A dressing history

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ABSTRACT

Over the past 30 years as caregivers, clinicians have been exposed to a plethora of new advanced wound dressings. The moist wound care revolution began in the 1970s with the introduction of film and hydrocolloid dressings, and today these are the traditional types of dressings of the advanced dressing categories. Wound-healing science has progressed significantly over the same period, as a result of intense clinical and scientific research around these product introductions. Today, the clinician understands moist wound healing, occlusion, cost effectiveness, wound bed preparation and MMP activity to name but a few of the many concepts in wound care that have flourished as a result of technology and product advancement. This review article presents a condensed history of dressing development over the past 30 years. However, in addition, such advancement is discussed in respect to its adoption in different parts of the world. The largest single markets of the world are generally the United States of America and Europe; as such, the development of both practice and technology generally begins there. Much has been written about these markets in previous review articles. For the purposes of this review, the development of wound care and the maturing of practice is discussed in respect to Canada, Japan and Australia representing smaller geographical areas where the development has been more recent but nonetheless significant.

Key words: Dressing ● Wound ● Occlusive ● Modern ● Review ● Australia ● Japan ● Canada

INTRODUCTION

Many articles have been written concerning the development of both product (1–4) and technology over the past three decades (6–25), often updates from the last. As such, these reviews have presented a regional perspective of the development of modern wound care during this period.

The development of the modern wound care concept and adoption of advanced products, however, are not universal (i.e. global) even today. Different markets develop at different times. Change of practice takes time and also differs by geographical region and culture.

Certain areas lead the way (e.g. the United States of America and United Kingdom), often as a result of market size and the globality of the English language. Other geographical areas follow, each learning from the other, which in turn results in a more rapid and focused development of practice and product.

Today, wound care is a global arena, with most geographical areas having some elements of technology and product, in addition to standards of practice, albeit at different stages of the evolutionary wound care path.

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A DRESSING HISTORY

The management of wounds began in Egyptian times (26) with grease-soaked gauze bandages – with little thought to wound management. Over the centuries, such care has become a little more sophisticated, but its primary goal – that of healing – remains the same. Traditional dressings such as gauze are non occlusive and dry out. Once this happens, they adhere to the wound bed. Even if they do not dry out, capillary loops (i.e. granulation tissue) can grow into the dressing structure (27), thereby resulting in dressing adherence. Such adherence leads to wound trauma, often noted with bleeding during dressing removal, and this can cause pain to the patient.

During the 1980s, wound care took a new direction with the widespread introduction of moist wound healing (28). In the next two decades, much has been proven around the benefits of moist healing.

Key Points

- many reviews previously written – but are normally region specific or influenced
- this review provides a different perspective
- the 1980s saw the proliferation of modern wound care products

Key Points

- choice of product should be based on the wound, the patient and their multiple needs
- moist interactive wound care has been around for three decades
- around 50% of all wounds do not receive appropriate care
- wound bed preparation paradigm presents a more encompassing concept *vs* simple moist wound healing
- debridement can be achieved by a variety of means

Wound dressings have been designed to function in a specific manner. Often, their interaction with adjunct/complementary devices may also have been designed for or at least clinically evaluated. The choice of product for optimal wound management is not straightforward. This choice should not be for a single wound factor or indeed one specific function. The wound, the patient and their multiple needs should also be considered (29).

Optimal wound care wisdom understands and promotes the need for a moist interactive dressing in chronic wounds with the ability to heal (30). Unfortunately, practice does not necessarily follow and a large number of inappropriate dressings are still used today. Any treatment choice should be cognisant of other patient-centred factors involved in the quality of their life in addition to healing.

Moist interactive wound care has been around for the last three decades. Therefore, the concept of moist wound healing is not new. Indeed, it is some 40 years since Winter (31) first published his findings regarding 'keeping a wound moist'. But, even today, there is low use of this moist wound concept in regular wound care practice, albeit at a growing trend. Documentation of moist wound-healing practices varies, depending on location and care setting, but it is generally accepted that less than 50% of chronic wounds receive modern moist wound dressings even when they are appropriate (32).

The main justifications are budget constraints (cost and unavailability) and lack of knowledge, particularly in routine health care providers, the result being that a large number of inappropriate dressings are applied to patients on a routine basis. These are mainly gauze-based dressings, which do little for healing.

