The development of an electronic wound management system for Western Australia

Santamaria N, Glance DG, Prentice J & Fielder K

Abstract

The MMEx Wounds Management System (MMEx WMS) has been developed as a collaboration between the WoundsWest Advisory Service (WWAS) of the Department of Health WA (DoHWA) and the University of Western Australian Centre for Software Practice (UWA CSP). The system was designed as a comprehensive wound imaging and clinical management system that would support collaborative management of a patient's wounds. Patients with chronic wounds are currently often treated by a number of clinicians at a number of sites during the course of the management of one wound; however, the transfer of clinical information between clinicians is compromised and rendered inefficient due to a multiplicity of factors including: paper-based systems, variation in wound assessment and time lags in sharing essential information between clinicians. The current problems are compounded in rural and remote locations in a state as large as Western Australia (WA). The design of the software was based on the extensive experience of the WoundsWest Service team together with research evidence-based best practice in the area of wounds management and collaborative healthcare. This design was coupled with an agile software development process that emphasises end-user participation, feedback and rapid, frequent iterations of software development. The entire first phase of the system was brought to a pilot implementation within a six-month period with high user acceptance. Ultimately, the MMEx WMS will improve wound management clinical outcomes and reduce costs associated with treatment and patient transfers due to the timely and accurate availability of wound treatment progress data and the increased availability of expert remote wound consultation.

Professor Nick Santamaria * RN, RPN, BAppSc MEdSt, Grad Dip Health Ed, PhD

Professor of Nursing Research, University of Melbourne & Royal Melbourne Hospital
The Royal Melbourne Hospital, Grattan Street
Parkville, VIC 3050
Tel 0414 560929
Email nick.santamaria@mh.org.au

Associate Professor David Glance PhD

Director, UWA Centre for Software Practice
University of Western Australia

Dr Jenny Prentice RN, BN, Cert STN, Cert Palliative Care, PhD

Project Director, WoundsWest

Kit Fielder RN, B Sc (Nsg)

Senior Project Officer IT WoundsWest

* Corresponding author

Introduction

The ability of clinicians to accurately determine if a wound is healing is critical to effective decision making and ultimately to positive patient outcomes[1,2]. Furthermore, accurate, rapid and concise wound documentation is at the core of good wound care[3]. These statements appear to be self-evident yet the current processes for achieving both of these goals are sub-optimal in the current healthcare environment due to a multiplicity of factors including: lack of appropriate equipment, antiquated paper-based systems and the absence of 'whole of system' approaches to wound imaging and documentation[4,5].

The WoundsWest initiative (WW) was established in 2006 as a partnership between the Department of Health WA (DoHWA), Curtin University and Silver Chain to provide a specific focus on the treatment of wounds in Western Australia (WA).

Commencing in 2009, WW has worked with the University of Western Australia, Centre for Software Practice (UWA CSP) in

modifying an e-health platform named MMEx to incorporate specific functionality around wounds management. MMEx is a web-based e-health platform[6] with a fully shareable electronic health record, patient management, secure messaging and other clinical management functionality. The wounds module of MMEx has been developed to satisfy the following requirements:

1. The system allows for the recording of comprehensive information about a wound, including health factors and parameters that could affect wound healing and management.

2. Information is drawn from a number of sources including the input from other health professionals involved in the care of the patient – obviating the need for double entry of data.

3. Wound images can be uploaded and analysed to give measures of surface area, depth and other characteristic data.

4. All of the information relating to a wound can be shared with patient consent with the WW Advisory Service (WWAS), which is able to provide a management plan. Alternatively, the health professionals themselves can outline a management plan and track the progress and outcomes.

5. Reporting and analysis functionality of wound prevalence, wound management performance and outcomes.

The full functional and technical specifications for the system were the result of prior work that the WW team had done as part of the initial project set-up and was the result of the collective experience of the WW team and research evidence-based practice in wounds management. The combination of these requirements with an existing e-health platform allowed for the rapid development and deployment of the system. The development process itself utilised an agile approach that encourages feedback from users and rapid iterations of development, deployment and feedback[7]. This facilitates input and participation from all users, enhancing the probability of user acceptance.

