHB, Analytics, Visualization, Health, Informatics
Developing Meaningful Decision Support Tools for Hospital Administrators using Dashboards

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Background: In this digital health era, healthcare institutions are expected to have the ability to measure and act on key indicators and events in real time. However, the current hospital information system in Sri Lanka do not provide this ability to the administrators of health care institutions. With the introduction of electronic Hospital Information Management System (HIMS), more and more data are being captured by the system and this has given the opportunity to develop a hospital dashboard for the use of administrators of the hospital. The objective of this study is to identify and develop essential components of a decision support dashboard for a hospital administrator of a typical tertiary care hospital in Sri Lanka.

Methods: Qualitative action research methodology was used in this study. The study was executed in tertiary care hospitals of Sri Lanka where the Hospital Management Information System (HIMS) is currently functioning. The purposive sampling method was used to identify potential participants, and ten in-depth interviews were conducted among the Hospital Administrators, Health Informaticians, and ward nurses working in selected hospitals. Purpose of these interviews was to identify the operational decisions made by hospital administrators, indicators or information used to make such decisions, data sources for these indicators, and the best way to visualize identified information/ indicators to assist decision making. Based on the results of these interviews, a decision support dashboard was designed, developed, and implemented as a module of the HIMS.

Results: Hospital admissions according to ward and time, Bed occupancy rate, Average patient stay, Disease burden of the institution, OPD attendance and average stay at the OPD, Service utilization details, Quality and safety indicators and an advance analysis tool were the key indicators identified as most important components of a decision support dashboard of a hospital administrator. It was revealed that these indicators would help the hospital administrator to make informed decisions on human resource allocation, forecasting, budgeting and improving the quality of services. Out of the requested indicators by the stakeholders; Hospital admissions, Bed occupancy, Average stay of patients, Disease burden, and Advance analysis of data were selected to incorporate in the Dashboard module of HIMS in the initial phase. Incorporation of clinical indicators to the dashboard will be done with the system maturity to capture relevant data.

Conclusion: With the introduction of the dashboard module of the HIMS, there is saving on the human resource as well as there is a vast improvement in the timeliness of the information. Administrators of the institutions need to adapt to use the available indicators and make evidence-based decisions. Further study is warranted to identify the usage of the dashboard by the administrators and impact of the dashboard on decision making.

KEYWORDS: Decision Support Dashboard, Hospital Information Management System, HIMS, Hospital Indicators.
Introduction of National Injury Surveillance with Open Source Information Management System

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Background: Injuries are the leading cause of hospitalization and have become a major contributor to disabilities and deaths in Sri Lanka. Annually more than 1 million people get inward care due to injuries, but millions more are affected although not admitted. Injuries cause destructive long-term consequences not only to the victim but also to the family and to the society as well. Therefore, prevention of injuries will give financial and social benefit. Surveillance is a very important component in any successful prevention programme. It tracks effectiveness and efficiency of on-going programmes. It helps develop policies, strategies, guidelines and expedites the current injury prevention activities. Therefore, Non-Communicable Disease (NCD) Unit, The National Focal Point for Injury Prevention of the Ministry of Health, Nutrition and Indigenous Medicine has started National Injury Surveillance System in 2016. In this system, the data is collected manually from both injured victims treated at the outpatient department (OPD) and inwards (hospitalized) using a new injury surveillance format (H – 1258).

The objective of this system is to create a method to report the injury-related data to the national and regional level decision makers. The system shall be able to analyze the data and suggest preventive measures for effective control of injury prevalence.

Methods: The system would be run in recognized Base Hospitals and above who have where internet facility, computer, and human resources are available. The technology used is an open source web-based software known as District Information System 2 (DHIS2) has been customized to create the online version of National Injury Surveillance System. All Out Patient Department (OPD) admissions due to injuries are entered into the system at the hospital level. Base hospital and above level hospitals are enrolled in the system at the initial phase and they are given access to the system. Regional Medical Officers of non-communicable disease at the regional level are also given access to the system and they can visualize and analyze the data of their region. NCD Unit at the Ministry of Health in Sri Lanka has access to island-wide data.

Results: This system was piloted in March 2017 at Base Hospital Wathupitiwala and District General Hospital Negombo for 2 months. Subsequently, the system was extended to other base hospitals. During 2017, 31814 cases were reported by the system from 74 hospitals within the 22 districts in the country. The system revealed that the most affected age group was 45 to 60 which is 17.1% out of the total injuries. The highest percentage of (36.1%) injuries were reported during the time period of 12.00 to 06.00pm. The animal bite was the main mechanism of injuries (65%) in 2017. Further, it shows that 55% of injuries have occurred within the home environment.

Conclusion: With the use of this system, NCD unit could collect a large number of data elements related to injuries which were not possible in the past and at a relatively quicker time. So, these data elements can be further analyzed in detail to identify significant association for injuries which may help to prevent injury prevalence in the country. However, at present, this system captures OPD admissions only. Inward admissions due to injuries are reported through the eIMMR system. It has planned to transfer inward data to the national injury surveillance system through an application programming interface (API). Further, Another API will be developed to transfer the data collected through the existing hospital.

KEYWORDS: Open Source System, Surveillance, NCD,
A mobile application for doctors to improve the recording of Cause of Death: A Sri Lankan study

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Background: Reliable mortality data, which are drawn from quality Cause of Death (COD) information, are essential for the government and their partners to monitor the health of the population, to study disease distribution and emerging or neglected health problems, to address health inequities, to develop evidence-based health policy initiatives and as well as to implement cost-effective public health programs. In Sri Lanka, though we have achieved almost 100% death registration, quality of COD data remains questionable. In Sri Lanka, close to 50 per cent of all deaths take place in hospitals and are certified by doctors using the Death Declaration. All cause of death (COD) statistics produced by the routine Civil Registration and Vital Statistics System for hospital deaths are based on the underlying cause of death derived from B33. Lack of training for doctors in correct medical certification contribute to a high proportion of unusable and poorly specified causes in the Sri Lankan COD distribution.

Objective was to assess improvement in the quality of COD written by medical doctors through a Cause of Death Guide mobile application.

Methods: An educational, interactive mobile application, “Cause of Death (CoD) Guide” was developed by the Ministry of Health, Sri Lanka, with technical advice from The University of Melbourne, Health Informatics Society of Sri Lanka and funding from Bloomberg Philanthropies Data for Health Initiative. App was developed as an offline software where the user can operate it without connecting into a network or internet. The contents of the app include: introduction to Death Declaration (Form B33), how to fill each section; a case book with explanations and guidelines for specific conditions, legal obligations. The app has an interactive learning component ‘COD Tutor’ which responds to the user. The app was introduced during the Medical Certification of Cause of Death (MCCOD) training program, in which a convenient sample of 25 hospitals were selected, 125 doctors (5 doctors from each hospital) were trained. A pretest was done to assess the quality of COD written by the participants using three standard case scenarios. Introduction of the app was followed by a post-test using three other case scenarios and results were assessed using the ‘COD quality assessment off-line tool’ developed by The University of Melbourne. Usability and knowledge on CRVS was assessed during the post-test. Ten questions specifically assessed the usability of the app, i.e. synchronization after installation, navigation, image pop-ups and zooming and closing, subject matter, interactivity of the COD tutor. Data were analyzed using SPSS Version 24.0.

Results: For the three case scenarios used, the pre-test COD had a mean error count of 3.24 (SD =1.003) and post-test COD had a mean error count of 1.06 (SD =1.003) with a significant (P< 0.05) improvement in quality of COD written by participants. Usability of the COD guide mobile application was rated 86.7% (n=104) as excellent, above average or average. Satisfactory knowledge in CRVS was shown with average mark of 78.4% (SD=3.0) in the post-test.

Conclusion: The Cause of Death Guide mobile application if used by doctors can improve the quality of medical certification of COD and could be used as an educational tool in medical training to introduce doctors to correct certification practices.

KEYWORDS: Cause of Death, mobile application, educational tool, doctors
Cloud-Base Home Environment Health Monitoring Framework

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Smart home infrastructure attracted the healthcare industry in establishing the elderly and children health monitoring and safety. This further heightened by the increasing ageing population globally added with cultural change in elderly care in Asian population. In this study, the researchers have move one step further looking into the health of the home environment and designed a potential home environment digital management framework. The objective of the study is to identify the most suitable location environmentally in existing house to place the elderly in their home. This study has adopted Internet of Things (IoT) framework with cloud-based storage and mobile monitoring. Ambient temperature, humidity, air quality, pH of water and amount of sunlight in each room, bathroom and other area such as living, dining, kitchen and stores are monitored through sensors connected by wireless enabled embedded system. The hourly data captured by the sensors stored in individually configured cloud storage. The stored data designed to be analysed using established home healthcare environmental index. The analysed data to be shared with the home users through personalised mobile configuration. Both cloud-storage and mobile monitoring have reliable and sufficient cyber security architecture in ensuring the captured data from third party abuse. The framework was built upon multi-location, multi-sensor concept in which ambient temperature from all the different location in a particular house will be recorded, compared and visualized before sending the summarized data for the home environmental index calculation for each identified location. A pilot study for three weeks in three different houses with identical structural design and different interior design was observed. This study reported that the following factors have direct impact on the study: a) type of windows; b) material used in fabricating the windows; c) floor mat material type and the dryness factors; d) ventilation design of the room; e) door position, width, height and material; f) house interior design and g) with or without attached bathroom. The presence of air condition, fan and other additional electronics item also significantly contributes towards the home environmental healthcare design. Absorption fan play a significant role in bathroom and kitchen. Home environmental health index is built upon air quality index, ambient temperature, humidity and water pH. The study concludes that the Home Environmental Health Index adopted in this study has assisted in identifying the best location or environmentally healthy in an existing link houses to place older adult or children.

