

# 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](mailto: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

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<sup>1,2</sup>. Furthermore, accurate, rapid and concise wound documentation is at the core of good wound care<sup>3</sup>. 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<sup>4,5</sup>.

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<sup>6</sup> 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<sup>7</sup>. 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<sup>8-11</sup>. Digital wound imaging systems are widely available and include systems such as AMWIS<sup>4,12</sup>, MAVIS<sup>5</sup>, ComCare<sup>13</sup> and Pixalere<sup>14</sup>. These systems have demonstrated clinical and cost benefit in the hospital, community and remote settings and have facilitated wound research<sup>15-19</sup>. More recently, laser-based wound measurement instruments have emerged which show clinical potential by removing the need for separate digital photography and manual measurement<sup>20</sup>. 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<sup>21</sup> 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:
  - o Medical/surgical history.
  - o Allergies and adverse reactions.
  - o Medications.
  - o BGL and HbA1c.
  - o Adjuvant therapies.

The screenshot displays a web-based form for creating a wound problem record. On the left is a navigation menu with icons for Medications, Medical History, Results, Documents, Procedures, Immunisations, Care Plans, Child Health, Women's Health, Speciality, Sexual Health, Event Log, and Import, along with a 'Close Patient' button. The main form area is divided into several sections:

- Wound Details:**
  - Date: 14/10/2010
  - Problem Type: Wound
  - Wound Location: Lower Leg - Left - Rear
  - Wound Type: Acute - Dehiscence
  - Other: (empty field)
  - Date Wound Occurred: 14/10/2010 (with an 'Unknown' checkbox)
  - Cause of Wound: (empty field)
  - Previous Management: (empty field)
  - Problems with Previous Management/Treatment: (empty field)
- Assessment:**
  - Title: Assessment - 14/10/2010
  - Date: 14/10/2010
  - Pain Symptoms - All Wounds (Pain Score 0 = Least, 10 = Most): Intermittent
  - Pain Type: Neuropathic (burning, stinging or tingling)
  - Pain Score: 0 1 2 3 4 5 6 7 8 9 10 (with 4 selected)
  - Pain Symptoms - Leg and Foot Ulcer Only:
 

	Left	Right
Wound/Leg Pain on Elevation	0 1 2 3 4 5 6 7 8 9 10 (with 4 selected)	0 1 2 3 4 5 6 7 8 9 10 (with 4 selected)
Ulcer Pain	0 1 2 3 4 5 6 7 8 9 10 (with 4 selected)	0 1 2 3 4 5 6 7 8 9 10 (with 4 selected)
Claudication	Yes	No
  - Walking Distance Without Pain (metres): (empty field)
  - Recent Investigations:
 

	Details/Results
Wound Swab	(empty field)
X Ray	(empty field)

Figure 1. Part of wound problem record field.

**Lower Leg Assessment**

Pulse Peroneal:

Autonomic Neuropathy:

**Peripheral Sensory Neuropathy - Right**      **Peripheral Sensory Neuropathy - Left**

Click to change:

- Unanswered
- + Positive
- Negative

**Tissue Integrity Right**      **Tissue Integrity Left**

**Tissue Integrity**

	Right	Left
Toe Nails	<input type="checkbox"/> Thick <input type="checkbox"/> Ingrown <input type="checkbox"/> Long	<input type="checkbox"/> Thick <input type="checkbox"/> Ingrown <input type="checkbox"/> Long

Figure 2. Lower leg assessment screen.

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

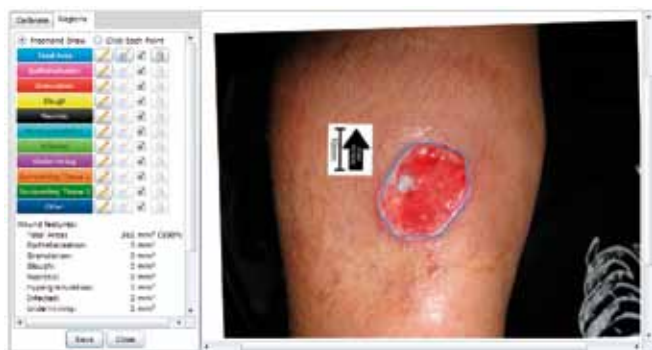


Figure 3. Wound imaging tool showing the calculation of the surface area of the wound from the perimeter tracing.