The MMEx Wound Management System (MMEx WMS) has been deployed in 21 sites within WA and is shortly to be evaluated for its adoption, use and user acceptance. At this point, further feedback will be incorporated before being rolled out more widely in the state.

This paper will describe the process undertaken by the WW team and the UWA CSP in developing the MMEx WMS.

An e-health approach to wounds management: the rationale

The use of digital photogrammetric techniques in wound measurement is well established and has been documented as being superior to existing manual methods for wound measurement, particularly when used in the assessment and treatment of chronic wounds[8-11]. Digital wound imaging systems are widely available and include systems such as AMWIS[4,12], MAVIS[5], ComCare[13] and Pixalere[14]. These systems have demonstrated clinical and cost benefit in the hospital, community and remote settings and have facilitated wound research[15-19]. More recently, laser-based wound measurement instruments have emerged which show clinical potential by removing the need for separate digital photography and manual measurement[20]. However none of these systems are designed to function across a whole healthcare system such as that of WA.

The MMEx WMS was based on a number of essential design parameters that were deemed critical to the success of the system. These parameters (mentioned above) were derived from our previous experience designing and using clinical digital wound imaging systems, the requirements of the DoHWA for interface with existing patient information systems and national and international standards for clinical imaging and security of patient data.

Although it was envisioned that the primary users of the system would be wound clinicians either working within health services or communicating with the WWAS, the system needed to allow for communication and for a collaborative approach to care with other agencies such as Silver Chain, private GPs and secondary and tertiary hospitals. The wound management plans created in the MMEx WMS are directly shareable but also allow for the transmission by secure messaging in HL7 format.

Using the system: creating a wound referral

Selecting or creating a patient record

The process of creating a wound referral starts with the selection or creation of a patient record. Until the advent of a unique patient identifier[21] in Australia, a patient is identified using any of a number of patient identifiers. The problem is exacerbated in WA by the fact that the DoHWA utilises different identifiers for patients in different regions. Different

groups may utilise external identifiers such as a Medicare number or health card number. In the worst case, the patient's name, date of birth and address are used to identify a patient. These identifiers can also be used as a cross-check to prevent duplicate patients being added.

On selection or creation of a patient, basic demographics are entered and the patient record opened to the wounds section.

Creating a wound problem record

Recording details of a wound is conceptualised as recording details of a 'wound problem'. The main areas of focus for the problem report are: (Figures 1 & 2)

- Wound attributes (type, date of occurrence, details of previous management).
- Pain assessment (symptoms, type, score).
- Relevant investigation summary.
- Wound images.
- Wound morphology (dimensions, appearance).
- Current wound management (dressing, fixation, compression, pressure relief, interventions, equipment).
- Related patient health checklist:
    - Medical/surgical history.
    - Allergies and adverse reactions.
    - Medications.
    - BGL and HbA1c.
    - Adjuvant therapies.