KEYWORDS: Home Environment, Healthcare, Elderly, Internet of Things, Cloud Storage
The TB Portals: Using data science and informatics to advance TB research through open-access, web-based sharing and analysis of integrated, multi-domain TB patient case data


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Background: There is an abundance of tuberculosis (TB) data, including ‘omics’ (ex. genomics) data, clinical research and electronic health records data, and advanced imaging data. These diverse data (from both patient and pathogen) are ripe for mining and meta-analysis, including across disciplines, to reveal unique insight about drug resistance, treatment outcomes, and disease risk. However, such comprehensive and interdisciplinary analyses require consolidation and integration of data into an electronic and accessible form. Additionally, user-friendly analytical tools must be available for researchers and clinicians to enable their own exploration and analysis of the dataset, specific to their own questions and interests. Here, we describe the TB Portals (TBP), an online, open-access platform through which integrated, multi-domain, and patient-centric TB data can be visualized and analyzed.

Methods: The TBP were built by the NIAID TB Portals Program, a multi-national collaboration to advance TB research through data sharing and analysis, with an emphasis on drug-resistant TB. De-identified, annotated, and standardized TB patient data, including clinical, imaging, and Mycobacterium tuberculosis (Mtb) genomic information are collected by participating institutions and consolidated in a central data portal that supports simple query and data visualization. These integrated data are also utilized in TBP analysis portals, enabling metadomain, genomic, and image data exploration and analysis. The TBP database is supported by Amazon Web Services (AWS) Simple Storage Service (S3) and PostgreSQL on AWS Relational Database. A mix of statistical methods (Fisher’s Exact Test and Student’s t-Test), genomic (PLINK v1.9, TB Profiler, Mykrobe Predictor, and KvarQ) and radiomic open-source tools, and web applications have been built into analysis portals.

Results: As of May 2018, 1236 TB cases are published in the TBP, with 9 partner country institutions from Eastern Europe, Asia, and sub-Saharan Africa participating in the Program; 75% of them are multi- or extensively drug resistant, and cases include treatment history, drug susceptibility testing results, and outcome information. 541 Mtb whole genomes, 1380 chest X-rays, and 1036 CT scans are linked to their respective patient cases, with information on drug-resistance mutations, lineage, and radiologist annotations. The Data Exploration Portal enables patient case cohort creation through 155 data descriptors and comparative statistical analysis of them across all domains of data; the Genomic Analysis Portal provides GWAS and drug resistance prediction functionality; and the Radiomics Analysis Portal features image similarity search and automated TB diagnostic and drug resistance prediction.

Conclusions: The TBP harmonize genomics, radiomics and clinical information and make it openly available in an online platform. Clinicians can take advantage of TBP’s patient-centric and rich metadata and its analytical tools for development of best clinical practices and personalized medicine. Researchers can use the TBP for preliminary hypotheses generation and testing that may inform design of future studies.

KEYWORDS: Tuberculosis, bioinformatics, clinical informatics, genomics, radiomics
Implementation of a Free and Open Source Picture Archiving and Communication Solution (PACS) for the largest specialized paediatric hospital in South Asia

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Background: The overwhelming majority of Sri Lanka’s hospitals, in both the government and private sector, radiology imaging is confined to the traditional film-based procedures. Radiologists use the films to diagnose and then it is handed over to the patient where they are eventually discarded. Considering the wastage of printing large number of X-ray, CT and MRI images, it is cost effective if radiology films are eliminated or at least reserved in cases where abnormalities are detected. However, migration of the radiological workflow of Sri Lanka’s hospitals to a fully digital platform is hampered by the excessive costs involved in the cost of commercial applications, which may even outweigh the cost of hardware. At the Lady Ridgeway Hospital (LRH), which is considered as one of the largest specialized paediatric hospitals in the world, we looked at implementing a Picture Archiving and Communications System (PACS) using free and open source software widely available on the internet.

Methods: We used the open source software called DCM-4-CHEE as a PACS server. This was installed initially in a HP Enterprise server with 8GB of RAM and 2 TB of hard disk. The existing network infrastructure was upgraded to support higher bandwidth requirements of the DICOM image transfer. Toshiba CT Scanner and Seimens MRI were connected to the PACS and all images were transferred automatically from June - 2016 onwards. Radiologists used ClearCanvas community edition or Osirix Lite DICOM Viewer, both available as free software, to view radiology images on their laptops in addition to the clinical workstations available in the radiology department. Utilizing the local area network available throughout the hospital, studies can be accessed almost immediately by the medical staff in the ward. 24 inch all in one computers with full high definition touch screens were installed in most wards to enable this facility. We used the open source software Weasis and Oviyam2, which can be integrated directly with DCM-4-CHEE to enable wards to access DICOM images without the need to print CT and MRI images. iOviyam software enabled medical staff to access the DICOM images even using their mobile phone. The PACS database was automatically backed up to a remote server using an automated backup script. The system had to be migrated to a larger server with a 6TB network attached storage in 2018 due to the utilization of all available capacity in the former server. We were able to demonstrate limited integration to the HIMS by passing requests for radiological images digitally to the PACS by HL-7 messaging system. Once integration is complete the modalities will be able to communicate bidirectionally with the HIMS so that CT and MRI will be populated with the day’s worklist and patient information reducing the need for radiographers to enter data manually to the machine.

Results: The pilot system archived over 2.1 terabytes of radiological images from 2016 June to date. These images are now available at a click for radiologists to compare with current images to determine disease progression or detect new abnormalities. Once the system is completely functional printing radiological images on film can be discontinued, reducing costs.

Conclusion: The free and open source system we implemented performed comparably to the commercial solutions proposed to the Ministry of Health. A low-cost solution such as ours can be utilized widely across most secondary and tertiary care hospitals.

KEYWORDS: PACS, Radiology, DCM4CHEE, Imaging
Development and Integration Models of an In-house Built Drug-allergy Checking System

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Background: Allergic reactions caused by medications administered in the fact of known allergies can be prevented effectively by a computerized drug-allergy checking system. In general, building an effective allergy prevention feature is challenging and most organizations lack the resources and expertise to develop in-house drug-allergy checking system. By applying a standardized medication terminology in allergy record documentation and medication order entry, a drug-allergy checking system with clinically relevant alerts is able to be developed. The experience of developing and integrating a standardized medication terminology based drug-allergy checking system for supporting optimal medication decision at the point-of-need and thereby improving patient safety is presented.

Methods: With the launch of Electronic Health Record Sharing System (eHRSS) in Hong Kong (HK) in 2016, Hong Kong Medication Terminology Table (HKMTT) is built. HKMTT is a territory wide standardized medication terminology table which is a compilation of identifying descriptions with coding of all individual drugs registered in HK. HKMTT is being applied in allergy record documentation and medication order entry (MOE). HKMTT acts as an essential component to integrate the allergy record, medication orders and the drug knowledge database of the drug-allergy checking system.

Moreover, the drug-allergy checking system supports integration with any legacy systems of allergy documentation and/or medication ordering through data mapping. The provision of this flexible drug-allergy checking system can serve as an incentive for attracting more health care providers to switch their practice to paper-less. Hence, more comprehensive medication decision support functions are able to be initiated further.

Results: An in-house HKMTT based drug-allergy checking system is developed in phases. At the first phase, the drug-allergy checking system is focusing on the most prevalent allergic drug groups (namely penicillins, cephalosporins and non-steroidal anti-inflammatory drugs). This preliminary drug-allergy checking system is being adopted by six healthcare institutions in HK nowadays. HKMTT is being adopted directly in patients’ allergy data and medication orders in majority of the adoption models. In January 2018, there are 157,365 HKMTT-encoded drug allergy records which are interoperable territory wide. Two healthcare institutions are applying the legacy MOE drug list but not HKMTT. The drug list in the legacy MOE system is mapped to HKMTT to activate the drug-allergy checking system.

The drug-allergy checking system is successfully implemented and is an effective allergy prevention feature. There were 6,347 allergic prompts triggered by the drug-allergy checking system in the year 2017. Those allergic prompts acted as medication safety measures, where over half of them were accepted by the prescribing doctors. The corresponding medication orders were not proceed.

Conclusion: A standardized medication terminology acts as a foundation for HK territory wide medication decision support functions. It plays an important role in representation, exchange, and automation of allergy/drug information and drug-allergy checking system. A successful implementation of drug-allergy checking system includes availability and quality of patient data and the flexibility of integration of drug information and system programmatically.

KEYWORDS: drug-allergy checking system, standardized medication terminology, patient safety
Use of ‘Online Outpatient Appointment System’ based on overbooking strategy for optimizing hospital resource utilization in a tertiary care-public sector hospital

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Background: In an effort to digitalize outpatient services, AIIMS launched online appointment system in the year 2014 to serve as a nucleus for nurturing excellence in all aspects of outpatient service and cater to more than 3 million patients in a year. Nevertheless, sooner the ‘patient no-shows’ emerged as an adverse effect of being a complete free system. This eventually led to overbooking strategy for optimizing patient throughput.

To evaluate the optimization of patient attendance in different outpatient departments by scientifically analyzing retrospective outpatient data.

Methods: Three years Historic hospital appointment data merged with numerous extraneous variables were used from the online appointment system/scheduling system. The overall ‘absenteeism’ rate for the year 2014, 2015 and 2016 was identified and descriptive statistics were used to identify the impact of different extraneous variables on patient attendance or no-show status. Logistic regression was used to develop a statistical model, which was then used to develop an in-house software to determine the no-show probability by taking into account of different contributing variables that can influence the show/no-show status. This tool was used in deciding overbooking limit for different outpatient departments to optimize the resource utilization. The efficacy of the overbooking strategy was assessed by comparing the limit suggested (software) vs actual attendance occurred during one month period in different departments.

Results: Application of statistical model based on overbooking strategy allowed the seamless implementation of outpatient online appointment system and eventually demonstrated a substantial reduction in patient waiting time, optimized doctor-patient ratio, and maximized the hospital resource utilization.

Conclusion: Application of statistics based on overbooking strategy standardized the outpatient scheduling process and optimized desired patient attendance across departments. It’s an easily replicable model for wider application in other public sector hospitals for outpatient scheduling. Furthermore, this dynamic approach accounts to improve capacity utilization, patient waiting-time, service quality and utilization of physician resources.