The basis for Winter's findings was faster healing, where a plastic cover created a moist environment. Others (33) went on to study this phenomenon in humans and demonstrated not only faster healing but better tissue quality [less scarring (34)] and reduced pain (35).

Dressing manufacturers have been cognisant of these findings for some time, and as a result, an evolutionary development process, through innovation, has provided the comprehensive range of moist interactive dressings available today.

The moist interactive dressings of today work on the same principle. By creating a moist environment, not only do they aid healing, they also soothe nerve endings, minimising or eliminating wound pain, allowing healing to progress more naturally.

During the evolutionary development of these products, manufacturers have become aware of product shortcomings and have designed better product variants. The modern wound care revolution truly began in the late 1980s and early 1990s, with an explosion of products and significant scientific/clinical research around the area of moist healing. It is now routinely accepted among key opinion leaders that moist wound healing has been shown to be superior with respect to wound management, when compared with dry dressings (35–41). This is not solely based on healing but a number of patient- and wound-related factors as presented in the wound bed preparation paradigm (42).

The wound bed preparation paradigm discussed by Sibbald *et al*. (42) involves treating the cause, local wound care and patient-centred concerns (Figure 1). Treating the cause revolves around the correct diagnosis of the wound aetiology. Patient-centred concerns must focus on what the patient sees as the primary reasons for receiving treatment for their wound. Local wound care needs to revolve around the three pillars of local wound care practice: debridement, bacterial balance/prolonged inflammation and moisture balance.

The three key considerations of local wound care, as outlined in Figure 1, are debridement, bacterial balance/prolonged inflammation and moist interactive healing.

Wound debridement can be achieved through different means, namely surgical, autolytic, enzymatic and mechanical (43). A number of factors come into play when choosing an appropriate debridement method (43). Care should be taken regarding the chosen method, as each can have a negative or positive impact on wound pain. More aggressive debridement regimes (e.g. surgical and mechanical) are initially detrimental to healing and more likely to be painful for the patient.

Wound infection (both in the superficial and in deep compartments) and prolonged inflammation can delay healing and may present with similar features clinically. Maintenance of wound bed bacterial balance can be of

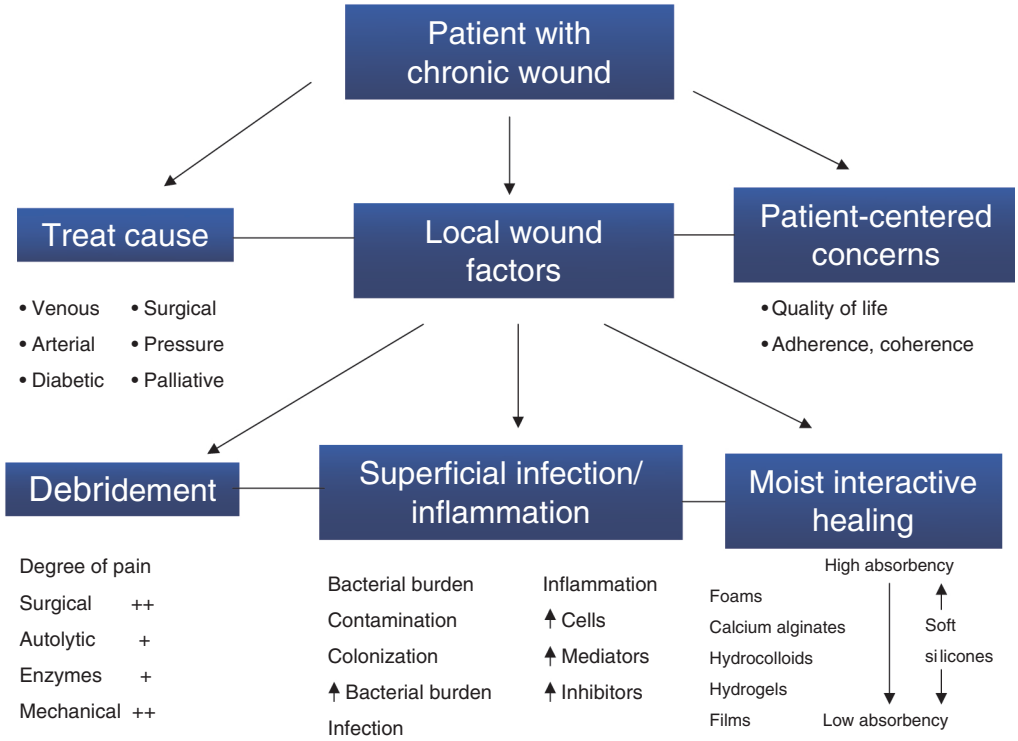

Figure 1. The chronic wound paradigm [adapted from Sibbald *et al.* (42)].

significant benefit in wound management, with increased local bacterial burden leading to the release of pro-inflammatory mediators and modulators of inflammation that result in local pain (44) and delayed healing.