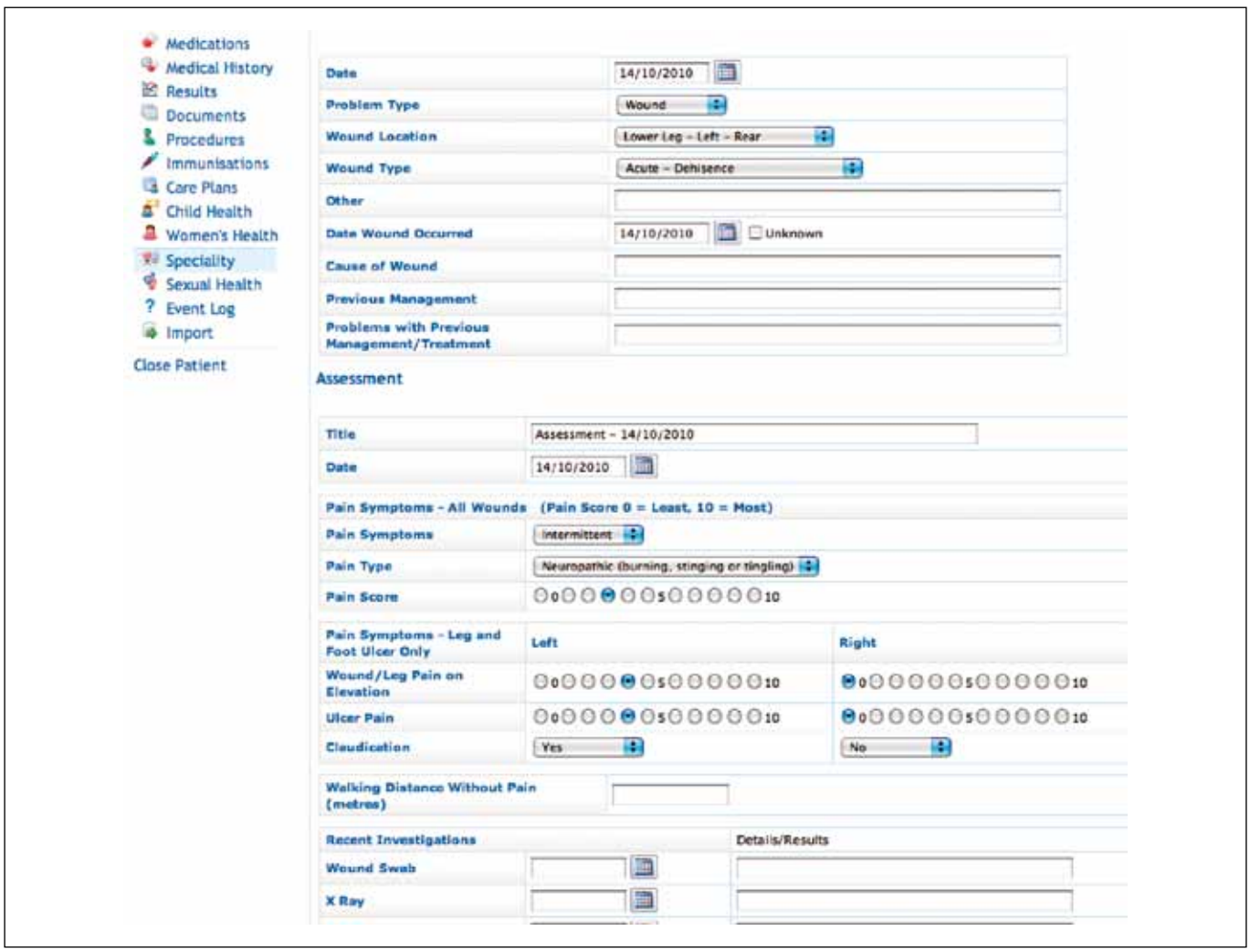

Figure 1. Part of wound problem record field.

