Panel Position Statements

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1 Health Informatics in the Developing World: Is This Our Problem?

The western world enjoys a far greater degree of sophistication in computer technology than the developing world; challenges include the fact that infrastructure and resources in the developing world lag far behind; education to use and maintain the technology is often lacking; and cultural and societal issues prohibit its use. Questions include: What is the role of the first world in promoting more widespread use of technology for health informatics? What are the advantages to the first world in promoting more widespread use? What is the role of scientists in the first world in developing technology suitable for less technologically savvy regions? Should we interfere in cultures that do not use technology as we do? What can we practically expect to positively influence by engaging with developing world? How do we engage with the developing world in a sustainable way? Finally, modern vaccines have made huge differences in health the world over; can we expect similar positive transformation from increased computer/information technology in the developing world?

Moderated by Zhiming Liu

1.1 Kudakwashe Dube

Introduction. *The western world enjoys a far greater degree of sophistication in computer technology than the developing world.* This lack of sophistication in

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Information and Communication Technology (ICT) can be an opportunity for health informaticians to introduce new technologies without some of the adoption barriers that are associated with the ICT sophistication found in the developed world. The major challenges in developing countries are chronic, numerous and are in addition to well-known challenges encountered in *Health Informatics* (HI) in the developed world [Adjorlolo2013][Dare2005].

First, *infrastructure and resources in the developing world lag far behind* [Foster2012]. However, introduction of new ICT has been observed to attain high levels of speedy adoption that are unparalleled by any in the developed world. This is usually accompanied by new and innovative uses that solve problems that are unique and endemic to the developing countries. A typical example is the adoption of wireless cellular telephony [Juma2012] and the mobile web-based technologies, which led to the new form of payment system based on transfer of mobile phone top-up balances from one phone number to another. Thus, health informaticians, with the benefit of experiences gained in the developed world, should participate in shaping the adoption of HI technologies in new ways that may not have been foreseen in the developed world.

Second, *education to use and maintain the technology is often lacking* [Braa1995]. This is mainly due to the non-availability of the technology. With some developing countries, like Zimbabwe, that are attaining above 90% literacy rates even in the midst of political and economic problems, educating the population to use and maintain the technology will take very short periods of time.

Third, *cultural and societal issues prohibit the use of Computer Technology.* Although this may be largely true, there are regions of the developing world where these issues make it easier to introduce ICTs than in developed world [Bell2006]. For instance, in some cultures in Africa, access to personal information may be tolerated within the context of the large extended family and friends. Privacy is associated more strongly with the physical body than with information about the physical body. Concepts like *ubuntu* that permeates the fabric of culture and society, make individuals become more prone towards emphasising the attainment of the common good, even at the expense of individual privacy, preferences and freedoms. Thus, through persuasion and education, it may be much easier to introduce ICT and HI technologies in some developing regions than in developed regions of the world. This could be viewed as an opportunity for HI researchers to engage with the aim of developing solutions that will have far-reaching impact in developing countries.

The Role of Health Informatics Researchers in Developing Countries. There is now a critical mass of a wide range of advanced HI technologies, experience and hindsight from several decades of research outputs in developed countries. The adoption of these advances usually takes a long time despite technological sophistication. Developing countries are still in their infancy in the adoptions of ICTs, not only in healthcare, but in many other domains. Even the first generation *Health Information Systems* (HIS) have not yet been adopted. There is a unique opportunity for HI researchers to define their critical roles and

to provide leadership and expertise as well as to further enhance research works for use in the introduction and adoption of both first and second generation HIS.

Advantages to the First World of Promoting Adoption of Health Informatics Technologies in the Third World. There are a number of advantages to the first world in promoting more widespread use of HI technologies in developing regions of the world. Most of these advantages could be realised if HI researchers in developed countries initiate collaborative environments with researchers and practitioners in developing countries.

First, developing countries make up the *novel context that offers a unique, flexible and malleable environment for new ways, paradigms and approaches to many aspects of HI* that focus on achieving the desired outcomes in the context of severely limited resources. The malleability of this environment arises from the fact that ICTs are not yet in widespread use in many countries, which lag many years behind. This makes it easy to introduce new technologies together with new paradigms and new ways of thinking that may be harder to introduce in developed regions that are subject to technological inertia and other challenges that result from introducing technological changes.