THE HEALING REVOLUTION

The initial moist interactive dressings were polyurethane films that were designed around Winter's initial findings. They simply adhered to the surrounding skin and maintained moisture within the wound environment. These dressings provided some pain relief by preventing dehydration of the wound surface and bathing the exposed nerve endings in physiological wound secretions. The aggressive adhesive, however, sometimes caused trauma upon removal (45), although recently developed removal techniques help to minimise this issue (46). Strong adhesive bonds in these dressings are likely to cause skin tears on removal, unless the adhesive bond is weakened by stretching the dressing laterally and parallel to the wound surface before trying to remove the dressing by gently lifting at a 90° angle above the wound surface. Despite the precautions with removal, their non absorbency continues to be a problem. When fluid accumulates below the surface or leakage channels break the seal to the external environment, bacterial proliferation is facilitated.

Following the limitations of the film dressings, a number of more absorbent moist wound care categories were developed and a plethora of products followed:

- hydrocolloids (47–52) were shown to produce a moist environment by gelling with wound fluid over the wound bed and below the semi-occlusive film covering;
- foams (53–61) provided an easy-to-remove non adhesive contact surface (some newer products contain adhesive surfaces);
- alginates (62,63) transform from a fibre to a gel with wound fluid contact and therefore provide a non stick wound contact surface and a moist wound environment;
- hydrogels (64–73) provided high water content in a gel lattice that rendered them non adherent and soothing and provided the wound with the necessary moisture.

All of these new products were designed with moist wound healing in mind, seeking the 'Holy Grail' of healing. Some products were designed to provide security with regard

Key Points

- initial wound care products based on Winter's findings
- dressings with aggressive adhesive can be problematic
- limitations of earlier dressings lead to the development of superior offerings
- continued development in technology can lead to further advancement in wound care

Key Points

- often product limitations are overcome using combinations of products
- use of combinations makes it difficult to assign 'healing' performance to any single product
- second and third generation products evolve with time
- the ultimate dressing may be skin itself and as a result many biological approaches to healing have been tried
- various biological materials (e.g. collagen) and cell derived materials (e.g. fibroblasts) have been evaluated

to adhesion, while maintaining a moist environment. Other products provide moisture balance by absorbing exudate. Finally, for optimal pain control, products needed to have a non stick, soothing nature (e.g. hydrogels). Continued and more widespread use of these products has provided insight into their advantages as well as their limitations.

Film and hydrocolloid dressings, with their aggressive adhesives, can result in skin stripping of the wound margins, if they are inappropriately removed (74,75). Foams can stick to the wound bed if wound exudation is low or has decreased during use (76).

Some products rely heavily on secondary coverings for retention (e.g. hydrogels), but product combinations can sometimes be detrimental to wound healing. For example, an absorptive secondary covering may remove the hydrogel moisture in the secondary layer and dehydrate the wound bed. On the other hand, if an adhesive film is used over an amorphous hydrogel, the excess moisture delivered to the wound margins can cause maceration and wound deterioration.

Alginates suffer from a combination of the limitations experience by both foam and hydrogel dressings (77). Alginates absorb wound fluid onto their fibres, and if they become supersaturated in their gel transformation, they may cause maceration of the surrounding skin or strikethrough of excess exudate, through any secondary dressing. If a wound is too dry to transform an alginate fibre into a hydrogel-like material, then the wound surface remains dry and the undissolved fibres do not provide moist interactive healing.

These findings led manufacturers to develop second- and third-generation products of existing devices (e.g. better hydrocolloids or foams) (78,79). Several variants of modern dressing classes appeared with wound contact surfaces to reduce adhesion (80). Absorptive fibres (e.g. hydrofibres) (81–86) and next-generation hydrocolloid dressings were developed to minimise adhesion to the wound, increase the absorption and permit painless removal of the dressings (87,88).

