

## Why Australia and Indian Researchers Should Collaborate to Advance Wound Management Innovation?

In 2011, 366 million people suffered from diabetes worldwide, resulting in 4.6 million deaths at a cost of US\$ 465 billion in direct healthcare expenditures.<sup>[1]</sup> India has the world's second largest diabetic population at 61.8 million (8.3% of total population),<sup>[1]</sup> while in Australia 8.1% of the population have been diagnosed with diabetes.<sup>[1]</sup> Diabetic foot ulcers (DFUs) affect up to 25% of diabetic patients, precipitating 85% of all diabetic amputations.<sup>[2,3]</sup> DFUs have significant social and economic impacts associated with increased hospitalisation rates, cost of care and the reduced capacity of patients and carers to work. In isolated regions of Australia and India the incidence of DFU and associated infection is substantially increased, resulting in hospitalisation rates up to 4-fold higher than that of major cities.<sup>[4]</sup> Indigenous Australians are particularly susceptible with diabetes rates three times that of non-Indigenous Australians, resulting in 10-fold higher hospitalisation rates and 38-fold higher amputation rates.<sup>[5-7]</sup> The challenge is to develop low-cost technologies and management strategies that prevent the progression from minor wound - ulcer - infection - amputation and ultimately death. Despite this clear need for improved approaches to diagnose, treat, manage and prevent wounds, research in wounds is still relatively under-developed compared with other medical conditions, and is yet to adopt modern biotechnology and innovative biomaterials approaches, or evidence-based clinical practice more broadly.

Progress in wound research in Australia has been

significantly accelerated in recent years through the establishment of the Wound Management Innovation Cooperative Research Centre (WMICRC) in July 2010. This 8-year, AUS\$ 110 million enterprise, involving 20 research, industry and government partners, is the largest wound research initiative globally and is focused on improving wound healing and the quality of life for people with wounds. An interdisciplinary, systematic and strategic approach has been adopted in three key interdependent research programs. The Enabling Technologies Research Program is focused on elucidating key molecular and biological mechanisms that underlie wound healing using advanced proteomics, metabolomics, single nucleotide polymorphism (SNP) profiling, next generation DNA sequencing and tissue engineering technologies. The overarching goal is to identify new therapeutic targets and biomarkers to enable development of novel diagnostic and prognostic tools and new wound therapies. The Tools and Therapies Research Program is using this new information and data from the existing literature to develop innovative tools, diagnostics and therapeutics for the next generation of advanced wound management products. This includes 'smart dressings' that incorporate biosensors to monitor wound healing and materials to release therapeutic compounds. The Clinical Application Research Program, arguably the most important group of activities in the WMICRC, is delivering improved wound management through the development, evaluation and implementation of evidence-based wound care, new preventative and treatment strategies and improved clinical care pathways.

The combined research, education, communication, and industry engagement outcomes of the WMICRC are aimed at transforming wound management to deliver social and economic benefits to communities, industry and the healthcare sector. We are cognisant, however, of the importance of conducting wound research within an interdisciplinary, national and international framework.

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### Zee Upton

Assistant Dean (Research), Faculty of Health; Tissue Repair and Regeneration Program, Institute of Health and Biomedical Innovation; Queensland University of Technology, Brisbane, Australia

#### Address for correspondence:

Prof. Zee Upton, Assistant Dean (Research), Faculty of Health; Tissue Repair and Regeneration Program, Institute of Health and Biomedical Innovation; Queensland University of Technology, Brisbane, Australia. E-mail: z.upton@qut.edu.au

Indeed, collaboration with researchers and clinicians who share close geographical context will be increasingly important.

To date, research in wound therapies and wound management has been largely pioneered and driven by research teams and opinion leaders in Europe and North America, and is not yet fully contextualized for the quite distinct circumstances that exist for populations in warmer climates, rural and remote communities and in resource poor countries. If we consider New Delhi, India, and Brisbane, Australia, for example, there is clear overlap in daily temperatures, with New Delhi's average daily minimum and maximum temperatures ranging from 19°C to 31°C,<sup>[8]</sup> while Brisbane's average daily minimum and maximum temperatures range from 16°C to 26°C.<sup>[9]</sup> Similarly, humidity is another important shared element, with humidity in New Delhi ranging from 38% to 82%,<sup>[10]</sup> while in Brisbane average daily minimum and maximum humidity ranges from 53% to 66%.<sup>[8]</sup> Both of these climate factors impact on wound healing, including affecting rates of wound infection and approaches to wound management. This includes management of wounds via offloading devices, most of which are designed around fully enclosed footwear that is not comfortable in hot and humid climates. This leads to poor compliance and hence poor healing outcomes. Anecdotal evidence suggests that similar discomforts underpin the poor compliance observed in the use of compression stockings and bandages in hot and humid climates.

Australia and India also share significant geographical challenges in terms of delivering of healthcare to rural and remote regions. Australia's population of 23 million people are predominantly urban-based (68%), but those that are not (32%), are sparsely dispersed over the country's 7.7 million square kilometre land mass,<sup>[11-13]</sup> making equitable delivery of health care regardless of geographical location challenging, and again underpins the increased incidence of DFU, associated infection and amputations experience by those living in rural and remote areas. The experience is almost reversed in India, with its estimated 1.2 billion people spread geographically over 3.3 million square kilometres, and with most, 69%, still largely rural based.<sup>[14-16]</sup> In this regard, the opportunities to collaborate on the development of mobile phone and Information Communication Technologies (ICT) technologies to improve the diagnosis and management of wounds remotely cannot be underestimated, albeit the key drivers in both countries may differ somewhat. The rollout of the National Broadband Network in Australia, combined with the phenomenal uptake of mobile phones in Australia, makes this entirely plausible. In March 2011 there were 22,120,100 mobile phones in Australia;<sup>[17]</sup>

that is one mobile phone for every person in Australia, and 43% of these are now Smart Phones.<sup>[17]</sup> Moreover, take-up is relatively even in both metropolitan (83%) and non-metropolitan (80%) regions.<sup>[18]</sup> Uptake of mobile phones is also exponentially increasing in India; in 2005/6 the number of mobile phones was predicted to rise from a base of 8.1 per 100 inhabitants to 36.5 in 2010/11 and to 71 in 2015/16.<sup>[19]</sup> Thus the exchange of wound management expertise and information via mobile phones is a practical and feasible approach, and worthy of collaborative effort given the needs and skills in both countries.

Finally, a further impetus to stimulate collaboration in wound management between Australian and Indian researchers is the cost of wound care. Unlike Europe and North America, the cost of wound products and dressings are largely not re-imbursed, hence the cost to individuals is high and may lead to sub-optimal wound management. The Indian health care system faces even greater challenges, but nevertheless it is clear that advances can be made by working together and adopting a multidisciplinary approach embracing frugal engineering concepts. This will assist in the development of cost-effective, culturally-and climate-appropriate technologies that will improve access to best practice clinical wound care in Australia and in India. For these reasons we believe that wound researchers and clinicians must increasingly collaborate with their counterparts in near neighbouring countries, and collaboration between Indian and Australian wound management researchers is particularly important given our shared economic futures. Indeed, it is time for wound researchers and clinicians in the tropics and sub-tropics to unite to improve wound management. Our climate, geography and health-funding share greater commonalities than found with Europe and North America.

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