KEYWORDS: No-shows, outpatient appointment, overbooking, appointment scheduling
Case study: Integrating eHealth into basic training curricula to transform allied health professionals’ education in government health sector of Sri Lanka

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Background: The World Health Organization defines transformative scaling up of health professionals’ education and training as the “sustainable expansion and reform of health professionals’ education and training to increase the quantity, quality and relevance of health professionals, and in doing so, strengthen the country health systems and improve population health outcomes”. Therefore, the Ministry of Health, Sri Lanka has identified few key areas to improve the quality of health professional’s education i.e. eHealth, professionalism and life skills.

Case presentation: The Education Training & Research Unit (ET&R) of the Ministry Health is responsible for providing technical guidance and coordinating pre-service training programmes for the health workforce excluding Medical Officers, Dental and Nursing graduates. Furthermore, it was noted that the allied health curricula had given less focus to eHealth before, although the general agreement among the curriculum developers was favorable. On the other hand, it was understood that incorporating generic components of eHealth in to basic training curricula has a higher chance of institutionalization than conducting in-service training programmes.

Strategy, implementation and output: One of the main positive strategies was to make a policy decision to incorporate a generic module on eHealth in to all allied health curricula with necessary changes to match the expected competencies of each programme. Hence the curriculum development committee (CDC) had relatively less resistance to incorporate eHealth component in to the curricula. The CDC consisted of health informatics experts, public health experts, medical administrators, tutors, medical educationists and other relevant professionals. The module was drafted by the health informatics experts considering generic outcomes and competencies in eHealth, generic content areas, novel teaching learning methods and assessment methods. The draft was reviewed by the CDC and agreed upon by the ET&R administration for implementation. The module covers four main components; basic concepts of Information Communication Technology (ICT), basic principles of Management Information Systems in Health, eHealth as a tool to improve efficiency in workplace and information management in workplace. The implementation was commenced with Public Health Field Officer training programme in 2016 and expanded to 5 more training programmes by May 2018. The lessons learnt from first implementation were used as reflective learning practices for subsequent programmes. There is a high demand from the remaining programmes to incorporate the module into their curriculum, for which the ET&R unit is technically assisting.

Discussion: Incorporating eHealth into allied health professionals’ basic curricula is considered one of the most important and timely policy decisions taken by the ET&R unit in favour of transforming their education. The availability of eHealth experts and team effort of the CDC has a strong impact on the development and implementation of the core module. However the mal-distribution of eHealth competent trainers in the country has a negative impact on conducting the module in regional training centres.

Conclusion: The core module must be incorporated into all the allied health curricula within next five years and necessary content changes must be carried out to keep it up to date. Regular monitoring and evaluation of the module implementation should be carried out. The eHealth competent trainers should be employed in regional training centers.

KEYWORDS: eHealth, allied heath, training curricula, transform, integration
RFID Approach to Track Clinician Activity in The Operating Theater

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Background: Patient safety is at the center of an efficient healthcare system. Medical errors are a threat to patient safety. It is relatively common in hospitals and is a serious public health problem. Therefore, it is an importance to have efficient activity detection systems in hospitals to detect clinician activities in order to keep mistakes at minimum. This research focuses on designing a system model which allows a computer to automatically identify the physical actions of an anesthetist in the operating theater in order to detect and correct his/her clinical errors. It involves finding suitable technologies to identify activities in the operating theater and designing a prototype system to detect an aspect of clinical work. This paper discusses that our attempt to use of Radio Frequency Identification (RFID) technology to capture anesthetist activities in a simulated operating theater.

The objective of this paper is to answer to the research question whether RFID system could be used to detect an anesthetist’s clinical activities in an operating theater.

Methods: An experimental study was set up to use active RFID equipment to detect the activities of an anesthetist in an operating theater. The experimental set up used the active RFID system of AURA Lab of the Auckland University of Technology. The experiments were conducted with clinical trainee staffs at the Simulation Centre for Patient Safety (SCPS) at the University of Auckland, New Zealand. An appropriate simulation suite was set up exactly like a clinical operating theater with clinical trainee staff. A mannequin was used as a patient and the room is provided video and sound recording facilities. Different operating room stories took place with five personnel in the room, an anesthetist, a surgeon, two nurses and an anesthetic technician. As we were tracking the anesthetist’s activities only, he wore tags on his parts of body.

Results: For each of the trials the RFID tag’s position on each parts of the body, forehead, back of head, front of body, back of body, and wrists was recorded for analysis. Based on the data, the distance traveled by each tag was calculated to measure the movements of anesthetist’s body parts.

Conclusion: This paper presents a trial using an RFID tracking system to detect anesthetist activity during anesthesia, in order to investigate whether the radio frequency identification system can be used to detect an anesthetist’s clinical activities in an operating theater. The experiments were organized to detect the anesthetist’s activities in a realistic operating theatre environment with clinical trainee staffs and a mannequin in a simulated operating theater. Several operating room scenarios were run to obtain the RFID data. However, we noticed that the RFID data we collected were noisy and incomplete. Because the RFID readings were influenced by the effect of multi-path reflection and attenuation due to the large amount of metal surfaces presented in the operating room. This study demonstrates that the RFID sensor system could be used to detect some characteristics such as total distance travelled by the anesthetist and his/her rotational movements during the operations. This is because the data was not completely captured by RFID system in the operating theater environment due to multi-path reflection and attenuation issues. Therefore, the further investigation is required to use active RFID sensor system to detect anesthetist activities in the operating theater.

KEYWORDS: Anesthesia, Clinical activity detection system, Clinical errors, RFID sensors
Citizen’s attitudes for handling their healthcare record by IT, 10 years change between 2008 and 2018

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Background: We conducted a survey to clarify the views of general population of Japan, concerning the handling of their medical records electronically, and to clarify the difference through 10 years using the same questionnaire we did 10 years ago. According to the attitudes for handling their medical records, Japanese people tend to think “I am treated in the department of the hospital” (not “by that doctor”) as they became more satisfied with other doctors of the same hospital reading their records. Regional health care system became popular as they became feeling less problematic. Even in unidentifiable, manner, people in both countries think the profits by the secondary use of medical records should be returned to public or patients. However, the percentage has shown no significant change through 10 years, except for the refusal of commercial use. Compiling in one medical record (which, in Japan, is not mandated as free access is granted) has been less favoured through 10 years, as well as chip card and password method’s confidence. About AI diagnosis, people preferred for doctors making use of AI program, rather than AI program alone. Explanation by human doctor is highly preferred. Objective was to clarify the views of general population of Japan, concerning the handling of their medical records electronically, and to clarify the difference through 10 years using the same questionnaire we did 10 years ago.

Methods: We surveyed people of Shizuoka prefecture in Japan using same questionnaires by sending by mail, which we had 510 valid answers in 2008 and 255 in 2018, out of 1000 mails sent in both years. Most of the answers are in 5 category Likert scale.

Results: Percentage of people who felt problematic or rather problematic when their records were read by other doctors of the same hospital were 20.5% in 2008, 10.2% in 2018. In case of read by other doctors in the regional healthcare system were 33.3% in 2008, 26.3% in 2018. About people who feel problematic (or rather problematic) for use of their anonymized records, use by Ministry, 10.0% became 8.4%, use by University research, 8.9% became 9.1%, use by insurance company, 20.1% became 18.1%, use by pharmaceutical company, 17.8% became 15.8%, use for commercial purposes, 20.5% became 23.7%. Percentage of the people who want (want it, or rather want it) to have their medical record compiled in one decreased 75.8% to 57.4%. Who feel unsecure (or rather unsecure) when their compiled medical records are accessible through internet, 24.4% became 24.5%. Who felt unsecure with chip card and password method increased from 13.4% to 18.4%. A new questionnaire in 2018 is for AI diagnosis. Percentages of people who felt acceptable (or rather acceptable) for 1) human doctor uses his/her brain, books, internet to make diagnosis and explain it by him/her: 35.5%, 2) same and explain it as messages through internet mail with explanations: 27.6%, 3) human doctor uses also AI program and explain it by him/her: 56.3%, 4) same and explain as messages: 39.6%, 5) AI program alone without human makes diagnosis and human doctor explains: 28.7%, 6) same and explain as messages: 18.3%. present as clearly as possible the outcome of the study and statistical significance if appropriate)

Conclusion: According to the attitudes for handling their medical records, Japanese people tend to think “I am treated in the department of the hospital” (not “by that doctor”) as they became more satisfied with other doctors of the same hospital reading their records. Regional health care system became popular as they became feeling less problematic. Even in unidentifiable, manner, people in both countries think the profits by the secondary use of medical records should be returned to public or patients. However, the percentage has shown no significant change through 10 years, except for the refusal of commercial use. Compiling in one medical record (which, in Japan, is not mandated as free access is granted) has been less favored through 10 years, as well as chip card and password method’s confidence. About AI diagnosis, people preferred for doctors making use of AI program, rather than AI program alone. Explanation by human doctor is highly preferred.

KEYWORDS: Surveys; Public opinion; Electronic health records; Privacy; Internet
Imaging Informatics One-Stop Tool to Improve the Workflow of Modern Radiology Department

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**Background:** Imaging Informatics plays a key role in any modern radiology department. An Imaging Informatics Professional's (IIP) day-to-day responsibilities are just more than management and troubleshooting. IIP perform loads of tasks including modality testing, imaging conversion, imaging import/export, image send/receive, HL7 connections, anonymization, transfer imaging to outside hospital, and correcting imaging data. There are few tools available, some of them are not free, which can provide some of the functions IIP wants to do. A comprehensive one-stop-shop solution would enable Imaging Informaticists to provide a better imaging support.

Smooth functioning of healthcare IT systems, particularly in department of radiology, plays a role to provide better patient care by clinical staff. Day to day support and troubleshooting tasks have impacts on modern radiology department. In an effort to empower the Imaging Informatics Professionals and to allow standardization in Imaging Informatics, we built a One-Stop Tool for them where they can perform all sorts of tasks during their day to day operations. A team of five Certified Imaging Informatics Professionals designed the system with their vast radiology informatics background.