These dressings were followed by the development of specialised wound contact materials that were purposely developed for pain management through easy non traumatic removal. Materials were specifically redesigned to have coatings that did not dry out and therefore remained non adherent. The most popular coating is silicone.

Silicones are not new to wound care; indeed, they have been around in the burns area for some 30 years (89,90). The majority of their use has been as non adherent silicone gel sheets for the treatment of burns (91) and in the resolution of hypertrophic scars (92). Silicones provide painless removal (93). These materials have now progressed beyond simple gels and coatings, recently being redeveloped as soft silicone dressing technology.

Soft silicone dressings rely on a hydrophobic soft silicone layer that prevents the dressing from adhering to the wound surface. They do so by maintaining contact without causing friction and shear, thereby reducing the tear force on removal.

The soft silicones are among the first products to be specifically designed for atraumatic removal from the wound and surrounding skin, with a focus on pain management (94). A variety of product variants exist, providing a versatile technology for a number of clinical situations (95).

A BIOLOGICAL APPROACH

More sophisticated biological approaches have been around for the over the 30 years in which the development of advanced wound care has taken place. Such an approach began in the burns area with the use of artificial skin substitutes (96), although these have become significantly more advanced (97–100) with the recent approvals of Dermagraft (101), Apligraf (102) and similar modalities.

Biologically active dressings, based on collagen (103,104), chitosan (105), hyaluronic acid (106,107), peptides (108) and growth factors (109,110), have been developed and evaluated, but most still require pivotal data to substantiate widespread use in beyond-difficult-to-heal wounds. This generally relates to their significant unit cost and the unavailability of good cost-effective data.

Recently, clinicians have seen the reintroduction of maggots into medical practice. This is a novel biological approach to wound debridement and cleansing (111). A number of commercial organisations now make these available in a number of countries.

Recent developments around the antimicrobial dressing's category (112,113) and regenerated cellulose-collagen dressings (114) have given significant focus on the area of metalloproteases and other pro-inflammatory mediators (cytokines/chemokines) in wound healing. Current research into the function of these products is greatly adding to the knowledge in this area.

ALTERNATIVE APPROACHES

Some non dressing approaches to wound healing exist. These generally centre on negative pressure therapy (115,116), hyperbaric oxygen (117), topical oxygen delivery (118) and warm-up therapies (119). Other approaches including transcutaneous electrical nerve stimulation, ultrasound and various skin grafting techniques (e.g. pinch grafts) have also been tried.

Some attempts have been made using systemic drugs to treat recalcitrant wounds (120) but with little success.

THE FUTURE

As knowledge in this area progresses, more sophisticated dressings can and will be developed. However, there is still much to be discovered regarding the healing process itself.

Although new theories and concepts [e.g. wound bed preparation (121)] bring focus to this area of care, significant advances are still required, particularly in the area of wound diagnosis, to allow effective dressings and therapies to be more accurately targeted.

SUMMARY

Wound therapies have evolved significantly over the past three decades, providing more effective and easily used dressings. Technology and product proliferation, however, varies by geography, usually as a function of economics and health care policy.

From the banana-leaf (122,123) and potato-peel (124) approaches of the Third world to the sophisticated hyaluronates (125) and growth factors (126) of the developed world, much has advanced.

Significant opportunity still exists, however. Newer and better technologies can and will be developed. Diagnostic tools and products will become available.

Even today, however, much choice exists, and the choice of a particular product remains a guessing game (127,128).

With the advent of care plans and the increase in clinical knowledge that these newer technologies and products bring to the wound care arena, as caregivers, we are better armed than ever before.

A well thought out local wound care regime, with the appropriate dressing or therapy choice (Table 1) that is patient, wound and disease specific, the healing outcome should be a vast improvement to that seen clinically three decades ago.

The remainder of this review focuses on the development of both dressings and practice from three geographical areas around the globe.

THE DEVELOPMENT OF DRESSING USAGE: AN AUSTRALIAN PERSPECTIVE

The use of wound dressings and wound products has been gradual in Australia, with a rapid increase over the past decade. To fully understand the issues involved, it is important to clarify the health systems in this country as it compares with Europe, USA and Asia.