Second, the developing country environment offers researchers *the unique push to rethink their theories, methods and techniques and modify them for high efficiency, impact and outcomes within the context of severely limited resources.* The result will benefit both worlds. Third, theory, techniques and technological advancement within the area of HI will be enhanced and strengthened by subjecting the outcomes of HI research works to diverse environments and contexts. The developing countries offer new environments and, possibly, novel contexts and challenges that may provide opportunities for making HI theory and technologies more robust or even extended in ways that may not have been conceivable in the developed world.

A typical example of the above two advantages was the announcement of efforts to create the $100-laptop for children in the developing countries. This attracted a lot of efforts that had significant impact on the engineering and development of low-power consumption computing devices (laptops, tablets and smart phones) that are currently benefiting both developed and developing countries. The original drive was to develop low-cost, low-power consuming and yet functioning computing devices that are suitable for resource- and power-limited environments in developing countries. Research outputs that are optimised for developed countries will also work for developed countries. Thus, the result of research work that optimises solutions for the environment that is the *lowest common denominator* benefits both worlds.

Fourth, every individual has a vested interest in the *availability of efficient and effective healthcare systems with effective disease monitoring and reporting capabilities everywhere on earth.* Globalisation trends that are characterised by rapid movements of people from one region of the world to another have led to diseases spreading quickly between developed and developing regions of the world. The widespread use of HI technologies from developed countries in developing countries is a major contribution towards the achievement of efficient

healthcare systems, including disease surveillance and monitoring systems, and, hence, a safe world for everyone.

The Role of Scientists in the First World. Scientists in the first world have a invaluable role to play in developing technology suitable for less technologically savvy regions of the world. From a more general point of view, the less technologically savvy regions of the world constitute the *lowest common denominator* for a world whose resources are limited and diminishing. It is, therefore, the universally moral and ethical as well as a duty of first world scientists (in fact, all scientists) to develop technological solutions that work first within the context of the *lowest common denominator* in order for the management of the world's limited resources to be sustainable. Such technologies would be optimised for limited resources as a key requirement. Such technologies need not be backward solutions that amounts to the return to antiquated and inefficient ways of solving problems in both the developing and the developed world. The developed world scientists have the resources to lead the challenge of searching for the simplest solution that require the fewest resources. In doing so, their central focus and major priority would be to develop technologies that work for less technological savvy regions of the world. Such technologies are expected to be resource-efficient, modern and effective appropriate functional solutions to problems in both developing and developed regions of the world. Health Informaticians in the developed world would be expected to take up the challenge of creating new technologies or foundations of new technological innovations that would be available for use everywhere in the world. It is not inconceivable, that such technologies will also become adopted later for use in developed regions of the world. For example, although mobile phone-based payment systems arose as a result of the introduction of mobile phone technologies in remote villages in Africa where there is lack of cash and no banks, there are discussions of introducing this novel developing world technology into developed regions of the world in European countries and Japan.

Interference in Cultures that Do Not Use Technology. The process of interfering with other cultures to introduce new technologies that were not used before has been one of the the driving forces behind human technological development, enrichment and advancement since time immemorial. It has worked positively over centuries. The modern developed world cannot claim to be originators of all modern technologies being used in their cultures as there is evidence that the technological foundations, theories and principles originate from other cultures around the world.

An important point to note here is the fact that there is no culture in the world that does not use technology and that does not change with changing technology. Technological changes can originate internally or externally to a culture. The impact on culture and society of technological changes that originate internally is not different from that of technological changes that originate externally. Furthermore, it could be argued that there is no such thing as interference when introducing new technology into a another culture even though the technology

may have a positive or negative impact on the the culture. This is so because cultures are dynamic and as technologies are introduced and substituted, the cultures adapt and change with either positive or negative impact to members of the society.

Given that HI researchers are not oblivious to codes of ethics nor are they immune to ethical, social and professional scrutiny and audit processes, there is the expectation that any interference required to introduce new HI technologies into any culture around the world would be well-intended and would not bring deliberate or foreseeable harm to the target culture while at the same time passing the various forms of ethical and professional scrutiny from all stakeholders and agents of international development.