**Methods:** Our Imaging Informatics One-Stop Tool provides various features in four major categories which are DICOM services, HL7 services, Image Import/Export, and Image Manipulations. DICOM services enable IIPs to easily test DICOM send/receive, Modality Worklist, and Query/Retrieve services. HL7 services helps to test HL7 connections, acknowledgements, and send/receive famous radiology HL7 messages i.e. ORM, ORU, and ADT. Image Import/Export helps importing from external media and local drives as well. IIPs can also burn CDs and transfer images to other DICOM nodes. The tool has been used for research and education as well to easily import images, anonymize them, and convert into different format i.e. JPEG and WEBP. For outside referrals tool helps to directly transfer images on Amazon and create a downloadable link of the images.

**Results:** We are successfully using this tool in our Imaging Informatics department and have solved several hundred, and counting, requests on it.

**Conclusion:** Our One-Stop Tool provides an all-in-one solution for the imaging informatics team to perform their tasks, which eventually is improving the efficiency of department of radiology.

**KEYWORDS:** PACS Administration, DICOM, HL7, WEBP, Imaging Informatics
Assessment of eRHMIS school health information system usability among users in Kegalle and Anuradhapura Districts

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Background: Family Health Bureau is the focal point responsible for planning, implementation, monitoring and evaluation of Maternal and Child Health (MCH) services, including School Health Programme of Sri Lanka. School Health Programme of the country was carried through as an entirely paper-based system. When working with the paper-based system, there were significant issues in data accuracy, timeliness and completeness. Current paper based school health information system consisted of eleven different forms with a total of twenty-five copies to be filled at different levels. In order to overcome this issues Electronic School Health information management system was developed as the second phase of eRHMIS (Electronic Reproductive Health Management Information System), data flow and data entry forms were modified to be compatible with electronic data flow. Background was to implement and evaluate the system usability of eRHMIS School Health component among users in both Kegalle and Anuradhapura districts, after introductory hands on training programme, before going to island wide implementation.

Methods: (Several Focus group discussions were carried out with all the stakeholders involved in school health programme. Existing data flow was examined and data entry forms were modified accordingly. After design electronic data sheets pilot projects were implement in Anuradhapura and Kegalle districts. All the health care workers involved in school health activities in above districts were trained. One month after establishing electronic data flow evaluation was done with Individual questionnaire with the System Usability Scale (John Brooke SUS)) .

Results: (Three forms were modified (H 1014, H1015A, and H1247) in order to prevent data duplications and to improve user friendliness. Form size of all three forms were reduced while maintain all data elements of the existing system. Number of forms need to be filled reduced to eight forms of total fourteen copies. None of existing data elements were removed from data collecting system. There were 91 participants from both districts and majority of them were males (n=66, 72.5%). Mean age of the participants were 41.3 years of age where majority (n=38, 41.8%) of participants were in 31-40 years age category. Majority of trainees attended to user training programme were PHIs where all the participants had minimum of GCE advanced level educational qualification. Majority of users attended to the training programme, 54(59.3%) were found to be accepted the system at SUS evaluation. System usability scale (SUS) average score of all users attended to the programme was 70.5 (SD=13.6). Score of 70 and above is considering as system acceptability. But 49 (53.8%) of them agreed with the statement that they need to learn more before get going with system like this. Within 3 months after implementation, system reporting rate summary shows excellent data completeness in both districts.)

Conclusions: (Revised school health management data flow has reduced manual workload by reducing number of forms to be filled and reducing the size of each form while maintaining the captivity of all data elements in the paper-based information system and Anuradhapura and Kegalle district eRHMIS users have accepted the School Health electronic health information management system, but they need more learning opportunities to get going with electronic information management systems.)

KEYWORDS: eRHMIS, DHIS2, School Health Information
Connections For Saving Lives- A Review of different models of tele medicine under National Health Mission in India

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Background: The purpose of the review is to provide an overview of the various telemedicine models functional in India and understand the challenges in its implementation.

Methods: A review of various tele medicine models functional in India under the National Health Mission was undertaken. A public sector model of telemedicine in Tripura and a tele medicine model working in Public private partnership in Rajasthan were studied in detail by a multi-disciplinary evaluation team including public health professionals and biomedical engineer. Service providers of different telemedicine models were contacted and a situation analysis was undertaken based on their inputs.

Results: Most of the telemedicine networks in India are working on hub and spoke model. The hub is mostly the tertiary level health care centre i.e. Medical College and the spokes are the peripheral health facilities including district hospitals (DHs), Community health centres (CHCs), Primary health centres (PHCs) and sub centres (SCs).

Most of the government operated models of telemedicine are focused at provision of telemedicine services at the level of secondary care i.e. DHs, Sub District Hospital (SDH) and CHCs. Some of the telemedicine models operational in public private partnership mode have managed to provide services at the Primary Health Centre (PHC)- Telangana and sub Centre level- Himachal Pradesh. In India, telemedicine is being utilized to provide mainly curative services including specialist and general consultations, though there are some models providing promotive and preventive services. The telemedicine setup is also being used to provide services other than teleconsultation like Tele Education, Tele support, telemonitoring services and tele training. The telemedicine platform in Public Private Partnership is more focussed on ensuring full circle of care including Diagnostic services and pharmacy services. The telemedicine models in PPP mode are also working in the direction of providing outreach services including community screening.

Some of the major challenges were observed in the implementation, growth and full utilization of telemedicine in the country are legal issues related to Telemedicine, Internet connectivity with reliable bandwidth, lack of awareness and motivation among treating physicians and patients and lack of provision of continuum of care.

Conclusion: In India, the current need is to integrate the facility with the existing health structure. The objective of utilizing the technology and emphasis on ensuring complete care should be clear before embarking on the resource intensive modality. The advantage of both government operated telemedicine models and the PPP models need to be explored by the health care delivery system. Clarity on the legal bindings in cases of tele consultations, engaging the commercial broadband providers for ensuring provision of internet connectivity and standardizing the protocols of tele consultation are some of the key interventions which need to be taken up on priority.

KEYWORDS: Telemedicine, government, challenges, recommendations
ABSTRACTS
GLOBAL TELEHEALTH 2018
Day 1: Contributed Papers

Instant Messaging in Dermatology: A Literature Review

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The use of smartphones and IM has the potential to transform the delivery of health services by providing an easy to use, cost-effective tool for remote doctor-to-doctor and patient-to-doctor consultation and diagnosis. Whilst the introduction of new technologies has improved access to healthcare, it has also created new challenges. The aim of this paper was to review the literature on the use of Instant Messaging (IM) and IM applications (apps) in dermatology.

Method: PubMed, Scopus, and Science Direct were searched for multiple terms for 20 individual IM apps linked to the terms telehealth, telemedicine, ehealth, e-health, mhealth, or m-health. After title and abstract review, 31 papers met the inclusion criteria of IM use in dermatology.

Results: Three papers, all from the developing world reported the benefits of using IM in a clinical dermatology service. Other uses included behavioural change, disease management, diagnosis, triage, screening, diagnoses, home monitoring, education, and administrative. Little mention was made of medico-legal issues such as consent, confidentiality, privacy and data security and storage.

Conclusion: Currently there is little use of IM in clinical dermatology services, but its potential is great. There is need to address ethical and medico-legal concerns and develop guidelines for its use. IM is a simple, cheap and effective solution for the developing world.

Comparative Study of Medical Reference and Information Mobile Apps for Healthcare Professionals and Students

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This paper presents a framework upon which medical applications can be evaluated both in terms of basic functionality, and their target area of users. The study was conducted on 40 mobile applications that were published within Google Play and Apple App store targeted for clinicians, medical practitioners and students. It was important to first classify the mobile apps selected because there are many generic applications, and some focus on special areas within the medical field. The classification process included determining the specialist areas of these applications such as educational and training, nursing, diagnosis and treatment, patient monitoring, testing and laboratories, and social networking. After the classification, a criterion to evaluate applications within individual categories, as well as in more general aspects such as their performance, security, user interface, and other software quality attributes, was developed. Test data was used to test the applications using the developed evaluation criteria, and the results were then used to determine the apps with surpassing features. As per the category-wise results, Medicine References and Education & Training categories had applications that had better scores than other categories. However, an equally important finding concluded that there are not enough applications to help with lab testing, and this gap needs to be filled. Most applications lacked the usability aspect and needed work in user interface (UI) and user experience (UX) areas.
Designing Telerehabilitation System for Multipronged Exercise in Patients with Multiple Sclerosis

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Patients with multiple sclerosis (PwMS) were shown to greatly benefit from multipronged exercise interventions comprising aerobic, resistance and corrective therapeutic components which result in endurance and strength improvement and reduction of fatigue and spasticity. However, telerehabilitation support of multipronged exercise programs in PwMS with significant mobility impairment has received limited attention. It is not clear whether severely disabled PwMS can successfully operate a telerehabilitation system at home independently. The goal of this study was to design a telerehabilitation system for individualized multipronged exercise programs and to assess the feasibility of the initial prototype in PwMS with significant mobility impairment. Usability assessment was based on the evaluation of patient ability to successfully carry out a standardized list of common tasks necessary to operate the system. For each task, time to completion, perceived difficulty and satisfaction were documented. Our results indicated a high level of acceptance of the system by these patients. On average, it took 83±41 seconds to complete all the major tasks necessary to operate the telerehabilitation system. After the initial introduction, all patients were able to successfully use the system and follow their individualized exercise prescription independently. A definitive systematic evaluation in a randomized clinical trial is warranted to demonstrate potential clinical impact of telerehabilitation in PwMS.

Selfie Telemedicine – What Are The Legal and Regulatory Issues?