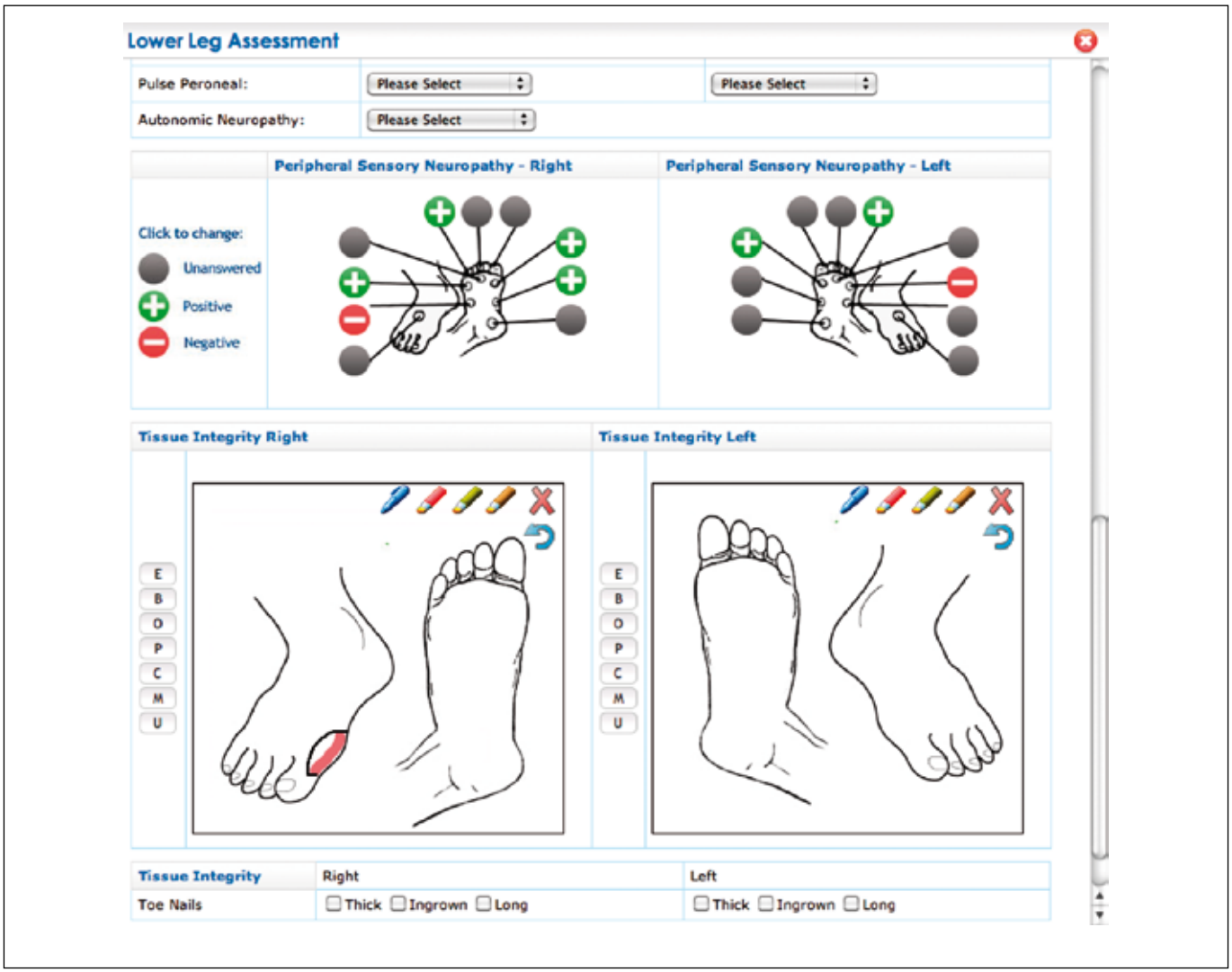

Figure 2. Lower leg assessment screen.

- Alcohol history/habits.
- Smoking history/habits.
- Functional ability.
- Mobility.
- Nutrition.
- Psycho-social situation.
- Factors affecting wound healing.
- Lower leg assessment.
- Physical measurements.
- Illicit substances.

Once the problem is created, the clinician can use the wounds image analysis tool to perform a series of measurements on the wound to calculate total and sub-surface areas of the wound. The image analysis tool is shown in Figure 3.

The MMEx WMS offers a problem-oriented view of the electronic record and so all aspects of the management of the wound are grouped together in one spot. This facilitates searching for information and being able to track progress or be alerted to any specific issues. Because the record can be worked on by any number of health professionals, and not necessarily all interested in the issue of the patient's wound, customised notifications are available to the team working on a problem to alert them when things have changed within the record.

Figure 3. Wound imaging tool showing the calculation of the surface area of the wound from the perimeter tracing.

A clinician managing a wound can refer the problem to the WWAS. This can be done either at the time of the problem creation or at any stage of the treatment. The WW advisor can create a management plan which sets out the management goals and gives recommendations of dressing procedures, pressure redistribution, referrals, patient education and follow-ups. Wound healing progress can be graphically represented and reported over time (Figure 4) and provides a quick visual cue as to wound surface changes.

Once the treatment of a wound is finalised, the problem can be closed and an outcome added. Reports can be run to detail the statistics on wound treatment on an individual, organisational or regional level.