The health system in Australia

Australia has a universal health system partly funded by a contribution by each taxpayer deducted from his/her weekly salary. This system provides payment of doctors' fees, pathology tests, radiology and other specialist services based on a schedule of fees. Patients are treated by their local general practitioner or by referral to a specialist. If there is a need for medication, this is prescribed by the doctor and dispensed by a pharmacist. The cost of medication is also reimbursed by the government, with the patient making a copayment of a few dollars if on a pension, or a maximum of $23 until a total of approximately $700 is spent; thereafter, the medication is at the concession rate. The list of drugs available is determined by the government on advice from an advisory committee. In general, wound dressings or wounds products such as bandages are not included on the schedule of products made available. The exceptions are some stomal products and a range of wound dressings, bandages and miscellaneous products available to veterans and

Key Points

- recent developments have looked at the area of inflammatory mediation
- other non dressing approaches have also been attempted (e.g. hyperbaric oxygen)
- more sophisticated dressings will be developed in the future
- technology and product proliferation, however, varies by geography, usually as a function of economics and health care policy
- Australia has seen a rapid increase in the use of modern wound care products in the last ten years
- wound dressings are not reimbursed in Australia and, as such, their full cost is borne by the user

Key Points

- many classes of dressings exist, each exhibiting different functions and behaviours
- choice should be based on functionality but must also address patient-centred concerns
- examples of each class are provided but are by no means all encompassing

Table 1 Classes of dressings [adapted from Reddy *et al.* (29)]

	Moisture balance (130)					
Class/category (129)	Donates/absorbs Fluid (131)	Prevents maceration (132)	Debridement (autolytic) (133)	Bacterial balance (134)	Other patient-centred concerns addressed	Examples
Wound contact layers (135)	None	No	No	None	None	Jelonet, NA Dressing, Adaptic, Urgotul
Films (136)	None – ambient moisture levels only	No	Minor – due to occlusion	Minor – due to barrier function (137)	None	Mefilm, Opsite, Tegaderm
Hydrogels (138)	Ability to donate; some have minor ability to absorb	No	High	None specifically, but they do not support bacterial growth. They may be used as vehicle for antibiotics	Generally comforting and soothing during use	Normlgel, Hypergel, Duoderm gel, IntaSite gel, Tegagel, Clearsite
Soft silicones (139)	Absorbency varies from minimal to high, depending on format	Yes	Minor – due to occlusion	None, except when occluded	Atraumatic removal (140)	Mepitel, Mepilex, Mepilex Border, Mepilex Transfer
Hydrocolloids (141)	Moderate absorption	No	High	Minor – due to acidic pH and barrier function (142)	Viral barrier	Duoderm, Tegasorb, Comfeel
Alginates and hydrofibres (143)	Moderate-to-high absorption	Yes	Moderate	None, except when occluded	Generally easily removed	Melgisorb, Kaltostat, Tegagen, Algisite M, Sorbsan, Aquacel
Foams and hydroactives (144)	Moderate-to-high absorption	Yes	Minor – due to occlusion	None, except through occlusion (137)	Cushioning of the wound site	Lyofoam, Allevyn, Tegafoam, Tielle, Biatain, Cutinova Hydro
Antimicrobials (145)	Minimal-to-moderate absorption	Yes	Depends on formulation	High	New formulations more effective	Acticoat, Iodosorb, Aquacel Ag, Actisorb
Collagens (146)	Moderate absorption	Yes	Moderate	None, except when occluded	Provides needed wound factor	Promogran
Hyaluronates (147)	Moderate absorption	Yes	Moderate	None, except when occluded	Provides needed wound factor	Hyalofill
Skin replacements (148)	None	None	None	None	Provides a moist environment but mainly provides needed cells	Biobrane, Dermagraft, Trancyte, Integral, Apligraf, Orcel, OASIS
Growth factors (149)	None	None	None	None	Provides needed wound factor	Regranex
Adjuncts (150)	No	Yes	None	None	Useful for wounds stagnant with dressings	VAC, Warm-up

Key Points

- Australia has a dual hospital system, private and public
- distribution methods within Australia impact use
- pack size also influences availability with the large hospital packs being inappropriate for the community
- the Australian wound care conference circuit began some 11 years ago
- The Australian Wound Management Association has some 2000 members
- the inaugural World Wound Congress held in Australia in 2000

their dependents. The schedule of these products is also determined by the government on advice of a reference committee. The veteran and their dependents are the only group who are able to obtain wound products subsidised by the government; all other patients regardless of their financial status must purchase their products themselves.