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Selfies, self-taken photographs using mobile phones or tablet computers, have become a way of life. People are now sending selfies to health professionals for medical advice or dermatology triage or postoperative wound assessment. These selfies may be unsolicited and sent to clinicians with whom the patient may or may not have a prior doctor-patient relationship or on the instruction of the attending doctor or even to social media groups. They may be sent by email, or by mobile phone and instant messaging applications, or sent to Websites, or telemedicine specific application sites. These photographs and accompanying information are legal documents, should form part of the patient’s record, and should be securely transmitted and stored to maintain patient confidentiality and privacy. This paper reviews the legal, ethical and regulatory issues associated with the different forms of selfie telemedicine.

Method: A scoping literature review was undertaken using PubMed, Scopus, Science Direct, Ebsco Host and Google Scholar which were searched for Selfie and any of medicine, telemedicine, telehealth, eHealth, or mHealth. Inclusion criteria were that the paper was in English and described the use of a selfie in relation to healthcare. These were then reviewed for reference to legal, ethical issues and regulatory issues.

Results: 68 papers met the inclusion criteria. Legal and ethical issues identified were consent, confidentiality, privacy, the doctor-patient relationship, data security, responsibility, record keeping, licensure, continuity of care, quality of care, image quality, concordance, phone stewardship and patient satisfaction.

Conclusion: The literature provides little guidance on how legal and ethical issues and shortcomings of selfie telemedicine should be addressed especially the responsibilities of the patient and physician for unsolicited requests. Nor does it provide advice on how records are to be kept, or how images and information stored and sent to and from mobile phones or computers are to be managed. The new issues that arise need to be addressed.
Using the Behaviour Change Wheel for Designing an Online Platform for Healthy Weight Loss - “POEmaS”

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Introduction: Behaviour change is a key point in weight management. Digital health interventions are attractive tools to deliver behaviour interventions for weight loss, due to the potential to reach a large number of people. We aimed to report how the Behaviour Change Wheel (BCW) was used to develop and implement a web platform to promote weight loss in Brazilian adults with overweight and obesity. Moreover, we aimed to describe the first 12 weeks of usage of the platform in a randomized controlled trial.

Methods: The BCW framework was used to define intake of fruit/vegetables, ultra-processed products and sweetened beverages, leisure physical activity and sitting time as target behaviours. The BCW components of behaviour- capability, opportunity and motivation were used to make a behaviour diagnosis of the population and BCW second layer oriented the selection of information, goal setting, self-monitoring, feedback, social support and incentives as behaviour techniques. Using these behaviour techniques, a 24-week behaviour intervention delivered by seven different platform functionalities was developed. The platform was tested in a three-arm parallel (basic platform versus enhanced platform versus minimal intervention control group) randomized controlled trial from September 2017 to April 2018. In the present analysis, we classified the platform functionalities according to the BCW behaviour component (capability, opportunity and behaviour) and used descriptive statistics and Spearman correlations to report functionalities usage according to the BCW behaviour component over the first 12 weeks of the trial. The study was approved by the Ethics Committee of the Federal University of Minas Gerais, Brazil and was registered under NCT 03435445.

Results: Over the first 12 weeks of the RCT, the 809 participants (619, 76.5% women; mean age 33.7 years, SD 10.3; mean BMI 29.9 kg/m², SD 4.3) were enrolled for use of the basic and enhance versions of the platform. Capability-driven functionalities were accessed by 455 (56.2%) users with median access of 1 (IQR 1-6) times, whereas opportunity-driven platform functionalities were accessed by 592 participants with 8 (IQR 1-27) median access times and motivation-driven functionalities were accessed by 560 (69.2%) participants with 13 (IQR 1-30) median times of access. Spearman correlations between the use of capability and opportunity functionalities, capability and motivation functionalities and opportunity and motivation functionalities were 0.74 (95% CI 0.70-0.77), 0.74 (95% CI 0.70-0.78), 0.89 (95% CI 0.87-0.91), respectively.

Discussion: BCW provided a systematic approach to planning, designing and implementing a complex weight loss intervention based on behaviour change. Moreover, it promoted a clear understanding of the relation between platform functionalities and behaviour determinants. The low use of the capability-driven functionalities might have been related to lack of accuracy in the behaviour diagnosis, as well as to implementation issues. The high correlation between the functionalities use suggests that the BCW approach did not determine the platform usage profile.

Conclusion: The BCW provided a framework for an evidence-based intervention on weight loss delivered by a web platform. Using the framework led to a clear understanding of the behaviour determinants and their relation to the platform features.
Day 2: Contributed Papers

Characterising Routine Physical Activity in the Office

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Workplace health is of concern to management and employees alike. Managers are concerned about the impact of health and wellbeing on productivity, while employees are concerned about impacts on quality of life. In the past two decades, there has been growing concern about the impact of sedentary behaviour at work. Before any interventions can be made to encourage physical activity at work proactively, it is desirable to understand the baseline characteristics of office based physical activity at work. Consumer wearable technology has provided a new and convenient mechanism for using personal monitoring to achieve remote observation of lifestyle related health behaviours. This paper describes how this technology can potentially be used to characterize different levels of workplace physical activity.

Habitual Personal Movement Patterns in a Structured Environment

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This paper presents an approach for describing personal movement patterns for typical daily activities undertaken by subjects within free living structured environments (e.g. home or office). Conventionally this requires specialized technology for personal movement monitoring involving measurement of location and motion, and results in the collection of large datasets in order to provide sufficient descriptive power. Here we advocate the preferential observation of sentinel activities based on the expectation of routine and repetitive personal movement episodes, which can be considered as ‘habits’. These identified habitual patterns provide a useful context for understanding the dominant characteristics of typical daily activities, enabling purposeful design of behaviour change interventions to improve healthy living. This approach has been applied here to office stepcount data from consumer wearables.

Exploring Key Elements for Successful Telehealth Implementation within Severely Under-Resourced Communities: A Case Study in the Pacific Islands

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The intent of this paper is to identify and provide insight on key enablers for successful implementation of telehealth services in severely under-resourced and rural populations. The case study presented is in the context of the U.S. Affiliated Pacific Islands that represent resilient and innovative communities who face many challenges of isolation, tiny populations, and developing economies. Long-standing telecommunication hindrances and lack of supporting resources are fundamental barriers to telehealth advancement. New undersea fiber optic developments present opportunities for reliable connectivity needed for telehealth applications. This paper reviews the emergence of telehealth champions in the region and reviews key elements that contribute to rapid and successful implementation of telehealth applications and services.
Clinician Perspectives of an Avatar-Directed Scheduling and Memory App

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Background and aims: Effective strategies are needed to address the need for scheduling support in the unique setting of a home rehabilitation service, providing home based therapy, as well as telerehabilitation. One approach is an electronic avatar-directed scheduling and memory aid in the form of an app. The aim of this study is to investigate clinician perspectives on the use of this type of technology.

Methods: In this mixed method study a total of sixteen clinicians from various disciplines based at a metropolitan hospital in Adelaide (SA, Australia) participated in 2 semi-structured focus groups aimed to explore experiences and attitudes towards scheduling support in the form of an avatar-directed app, perceptions on the usefulness of the app, as well as acceptability. Thematic analysis was undertaken on focus groups’ transcripts. Self-reported technology proficiency, perceived usefulness (PU), and perceived ease of use (PEOU) were assessed quantitatively. Summary statistics were used to analyse the quantitative data and Spearman’s correlation was used to explore the relationship between participant characteristics and individual and mean scores for PU and PEOU.

Results: Four themes emerged from the focus groups: effectiveness versus efficiency, patient empowerment, practicality and ease of use, and likability of the avatar. Clinicians experienced time constraints, and welcomed technology that could assist with reliable scheduling of appointments and therapy sessions. They liked the concept of the avatar and found the app interesting, novel and fun. However, although the app was reasonably easy to use, the setting up was problematic and time consuming. Clinicians did not see the app as beneficial to their patients, and felt that the technology did not add value to the delivery of care. The older, more experienced, clinicians found the app more difficult to use, but neither the level of technological competency, nor gender, was found to be associated with PU or PEOU.

Discussion: Although clinicians appreciated the concept of an avatar-directed scheduling and memory app, they did not see it as a useful tool in the provision of scheduling assistance in this particular setting providing short-term rehabilitation services. Clinicians felt time-poor and emphasized the importance of a time-efficient solution. Perceived lack of usefulness in this context and poor likeability of the avatar highlight the need for clinician involvement in the design process before an app can be successfully implemented in a clinical setting.

Security and Other Ethical Concerns of Instant Messaging in Healthcare

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There is a growing body of evidence highlighting the benefits of mobile health in terms of cost effectiveness, efficiency and patient satisfaction. These benefits have been further enhanced through the development of Instant Messaging (IM) applications (apps) that enable the transmission of images and text messages. The aim of this paper is to review the use of IM in clinical services, and to understand the medico legal concerns with regard to the security and management of protected health information on doctors’ phones. Method: PubMed was searched using the various IM apps as a search term. Inclusion criteria were that the paper was in English and described the use of IM in a clinical service. Results: 39 papers met the inclusion criteria. Data are at risk at several levels, including during transmission, storage on servers en route, and on the sender’s and receiver’s phones. Consent is seldom obtained for instant messaging, and confidentiality, privacy, data security and record keeping remain areas of concern. Conclusion: The use of IM, and in particular WhatsApp, is now commonplace amongst clinicians and used extensively across different clinical services. Security concerns have created barriers preventing the global adoption of IM in healthcare. Guidelines in the management and use of IM need to be developed in order to prevent the unwanted consequences of non-compliance by uninformed clinicians. With improved security, IM has proven to be a viable option in the developing world.
A Patient Agent to Manage Blockchains for Remote Patient Monitoring

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Continuous monitoring of patient’s physiological signs has the potential to augment traditional medical practice, particularly in developing countries that have a shortage of healthcare professionals. However, continuously streamed data presents additional security, storage and retrieval challenges and further inhibits initiatives to integrate data to form electronic health record systems. Blockchain technologies enable data to be stored securely and inexpensively without recourse to a trusted authority. Blockchain technologies also promise to provide architectures for electronic health records that do not require huge government expenditure that challenge developing nations. However, Blockchain deployment, particularly with streamed data challenges existing Blockchain algorithms that take too long to place data in a block, and have no mechanism to determine whether every data point in every stream should be stored in such a secure way. This article presents an architecture that involves a Patient Agent, coordinating the insertion of continuous data streams into Blockchains to form an electronic health record.