Development methodology and future directions

The development of the WMS in MMEx was the result of a collaboration between the WW team and the developers of the UWA CSP. The development of the system was derived first and foremost from the experience of the staff of the WW team and research evidence-based best practice in wounds management. This was translated into the existing MMEx e-health platform that facilitated communication and collaborative, multidisciplinary team approaches to patient

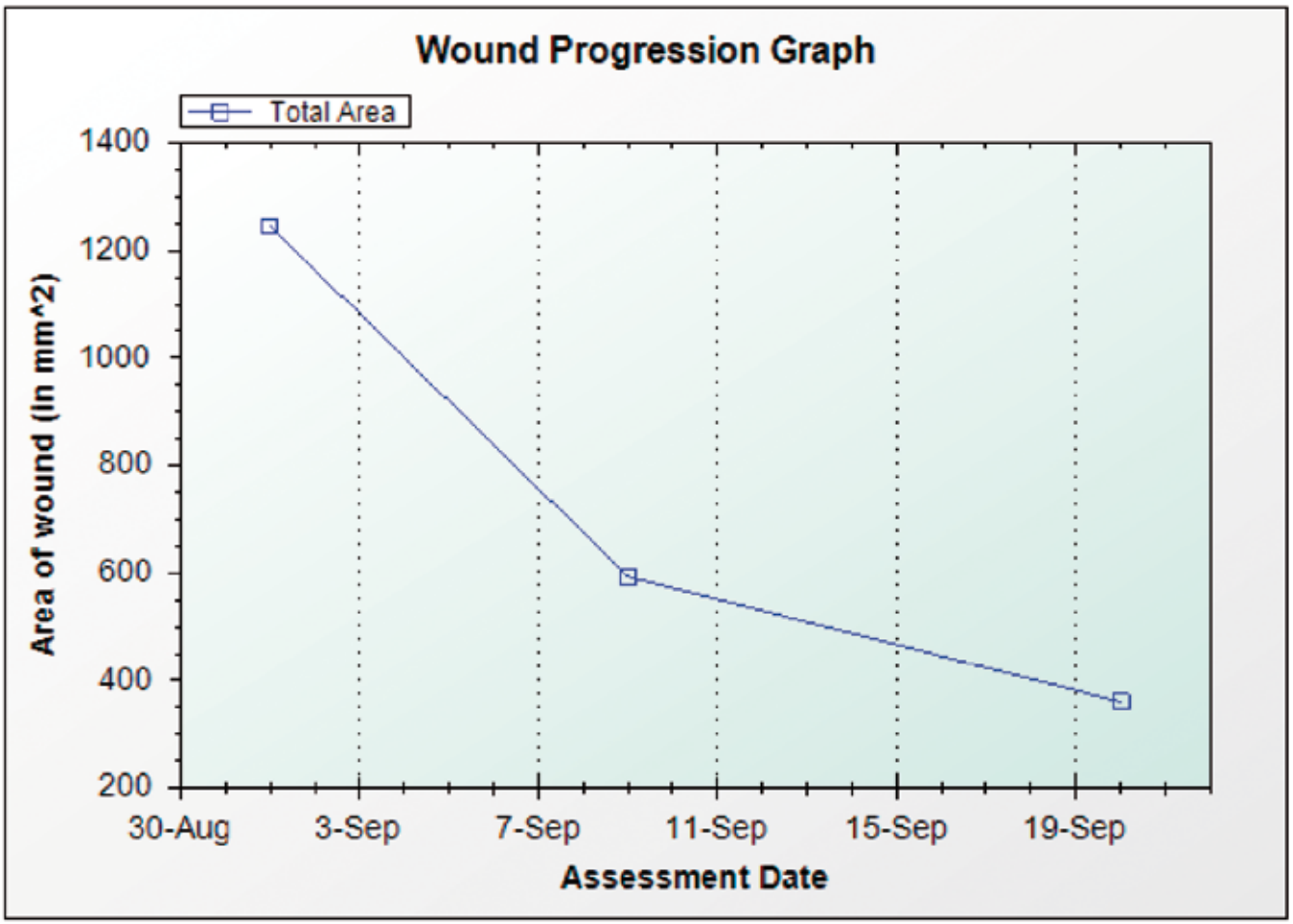

Figure 4. Wound healing rate illustrated by a graph of wound surface area over time.

care. A feature of the way MMEx has been developed is that each new piece of functionality relies on generic parts of the system which allow for reuse of components across the system and data that has been entered for other purposes to be reused. The final piece of this development is the participation of end users and their feedback (positive and negative) on the system. The development forms a type of social contract between the users and the developers in that problems and change requests are actioned rapidly in return for a user's ongoing involvement in providing feedback. Improvements can also be made to the system on review by the WW and UWA CSP teams and rolled out in cooperation with the users.