Practical Expectations of What to Positively Influence by Engaging the Developing World. There are many areas in which HI researchers and practitioners in the developed world could have practical expectations of exerting positive influence through engagement with the developing world researchers. These include the following:

1. The development of policies that encourage the adoption of new locally customised HI technologies in public and private healthcare organisations.
2. The empowerment of local experts to participate and carry out the local customisation work on the HI technologies to be transferred as well as the knowledge and information contents of these technologies.
3. The stimulation of collaborative research works/projects and work groups at universities in developing countries and development of local centres of excellence and engagement with the developed world.
4. The encouragement of local researchers and experts to participate in efforts that seek to introduce the technologies targeted at the developing world.
5. The facilitation of discussions and exchanges of innovative research problems, ideas, methods and outcomes of technology adoption efforts through joint conferences and similar forums.

Sustainable Engagement with the Developing World. To be sustainable, any form of engagement with the developing world must incorporate the following key elements:

1. The contribution towards empowering local researchers, practitioners and policy makers to build their own capacity for engaging in international collaborations for facilitating bi-directional technology transfer.
2. The involvement of local institutions that are agents of sustainable human capital replenishment, focusing on young people, in particular, at universities, research centres and technical institutes in projects that seek to develop technologies that are suitable for the developing world.
3. The involvement of local practitioners and policy makers, e.g., Ministries of Health and of Higher Education as well as clinicians' professional associations. This should be coupled with a contribution towards an environment that brings practitioners and policy makers to work together with researchers at universities.

4. The recognition that the role and use of the HI technologies to be "transferred" will need to be redefined in the terms of the language, culture and general social and economic contexts of the developing world and then learned [Braa1995]. Only then sustainable maintenance and innovations that extend and develop further the "transferred" HI technologies can be realised in a way that may also benefit the developing world.

Expectations of Positive Transformation from Increased Use of ICT in the Developing World. Clearly, modern vaccines have made huge differences in health the world over. Such direct positive transformation may be hard to expect from increased computer/information technology use in the developing world, especially in the short- to medium-term. This is due to the fact that the developing world is still struggling with the basic necessities of their Healthcare Systems. However, if the introduction of the new technologies is harmonised with and targeted towards the major problem areas of these Healthcare Systems, it could be reasonable to expect the same positive transformation as that being seen from modern vaccines.

Conclusion: ***Challenges in Health Informatics in the Developing World.*** The major challenges for HI in the developing world are dictated by key trends that will shape health concerns in these regions of the world as well as create novel opportunities for Health Informatics to address major challenges that the area will be facing. These trends have been identified in many government reports across the developing world as well as through studies conducted by private bodies [Robertson2009] and international organisations [WHO-HMN2011]. The trends may be summarised as follows:

1. Increasing the private sector role in regions where health monitoring and reporting is generally handled by the public sector, which may lead to under-reporting at the national level. The HI challenge is supporting interoperability and monitoring across the public and private sectors;
2. Changing profiles of disease challenges due to escalating economic developments. The HI challenge is to provide decision-support systems that accommodate the old and emerging disease profiles;
3. The threat of pandemic risk will span both the developed and developing world. The HI challenge is to support monitoring and control of pandemics in ways that are beneficial to both the developing and developed world;
4. Treatments enhancements will result from advances in medical technology but their distribution will be hampered by lack of infrastructural improvements;
5. The brain-drain from health systems of the developing world to the developed world will escalate as a result of globalisation. The HI challenge is the development of knowledge-rich decision-support systems that can be used by clinicians with low-levels of qualification and training and that should be run on low-cost and wirelessly networked mobile computing devices.

It will be necessary for HI in developing countries to address the problems that arise from these trends in order to have any positive impact. The developing world defines our technological lowest common denominator that should be our target for sustainable technological advancements in a world that is tending towards diminished resources.

Thus, HI in the developing world is our problem if the technologies that we are developing are to be robust, sustainable and continuously innovative. Even if our target is the developed world, the solutions that we develop must be relevant to the technological lowest common denominator in order to be sustainable everywhere.

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1.2 Deshendran Moodley

Globally, it is apparent that much still needs to be done in terms of health ICT. There are fundamental challenges with existing health ICT solutions which seems

to indicate that a quantum leap in research and innovation is required. Despite the fact that there are challenges in terms of e.g. privacy and confidentiality, we should be further along in health ICT than we currently are. One can draw money from ATM machines and pay with a VISA card in Kigali but cannot access a shared health record. It is clear that health lags behind other industries in the application of ICT. We believe that ICT has the potential to have a higher impact in health care delivery in developing countries than the developed world. Discussion points, issues, challenges and future directions:

1. A deeper understanding of the social, cultural and political environment is required to create and deploy effective technologies. Systems must cater for the local situation which can be highly dynamic. While lessons can be learnt from experiences in high income countries, innovation is required to tailor solutions for local settings.
2. There is a need to develop local ICT innovators, to strengthen Computer Science departments at local universities, and improve capacity for technology creation rather than just technology use.
3. Is ICT for Health (ICT4H) a Computer Science research area? Is this "applied" Computer Science or purely a software development exercise?
4. Open architectures and frameworks are required to facilitate interoperability between fragmented health applications and systems, from aggregated reporting systems that operate at the population level to EMR systems at the individual level.
5. Other areas where advanced technologies are required include: capturing of sharable clinical knowledge and process models, real-time clinical decision support, public health simulation to support policy making and revision of health priorities.