Health Information Technology and Telehealth Challenges in the U.S. Affiliated Pacific Islands Region

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Small island developing states (SIDS) have much to gain from the use of Health Information Technology (HIT) and telehealth to improve care, improve population health, increase access to care, and lessen costs. At the same time, planning, implementing, and operationalizing HIT is costly and requires significant technical, human, financial and planning resource infrastructure to support implementation and operations. This paper provides a broad overview of how HIT and telehealth has evolved in the U.S. Affiliated Pacific Islands (USAPI) SIDS, the progress that has been achieved, the role of political affiliations and international assistance, and the many challenges that remain. The paper highlights the differences in treatment between the territories and the nations affiliated with the United States through the Compacts of Free Association (COFA), and the important roles of other donor countries, regional, and international organizations. The paper also raises questions of how advances in HIT and telehealth can be further achieved and sustained in the USAPIs. Finally, the paper identifies the need for the building of knowledge and skills to develop careful plans so pitfalls of silos, proprietary systems, and inadequate technical support can be lessened or avoided in the grand challenge of adoption and maturing of HIT and telehealth.
The importance of effective communication during conventional face-to-face care delivery, and during telehealth (aka telemedicine) encounters

Eric Gombrich, Cloudbreak Health, United States of America

Rationale: A common experience in the delivery of healthcare within any heterogenous culture such as the United States is the challenge of provider & caregiver communication with a patient whom speaks a different language, or otherwise has communication challenges such as the deaf or hard of hearing (DHH). There are numerous ways these communications gaps are managed in the context of face to face care including communicating through other staff members, family / friends, or using language-specific interpreters during the encounter. However, as telehealth or telemedicine approaches are used over distance between the provider and the patient, additional challenges emerge in how to serve this portion of patients in effective ways.

Challenge: In 2013, the Limited English Proficient (LEP) population across the United States was approaching 10% and growing rapidly. In fact, that growth was approximately 80% since 2009. In California alone, in 2015 the LEP population was approaching 19% and again, continuing to grow. This growth mirrors the patterns seen in other parts of the world as mass-migration and refugee populations move into new geographies and cultures.

Simultaneously, Telehealth is proving to deliver great potential to improve access to healthcare by removing the need for physical proximity between patient and healthcare professional. As a result of this, the use of telehealth technology to deliver care is accelerating at a logarithmic pace.

The convergence of these two facts is creating new management challenges in the delivery of care, particularly in terms of the socio-linguistic barriers that may exist between patient and healthcare professional as distance between them increases.

Results: In this discussion, the presenter will discuss some of the key elements and challenges in the delivery of language interpretation services, and why for example, use of family members or allied care staff often times impede the effective delivery of care. The presentation will also discuss innovations in how language interpretation between patient and healthcare professional is resulting in improved outcomes, including reductions in the time an encounter takes (30% faster) and with improved clinical outcomes (XXX). Finally, the presentation will discuss how these innovations can be easily applied into the delivery of care through telehealth or telemedicine, and thus ensure such new models of care delivery are available and equitable to all, and not discriminatory to certain parts of the population.

1 https://www.migrationpolicy.org/article/limited-english-proficient-population-united-states
2 2015 Data Sources: Migrationpolicy.org; LEP.gov; Oregon.gov
The Evolution of Telehealth: moving from use-case specific telehealth technology to Unified Telehealth

Eric Gombrich, Cloudbreak Health, United States of America

**Rationale:** Like many things, the adoption of telehealth (including “telemedicine”) for care delivery can be viewed as having followed the conventional “Rogers Adoption Curve”\(^1\). However, upon further reflection, “telehealth” is not ubiquitous, and very much linked to specific use-cases and clinical scenarios, each of which may have specific requirements, and be at distinct places on the Adoption Curve. Considering “telehealth” as both ubiquitous and federated from other care delivery models is posing challenges for healthcare organizations as they progress along the Adoption Curve.

This presentation will discuss some of the identified challenges resulting from early-adopter’s experiences, and what they are doing to unify or harmonize what are truly discreet use-cases of technology to render care over a distance; telehealth.

**Challenge:** Telehealth has and is proving to deliver great potential to improve access to healthcare. By removing the need for physical proximity between patient and healthcare professional, care can be accessed more quickly and at lower cost. As a result of this, the use of telehealth technology to deliver care is accelerating at a logarithmic pace\(^2\).

The evolution of telehealth (and telemedicine) services has followed a path common in healthcare; an initial pilot project (phase 1) proved successful, leading to controlled but expanded use (Phase 2), and when successful expanded for broad-scale use (Phase 3). However, the transition to this 3rd phase in the adoption process is posing challenges for many in the healthcare industry for clear reasons.

Specifically, initial pilot projects (phase 1) were, for all intents and purposes, proof-points of using the technology to render care; answering the question “can care be delivered using the technology in this way safely and with appropriate clinical effect & outcomes?” In many cases, the results of these pilots have proved positive.

Based on this, others then asked to use the technology to serve a broader population of patients for the same clinical use case (phase 2). As this ‘expansion’ in Phase 2 occurred, many organizations began to realize there was much more to managing care delivery via this modality (telehealth) than simply using the technology. For example, staffing, licensing & credentialing, remuneration for staff, scheduling, and billing are all managed uniquely in the context of telehealth versus conventional face-to-face care. Failure to address these operational elements has led to significant challenges for many organizations.

Furthermore, often times the Phase 1 & Phase 2 work of individual, isolated use-cases - each with its own clinical and/or functional requirements - was conducted on independent, isolated technology platforms. As these multiple use-cases for telehealth have progressed thru the Adoption Curve and are reaching phase 3 for broad-scale deployment, Information Technology & Engineering departments are struggling to bring the panoply of technologies together in a manageable way.

**Results:** In this presentation, we will discuss some of the key considerations not only in the effective scaling of a telehealth service through all 3 phases, but more importantly how some organizations are now harmonizing efforts across disparate use-cases, and establishing a true “unified telehealth platform” that enables various stakeholders to each meet their respective needs, while preserving historical investments.

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\(^1\) [http://www.valuebasedmanagement.net/methods_rogers_innovation_adoption_curve.html](http://www.valuebasedmanagement.net/methods_rogers_innovation_adoption_curve.html)

We don’t need new technology in telemedicine, we need a new business model

Nigel Williams, Start Telehealth, Australia

Healthcare “anytime anywhere” is inevitably going to be the norm soon. Combination of Telehealth, mHealth and home-based technologies can foster this promise.

However, many of these technologies with ongoing innovations and improvements have been around for few years now but despite best intentions they have seen only limited success. One of the reasons we believe is many of these initiatives are focused on pure preventive healthcare benefits that may fall under discretionary expenditure. This in turn fosters significant barriers to adoption and disruption and also fails to sustain commercial viability.

There is an inherent conflict between hospitals, who want admissions, insurance companies who don’t want to cover new technology, doctors who traditionally are late adopters and patients who have become accustomed to convenience in other areas of their digital life.

So Elxr Smart Health spent as much time developing business models as we have on developing technology. We are looking at already successful areas of healthcare that have emerged in recent years and developing solutions that can power those behaviour shifts.

Medical tourism is one of those areas and by its nature, it involves distant care and telemedicine can be a big part of pre-admission, and post admission as well as during the procedure itself. Elxr aims to keep the continuity of care throughout the process with a platform that can not only do video consultations but facilitate examinations with integrated devices.

These Telehealth platforms integrate several technology areas like integrated Bluetooth wireless devices to enable Patient Generated Health Data, Artificial Intelligence powered platform and OCR enabled cameras for automatic detection and early warnings, voice-based interfaces and interactive devices for ease of operating. We want Elxr to be a differentiator when deciding on a medical tourism destination.
Comprehensive approach to the National Network of Teleaudiology in Word Hearing Center in Kajetany, Poland

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Treatment of hearing impairments nowadays uses numerous state-of-the-art technologies, such as hearing aids and auditory implants, allowing hard-of-hearing and deaf people to hear the word and communicate. These modern treatment methods usually entail complicated set-up, regulation and adjustment procedures requiring frequent consultations with an experienced specialists with access to the equipment, usually available in specialist centers and hospitals.

The treatment results are dependent on the good organization of the medical care and rehabilitation. Patients’ visits in the specialist center often entail long trips from their homes. Additionally, patients, particularly children and persons with collateral mental disorders, after the long travel are tired, irritated and unwilling to cooperate. To deal with these problems and improve the quality of patient care, the Institute of Physiology and Pathology of Hearing (IFPS) developed and implemented into the clinical practice the National Network of Teleaudiology, a specialized network allowing the use of the internet and modern IT tools to provide medical care, rehabilitation and technical support for patients visiting a subsidiary or affiliated policlinics of the Institute.

After success in Poland we started cooperation with different centers on other continents. Such example is Odessa in Ukraine where we cooperate with Black Sea Center of Hearing and Speech "Medincus". Currently, NNT consists of 21 cooperating centers in Poland and 4 abroad in the Ukraine (Odessa and Lutsk), Belarus (Brest) and Kyrgyzstan (Bishkek). It is possible to diagnose patients with complicated ear diseases using videoscopy and various objective hearing assessments (for example ABR).

The first telefitting – remote fitting of the cochlear implant – was performed in Bishkek, Kyrgyzstan together with the World Hearing Center, also remote ABR assessment was performed. In other countries hearing screening in children was performed with automated database analysis. Coded data was sent to the central base and feedback information was returned to the centers that took part in research. The project was realized in Tajikistan and Kyrgyzstan. In Africa there are in progress another projects connected with screening and assessment (Senegal and Nigeria).