Future enhancements of the system are planned. The incorporation of automatic guidance based on information provided in the assessments is one aspect of proposed development. A second focus will be the ability to track dressing products used during wound treatment in order to estimate overall costs to the health service of wound treatment.

Conclusion

The MMEx WMS is the result of a successful collaboration between the WW team of the DoHWA and the UWA CSP. Combining a specification derived from experience and research evidence-based best practice with modern development methodologies and early user engagement, the initial results of a partial deployment have been encouraging with high levels of user engagement and system adoption.

References

1. Flanagan M. Wound measurement: can it help us to monitor progression to healing? J Wound Care 2003; **125**:189–194.
2. McArdle J, Smith M, Brewin E & Young M. Visitrak: wound measurement as an aid to making treatment decisions. Diabetic Foot 2005; **8**:207–211.
3. Plassmann P. Measuring wounds. J Wound Care 1995; **4**:269–272.
4. Santamaria N & Clayton L. Cleaning Up: The development of The Alfred/Medseed wound imaging system. Collegian 2000; **7**(4):14-18.
5. Plassmann P & Jones T. "Mavis": a non-invasive instrument to measure area and volume of wounds. Med Eng Phys 1998; **20**:332–338.
6. MMEx eHealth Platform. Information available at: http://www.mmex.net.au
7. Highsmith J & Cockburn A. Agile Software Development: The Business of Innovation. Computer 2001; **34**.9:120–122.
8. Majeske C. Reliability of wound surface area measurements. Phys Ther 1992; **72**:138–141.
9. Shaw J, Hughes CM, Lagan KM, Bell PM & Stevenson MR. An evaluation of three wound measurement techniques in diabetic foot wounds. Diabetes Care 2007; **30**:2641–2642.
10. Gethin GT & Cowman S. Wound measurement: the contribution to practice. EWMA J 2007; **7**:26–28.
11. Austin D & Santamaria N. Digital imaging and the chronic wound: clinical application and patient perception. Journal of Stomal Therapy Australia 2002; **23**(4):24-29.
12. Advanced Medical Wound Imaging System (AMWIS). Medseed Pty Ltd, Melbourne, Victoria.
13. ComCare. Silver Chain Nursing Association, Perth, Western Australia.
14. Pixalere. Abbotsford, British Columbia CA.
15. Loyola M. An evaluation of the Tele-Wound (Pixalere) telehealth initiative. 2005. Interior Health, British Columbia CA.
16. Santamaria N, Austin D & Clayton L. Multi-site trial and evaluation of the Alfred/Medseed Wound Imaging System prototype. Primary Intention 2003; **10**(3):119–124.
17. Santamaria N Carville K Ellis I & Prentice J. The effectiveness of digital imaging and remote wound consultation on healing rates in chronic lower leg ulcers in the Kimberley region of Western Australia. Primary Intention 2004; **12**(2):62–70.
18. Flowers C, Newall N, Kapp S, Lewin G, Gliddon T, Carville K, Martinelli D & Santamaria N. Clinician inter-rater reliability using a medical wound imaging system. Wound Practice & Research 2008; **16**(1):22–31.
19. Santamaria N, Carville K, Prentice J, Ellis I, Ellis T, Lewin G, Newall N, Haslehurst P & Bremner A. Reducing pressure ulcer prevalence in residential aged care: Results from Phase II of The PRIME Trial. Wound Practice & Research 2009; **17**(1):12–22.
20. ARANZ Medical, Christchurch, New Zealand.
21. National Healthcare Identifiers. Accessed on 21 September 2010: http://nehta.gov.au/connecting-australia/healthcare-identifiers