1.3 Bill Thies

Designing for Technology Transfer. One of the most under-appreciated design challenges for health informatics in the developing world is that of technology transfer. If you look at vaccines, there are often decades of high-tech research and development that is delivered in a single shot—an exemplar of good technology transfer. Some areas of computing offer similar benefits. For example, a randomized algorithm may be very difficult to design or prove efficient, but it is often very easy to use. Unfortunately, the situation is often reversed for health informatics. Many information systems that we attempt to transfer to the developing world are easier to produce than they are to maintain! When this is true, we do a disservice by developing them as outsiders, as it only exacerbates the challenges of localization and maintenance. I will explore the implications of this observation, including an intentional focus on designing for technology transfer as well as an openness to prioritizing education and training over the development of new technology artifacts.

2 Human Factors in Health Informatics: Something We Should Be Bothered with?

The potential of computer technology in modern medicine and health services is vast, but in many instances is hampered by low uptake on the part of the users. Challenges include inability to use existing technology, refusal on the part of both individuals and organizations to invest in the time to change to new methodologies, refusal to share via electronic media, and suitability of technology across the age, cultural and other spectra. Questions include: How much of these problems can we expect to just "fade away" as people grow up a computerized world? Whose job is it to address these problems—i.e., is this simply a marketing problem or what kind of ownership should each of us take for each of these issues? How can we address these problems both as individuals and as a group? How much are we willing to allow and/or encourage funding agencies to support this somewhat "soft" science? How can we convince vendors to be more sensitive to the needs of the customer? Finally, can we, in fact, really make technology more user-friendly or should we expect people to just "deal with it"?

Moderated by Alan Wassyng

2.1 Jane Liu

Many devices and applications for wellness management and health care (including intelligent medication schedulers and dispensers; mobile heart-beat, blood pressure and pulse rate monitors; and individual personal health electronic records) are user-centric: They are used on a discretionary basis by people with diverse needs, personal preferences and skills and run on platforms owned and maintained by the users. In addition to being able to adapt to changes in user's needs while in use, a user-centric device must be easily configurable and customizable by the user. Some user-centric devices and applications require little or no training of their users but may rely on the users to perform some mission-critical functions. Such a device or application must be able to monitor and respond to user actions in order to ensure that the user and device together never do any harm and all unavoidable errors are either recoverable or tolerable. These challenges must be overcome for the devices and applications to be widely used and indispensable tools.

2.2 Joseph Cafazzo

To ignore this aspect of the design of healthcare IT systems, is to deny its full utility. Far too many systems exist in practice that do not fully realize the promise of creating a safer more efficient healthcare system, largely due arbitrary design that does not consider the complexity of human cognition and performance, and the environment in which they work. Moving beyond the provision of healthcare services in the traditional sense, we cannot create the next generation of patient self-care tools without creating a user-experience that will elicit positive health behaviours, that ultimately will lead to improved health outcomes and reduced dependency on traditional care.

2.3 Oleg Sokolsky

Human factors in health informatics are one of the most important factors in patient safety. It is critical that engineers developing new information technologies for health care be aware of the following two aspects of human factors. On the one hand, developers of information technology have to be aware of workflows and clinical guidelines that caregivers follow in their daily routine. A tool that does not fit into these workflows either remains unused, wasting its potential, or—worse—creates new safety hazards for patients through workarounds and shortcuts that caregivers are forced to apply in order to use the tool. On the other hand, behavior of tools have to match mental models that caregivers have. That is, caregivers have to have unambiguous understanding of what the tool is telling them and what it expects as input. Mode confusion, that is, a mismatch between the tool actual state and the state perceived by a caregiver, creates further safety hazards for patients. A necessary but not sufficient condition for avoiding mode confusion is to provide intuitive and unambiguous user interfaces.