In addition, the WHC is equipped with integrated system for audio and video recording. All telemedical connections used in everyday medical/clinical practice, such as telerehabilitation, telefitting, teleconsultations, are registered in a central data base. All surgical procedures can be registered and stored in a central surgical registry. The whole video network works in Full HD resolution that ensures the image of high definition and quality. The system allows to transmit live surgeries to any room in the Center. This creates outstanding educational possibilities, trainees can watch transmission on computer and projection screens. Thanks to this state-of-the-art videoconference system we have a capability to connect with centers all over the world and realize live transmissions from operating and conference rooms.
Health Information System Reforms in Kiribati

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Objective: The increasing advance in transforming patient medical records from paper to electronic is becoming a major focus nationally, regionally and globally. Kiribati, situated in the South Pacific regions also started this transition of transforming patient’s paper medical records to electronic media. This paper will demonstrate how the Kiribati Health Information and the Monthly Consolidated Report Systems changes over time progressively, strength and lesson learnt about the systems followed by the recommendations as the way forward for these systems.

Methods: The transition was initiated since the development of the original online databases (KHIS and MS1) in 2011 with the expectation of the good outcome. Prior to the design of the databases, a numerous face to face interview and consultations was conducted to all head of departments within the Ministry of Health and Medical Services where similar intentions across the departments for the needs of the central databases arouses, where all data from various departments and sections within the Ministry of Health of Medical Services, would be centralized in the Health Information Unit. After a numerous consultations and interview, the databases designed and developed from the scratch that suit the Kiribati situation.

Results: The new systems, Kiribati Health Information System and Monthly Consolidated System were deployed successfully in the early year of 2012 after several series of training conducted by JICA volunteer and Chief Health Information Officer, to Medical Record Staff, Laboratory staff, Curative Nurses, Doctors and Dental staff. A total number of over 50 health professionals trained on the new system usage. Since then, a monthly and quarterly feedbacks on the accumulated diseases with the health services been provided by the Health Information Units to Doctors, Nurses, and Senior Management Committee for policy and decision making on a regular basis. Also, the annual health bulletins frequently produced on a yearly basis.

Conclusion: The development of the new online databases KHIS and MS1 contributes to the strengthening of health care services because of the easily provision of regular feedbacks generated from these systems and shared with health care providers and senior management committee for decision making and policy within the Ministry of Health and Medical Services to improve health care services. Also the systems been improving and enhancing the data quality and sharing among health key stakeholders via the health bulletins that regularly produced from these systems on a monthly, quarterly and annual basis. However, there are still gaps that need to be addressed thus recommendations proposed for the HIS way forward in the future.

Comments: Comments and further inputs to this paper are mostly welcome and highly appreciated to ensure the quality of this article. There were very limited studies conducted around this area for decades in Kiribati, and this is seems to be the second of its kind if it's happen to be accepted for publication.
The development of a gastric cancer risk prediction model among Koreans based on data collected from National Health Insurance Service

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Study Background: The data from National Health Insurance Service (NHIS) indicates that Gastric cancer is one of the most frequently diagnosed cancer in Korean population. Risk prediction of gastric cancer occurrence is of an important issue. In this study, we developed a gastric cancer risk prediction model utilizing health examination data from the National Health Insurance Services (NHIS), which targeted for the use in the individualized health management program.

Materials and Methods: We created a model to predicting gastric cancer risk using data collected from health screening and medical history of Korean population between 2004 and 2005. Cox proportional hazards model was used for the analysis, age, BMI, familial history, smoking, alcohol intake, exercise, diet were considered as covariates. Maximum of ten years were followed-up for any occurrence of gastric cancer in 10,015,960 health screening subjects. The data were randomly divided either for creating a predicting model or statistical verification in 7 to 3 ratio. To examine the model’s predictively, ROC analysis was performed.

Results: The common variates that raise gastric cancer risk in both male and female were age, BMI, familial history, and alcohol intake. Smoking (≥15 pack/year) only showed significance as a predictive value in male population (HR=1.32, 95% CI: 1.29-1.35). Harrell’s C-statistics were estimated 0.868 in males [95% CI: 0.866-0.871] and 0.803 in females [95% CI: 0.797-0.81].

Conclusion: Our study confirmed that old age, low or excessive weight, presence of familial history, large alcohol intake, and smoking had direct relation in increased risk of the cancer. However, covariates other than age, amount of smoking, and familial history resulted risk ratio that is close to 1, and familial history records includes not only gastric cancer but all other cancer history of any particular family members. Thus, our model has limitation in predicting the individualized risk, particularly high-risk groups Other risk factors should further be integrated to refine, and develop more sophisticated model for an individualized risk prediction identifying the high risk group.

Miyoun Shin expresses her appreciation for the support from the “International Cooperation & Education Program (NCCRI•NCCI 52210-52211, 2018)” of National Cancer Center, Korea
Comparison of work burden on nursing care providers with and without a sensing system: an empirical study

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Background: The unprecedented aging society has evolved in the real world and has been expanding steadily. Japan, in particular, is confronted with population aging at the fastest pace in the world. The increasing need of nursing care have brought burdens on nursing care providers, where those in nursing homes have to deal with exhausting labor (i.e., long hours, overtime work, and late-night work). The physical and mental fatigue is severe and also undermining their health, leading to conditions such as migraine, depression, and backache. To cope with the issue of high labor intensity of nursing care, the Japanese government is promoting the utilization of the Internet of Things (IoT) to support nursing care providers. Little is, however, known about the effectiveness of IoT on improved benefit of nursing homes.

Objective: We investigated whether a sleep state sensor for residents in a nursing home was associated with improved mental burdens on nursing care providers.

Materials and Methods: The study design was an empirical study in a nursing home in Japan. First, we developed an innovative IoT system with sleep state sensors. The sleep state sensors detected body motion such as the frequency of toss-turning and measured heartbeat and respiration. The mat type sensors were set under mattresses of 20 elderly persons in single rooms. The sensors showed the information of sleep state (i.e., awake or sleep) and action state (i.e., lying, sitting, or leaving-bed) in real time using mobile devices or on a laptop display at a staff station. This information can be used as a trigger for attention from the nursing care providers. Second, to examine mental burdens on nursing care providers, we conducted a questionnaire survey with Profile of Mood States Second Edition (POMS 2) before and after the empirical study. The self-reported scale assessed the mood states of individual nursing care providers for two weeks. We analyzed the mood states of nursing care providers with and without sleeping state sensors.

Results: Of ten eligible nursing care providers, five nursing care providers utilized sleep state sensors for three weeks and five nursing care providers in a control group provided care services in a conventional way for three weeks. In terms of mental burdens on nursing care providers, no significant differences were observed between before and after the empirical study among nursing care providers with sensors (p = 0.815). As for control groups, no significant differences were also observed (p = 0.931). Regarding a subscale of “Anger-Hostility,” the mean score was decreased from 7.8 to 6.2 in the group with sleep state sensors. On the other hand, the mean score was increased from 3.8 to 5.4 in the control group.

Conclusions: For a three-week empirical study in a nursing home, sleep state sensing for elderly residents might not be associated with improved mental burdens on nursing care providers.
Connections For Saving Lives - A Review of different models of tele medicine under National Health Mission in India

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¹National Health Systems Resource Centre, New Delhi, India

Objectives: The purpose of the review is to provide an overview of the various telemedicine models functional in India and understand the challenges in its implementation.

Methods: A review of various telemedicine models functional in India under the National Health Mission was undertaken. A public sector model of telemedicine in Tripura and a telemedicine model working in Public private partnership in Rajasthan were studied in detail by a multi disciplinary evaluation team including public health professionals and biomedical engineer. Service providers of different telemedicine models were contacted and a situation analysis was undertaken based on their inputs.

Results: Most of the telemedicine networks in India are working on hub and spoke model. The hub is mostly the tertiary level health care centre i.e. Medical College and the spokes are the peripheral health facilities including district hospitals (DHs), Community health centres (CHCs), Primary health centres(PHCs) and sub centres(SCs). Most of the government operated models of telemedicine are focused at provision of telemedicine services at the level of secondary care i.e. DHs, Sub District Hospital(SDH) and CHCs. Some of the telemedicine models operational in public private partnership mode have managed to provide services at the Primary Health Centre (PHC)- Telangana and sub Centre level- Himachal Pradesh.

In India, telemedicine is being utilized to provide mainly curative services including specialist and general consultations, though there are some models providing promotive and preventive services. The telemedicine setup is also being used to provide services other than teleconsultation like Tele Education, Tele support, telemonitoring services and tele training. The telemedicine platform in Public Private Partnership is more focussed on ensuring full circle of care including Diagnostic services and pharmacy services. The telemedicine models in PPP mode are also working in the direction of providing outreach services including community screening.

Some of the major challenges were observed in the implementation, growth and full utilization of telemedicine in the country are legal issues related to Telemedicine, Internet connectivity with reliable bandwidth, lack of awareness and motivation among treating physicians and patients and lack of provision of continuum of care.

Conclusion: In India, the current need is to integrate the facility with the existing health structure. The objective of utilizing the technology and emphasis on ensuring complete care should be clear before embarking on the resource intensive modality. The advantage of both government operated telemedicine models and the PPP models need to be explored by the health care delivery system.