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

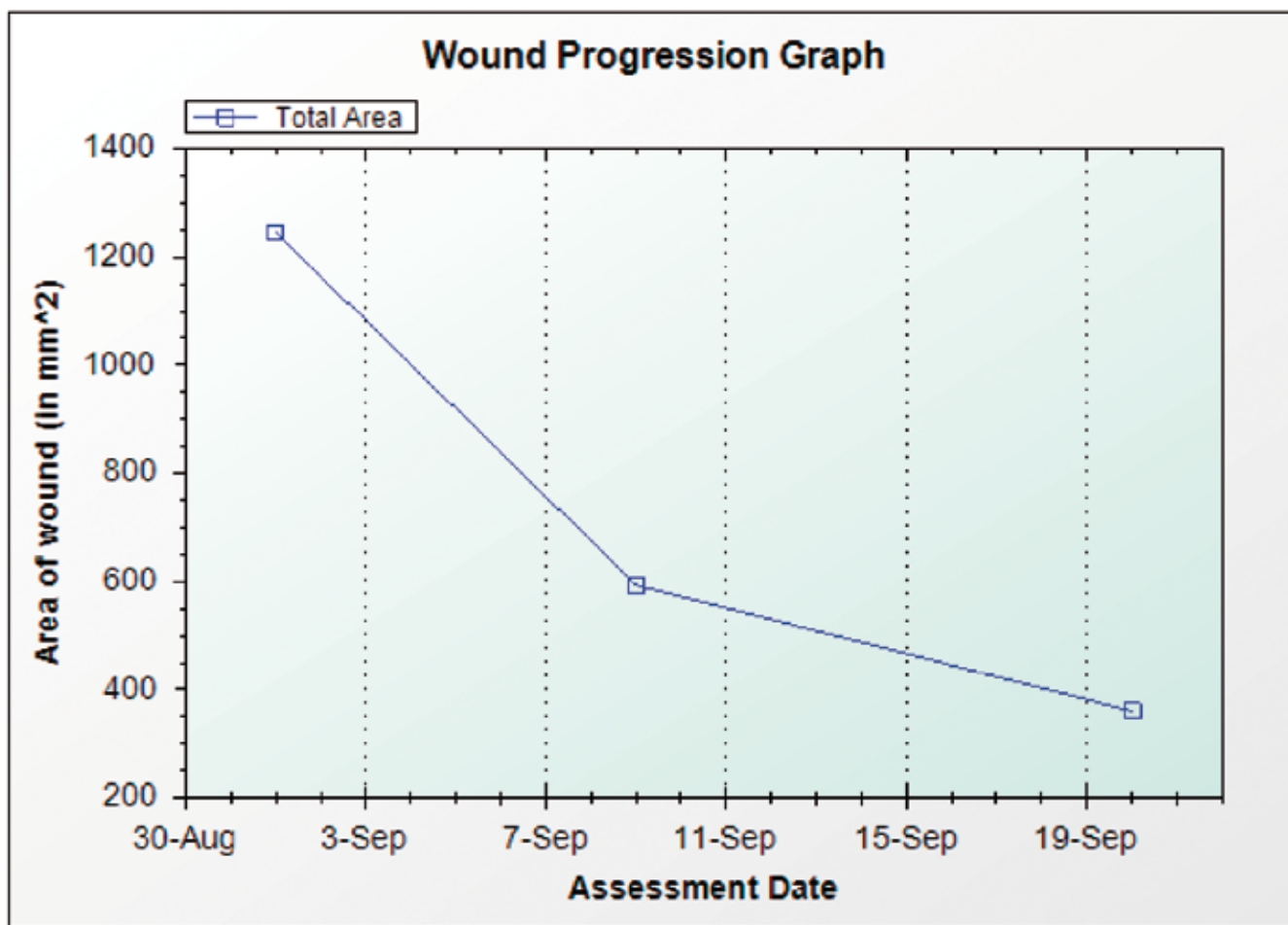


Figure 4. Wound healing rate illustrated by a graph of wound surface area over time.

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.

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## Australian Pressure Ulcer Advisory Panel CALL FOR NOMINATIONS

The Australian Pressure Ulcer Advisory Panel (APUAP) Clinical Governance Committee calls for nominations from clinicians, scientists and educators with an interest in pressure ulcers to become members of the three APUAP subcommittees:

- Policy
- Education
- Research

Nominations must be received in writing and address the relevant criteria for the subcommittee for which application is made. The criteria can be found in the AWMA newsletter or on the AWMA website [www.awma.com.au](http://www.awma.com.au)