Clarity on the legal bindings in cases of tele consultations, engaging the commercial broadband providers for ensuring provision of internet connectivity and standardizing the protocols of tele consultation are some of the key interventions which need to be taken up on priority.
Healthcare accessibility for North East India: A Nagaland Telemedicine Pilot Project

Radhika Adholeya, Kavita Kachroo, Swati Saran, Anil Joshi, Sanjay Verma, Sourabh Saxena

Objectives:
• To reach out to unreachable, for basic health care needs
• To do screening and early intervention specially for high risk pregnancies & NCD
• To provide timely treatment and reduce complications
• To strengthen follow up and referrals
• To increase participation of local private providers (PPP Mode)

Background: Telemedicine has the power not only to break down typical geographical barriers to care access, but to make the entire healthcare delivery model more convenient to patients. More convenient, accessible care for patients is the driving force behind the telemedicine field. Telemedicine was originally developed as a way to address care shortages, especially in remote rural areas. Now telemedicine is used around the world, whether it’s to provide basic healthcare in third-world countries or allow an elderly patient with mobility issues to see the doctor from home. It saves on healthcare costs, telemedicine has the power to cut our healthcare spending by reducing problems like medication non-adherence and unnecessary ER visits, and making typical doctor visits more efficient. It extends access to consult from specialists. A medical practice or hospital system can immediately expand access to niche medical specialists. This makes it easy for primary care doctors to consult medical specialists on a patient case, and for patients to see a needed specialist. It provides access to pharmacies or institutions engaged in medical research and studies. It helps in increasing patient engagement Telemedicine engages patients by allowing them to connect with their doctor more frequently, in a convenient way. That means more questions asked and answered, a stronger doctor-patient relationship, and patients who feel empowered to manage their care. Better quality patient care. Telemedicine makes it easier for providers to follow-up with patients and make sure everything is going well. Whether they are using a more extensive remote patient monitoring system to watch the patient’s heart, or doing a video chat to answer medication questions after a hospital discharge telemedicine leads to better care outcomes. In addition, Telemedicine also provides the following benefits -
• Reaching out to inaccessible areas through technology
• Making technology enabled environment for improving the quality of services
• Reducing the turnaround time (TAT) of patient
• Assuring the accountability through EMR
• Inculcating the health seeking behaviour in the population
• Provision of evidence-based treatment through technology driven lab and devices
• Strengthening of follow-up care through technology driven by introducing UHID, SMS, Tele-calling


Sampling: The project area was selected on the basis of inaccessibility of health facility and approachability for the local people. It was done with the help of local NGO. Local NGO has collaborated to provide the basic infrastructure support and man power for the centre. It was important to involve the local people because of the language barrier and understanding the health dynamics of that place.

Training & Capacity Building: Before starting the centre, Telemedicine Training was provided to the paramedic staff of the Nagaland TM centre at Delhi Head office of Upchar. It was five days training based on Software understanding and clinical skills. A complete Simulation exercise of Telemedicine model was done in Delhi with five patients. Pre- post assessment was done with set of questions. Limitations of Telemedicine was discussed in details along with referrals and support activities.

Operations: The project is based on software (EMR) which is connecting the TM centre with the healthcare providers; an online healthcare ecosystem which connects providers, patients, labs and pharmacies; and Integrated
hardware and web based software service helps doctors switch from paper records to digital, without impacting their workflow. It includes Calendar & Appointments, Prescription pad, OPD billing, Lab and Pharmacy Orders, Activity Planning, Reminders and Alerts for compliance. Includes drug database, LOINC coding for Lab tests. Live OPD of two hours everyday (10am-12noon) was done. This pilot project was done for 8 weeks in bootstrapping mode. Some seed funding was received from Department of science & technology (DST) for establishing the Telemedicine project.

Results: 112 Patients were treated in two months by online live OPD everyday for 2 hrs (10am-12pm) at Ungma village of Mokokchung district of Nagaland. Special emphasis was given for screening and early intervention along with preventive health. ANC case (1) and suspected TB case (1) were referred to local PHC (Mokookchung). Two community outreach camp was conducted.

Key findings:

- The OPD patients age group was generally middle or older group – 86.9% Patients age ranging from 40-88 Yrs. As young as 4 month old child visited and as old as 88 yrs.
- The ratio of Women versus men was on positive side. Maximum patients were females 68.1% females as compared to males in the OPD.
- Serious patients of stroke, Congestive cardiac failure, Left ventricular hypertrophy, Angina, High risk pregnancy, Suspected MDR TB, Brain tumour, anaemia, eye and ear problems and Bipolar disorder cases were seen.

Non-Communicable diseases (NCD):

- Huge prevalence of Hypertension is seen in OPD patients. 55% of the total OPD patients were having Hypertension and they were found to be without medication or irregular medication. It is seen as early as at the age of 35 years and BP as high as 251/130 mm hg is seen. 9% cases were found to be borderline and suggested lifestyle modification.
- Diabetes is also not uncommon in Nagaland. 8.6% cases were diagnosed with high blood sugar levels and were started with lifestyle modifications and medication.
- Cardiac diseases are highly prevalent and many patients visited who were already diagnosed and on medication for CAD.
- Acid peptic disorder (APD) and GI related cases were maximum after NCD. 33% of the total OPD patients were found to be suffering with APD, constipation and digestion related problems.
- Screening of cervical cancer (VIA) & Prostate cancer was done (with the help of PSA).
- Arthritis, traumatic injury and history of fall was seen on regular basis, which requires chronic pain management and physiotherapy.

Communicable diseases:

- Frequently Renal stones and Urinary tract infection cases were seen.
- Gynaecology and Obstetrics cases were seen in everyday OPD. Menopausal problems, Gynaecological infection (PID), Periods related problems and Antenatal cases were seen.
- Respiratory infections, Skin infections and ENT Problems cases were seen.

Way Forward:

- Presence of female staff and Female doctor helps in more women patients movement.
- Eye & Ear checkup require Innovative medical devices in the centre for clinical decision making.
- Elderly age group finds it a very comfortable and convenient means for consultation.
- Chronic diseases do not require much of intervention so telemedicine is a good choice for such cases.
- Monitoring of BP and Blood sugar can be managed at the TM centre which will reduce its associated complications.
- Screening of cancer can be done at TM centres.
Cloud driven application for measurement of wound size

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Measurements are key to management, especially for long term problems like ulcers. We hereby describe a web application for measurement of ulcer size which provides consistent and comparable documentation irrespective of provider, lighting as well as device. The application features and usage methodologies have been designed to be suitable for standalone, team-sharing and tele-monitoring scenarios.

Introduction: Chronic ulcers are generally kept hidden and exposed only at the time of dressing. That means that the provider on the spot has to make decisions, many of which depend on previous parameters. Ulcers are a visual problem, much suitable for telehealth purposes. Long term management is best monitored through photographs. The exact size of an ulcer is an important criterion for management. However, measuring the size correctly is difficult due to problems of body contour, curvature.

We propose the development of an online toolkit for measurement of wounds that will be hosted on the cloud, and released under a non-proprietary open source license. We believe that such a system will be an important tool for practitioners and will contribute significantly to patients care.

Prior Methods: Various contact based methods of measuring wounds include scale/ruler measurements (linear measurements), acetate paper measurements [4, 10], depth gauges, ultrasound imaging. Linear measurements involve taking two or more axial measures of the wound. These require minimal time to acquire wound parameters. Tracing the wound perimeter with a marker on clear acetate or similar film can be more accurate, but is complicated by condensation that causes fogging of the film surface and obscures the wound margins. This method requires contact with the wound area, and can lead to patient discomfort and even infection.

Automated techniques have been developed [3] to overcome these drawbacks. Stereophotogrammetry utilizes two cameras to construct a 3D image of the wound from which the surface area of the wound can be reliably extracted [1]. A variant of this approach uses single camera with a target sheet for calibration [9]. Among open source techniques, Shetty et al. [8] use ImageJ to process an image having a known size of paper strip beside the wound. Image processing algorithms compare the paper strip with the wound to determine the exact physical surface area. Laser based triangulation [6] and structured light [5, 7], to map the 3D surface of a wound and then segment out the wound region to estimate surface area can be more accurate than these approaches but is significantly more expensive.

Our Methodology: Our technique involves the following broad steps: (a) User takes image of the wound region, with a known scale placed in background, (b) The scale and wound are extracted from the image, (c) Measurements on the scale are used to determine how many pixels correspond to 1mm², (d) User is asked to mark the wound area, the number of pixels corresponding to this marked region are used to determine the wound area in mm². Figure 1 shows an example workflow of segmentation and measurement using our method. Our work is likely to resemble tools discussed in [8, 9].

We will be making this work available through an online web application accessible through any mobile device. Future enhancements include automatic focus correction of the image and automatic segmentation of the wound area. Our long term goal is to create an open source toolkit around wound estimation by combining some of the best practices outlined in section 2.
Figure 1: Wound measurement workflow

(a) Image of wound with scale; (b) Wound and scale extracted from image; (c) Extent and size of wound measured using algorithms

References:
## APAMI SOUTHAMPTON TRAVEL AWARD RECIPIENTS

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<tr>
<th>Name</th>
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<td>India</td>
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<tr>
<td>Jakir Masud</td>
<td>Taiwan</td>
<td>Taipei Medical University</td>
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<tr>
<td>Myron Anthony Godinho</td>
<td>Australia</td>
<td>WHO Collaborating Centre for eHealth, School of Public Health &amp; Community Medicine, UNSW Sydney</td>
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<tr>
<td>Ni Wang</td>
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<td>School of Biomedical Engineering, Capital Medical University, Beijing, China</td>
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<td>Rubana Islam</td>
<td>Bangladesh</td>
<td>University of New South Wales</td>
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<td>Sakiko Itoh</td>
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<td>Samaneh Madanian</td>
<td>New Zealand</td>
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<td>Satoshi Iwai</td>
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<tr>
<td>Zafar Iqbal</td>
<td>Qatar</td>
<td>Sidra Medicine</td>
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</tbody>
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## APAMI BURSARY RECIPIENTS

<table>
<thead>
<tr>
<th>Name</th>
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<th>Institution</th>
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</thead>
<tbody>
<tr>
<td>Kalaivani Chellappan</td>
<td>Malaysia</td>
<td>Universiti Kebangsaan Malaysia</td>
</tr>
<tr>
<td>Kumar Dron Shrivastav</td>
<td>India</td>
<td>Amity University, Noida, Uttar Pradesh, India</td>
</tr>
<tr>
<td>Ni’mah Hanifah</td>
<td>Indonesia</td>
<td>SIMKES, Faculty of Medicine, Universitas Gadjah Mada</td>
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<tr>
<td>Tahmina Nasrin Poly</td>
<td>Taiwan</td>
<td>Taipei Medical University</td>
</tr>
<tr>
<td>Wang Fuzhi</td>
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<td>Bengbu Medical College</td>
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