This, however, does create a problem for the ongoing use by, in particular, the lower-income groups such as pensioners who may not be in a position to afford the cost of wound dressings and products needed for their treatment. In general, local general practitioners will provide products for dressing wounds when the patient visits their clinic, and while treated in hospital, all products are provided.

Australia has a dual hospital system with public hospitals funded by the various State governments from grants by the federal government and private hospitals operated by various organisations and paid for by the patient or by a health insurance company if the patient has private health cover. Some private hospitals may insist on the patient paying extra to cover the costs of specialised dressings.

Product distribution in Australia

The distribution method for wound products has a strong impact on their use in Australia. Products are, in most cases, distributed directly to hospitals by the manufacturer or agent and via wholesalers to medical practices and pharmacies. Nursing home and special accommodation facilities obtain their supplies from a community pharmacy. The public usually obtain their dressings from one of over 5000 community pharmacies or a limited number of companies who supply treatment aids directly to the public. Apart from veterans and their dependents, all other patients pay for their supplies directly with no reimbursement, refund or tariff system in operation. This impacts on the ability of lower-income groups such as pensioners to continue to use modern wound products.

The other factor that influences availability is pack size. In some cases, manufacturers provide products in pack sizes from 50 to 100, suitable for hospitals or medical practices but excessive for the individual patients. It will be important for greater penetration to occur for pack sizes to be consumer sensitive.

Wound management organisations in Australia

In March 1993, in Perth, Western Australia, during the Inaugural Australian Conference on Wound Care, *Turning Wound Care Upside Down*, a steering committee was convened to oversee the formation of the Australian Wound Management Association (AWMA). The association was formally recognised a year later in Melbourne at the Australian International Wound Management Conference, in March 1994.

The AWMA is a multidisciplinary, non profit association consisting of people who are committed to developing and improving wound management for all individuals through education, research, communication and networks.

The association acts as a parent body to the autonomous state wound management associations in New South Wales, Queensland, South Australia, Tasmania, Victoria, Australian Capital Territory and Western Australia. There are approximately 2000 members from the disciplines of nursing, medicine, pharmacy, podiatry, industry and the sciences. The New Zealand Wound Care Society is an affiliate of AWMA. Membership of the association is either through membership of state associations or directly through AWMA. Corporate membership is also welcomed.

Every second year, the association holds a national wound care conference with valuable assistance from the host state wound care association. On the alternate year, each state association holds a wound care conference.

Primary Intention – The Australian Journal of Wound Management is produced and published by the Association four times a year. The AWMA has forged strong links with other international wound healing societies. The Association hosted the First World Wound Healing Meeting in Melbourne in September 2000. At this meeting, the International Union of Wound Healing Societies was formed.

Guidelines and standards for wound management in Australia

The association aims to improve the community's understanding of wounds and wound management practices, and the association formed a Pressure Ulcer Interest Subcommittee in 1996. This committee has developed guidelines for the prediction and prevention of pressure ulcers.

The topics included in the clinical practice guidelines are:

- staging of pressure ulcers
- risk factors:
  - intensity and duration of pressure
  - tissue tolerance for pressure
  - extrinsic factors
  - intrinsic factors
- risk assessment tools
- skin care:
  - skin assessment
  - skin hygiene
  - skin moisture maintenance
  - maintenance of a suitable skin temperature
  - influence of nutrition on the skin
- mechanical loading and support surfaces:
  - positioning and repositioning
  - eliminating shear and friction
  - reducing heel pressure
  - activity and mobilisation
  - support surfaces
  - basic hospital mattresses
  - foam pressure-reducing devices
  - sheepskins, fibre-filled overlays and gel pads
  - static air mattresses and overlays
  - alternating pressure devices
  - low-air-loss devices
  - high-air-loss or air-fluidised beds
  - turning beds
  - evaluating support surfaces
  - selecting a support surface
- documentation
- summary of pressure ulcer preventative strategies.

The clinical practice guidelines are available in three forms: the full text, an abridged version and a pocket guide. They have been widely distributed around the country, and the full text version is available on the AWMA website (http://www.awma.com.au).

In 2002, the association also published standards for wound management.

The standards cover a broad range of practices:

Collaborative practice and interdisciplinary care

The optimal healing of the individual with a wound or potential wound is promoted by a collaborative and interdisciplinary approach to wound management.

Professional practice

The safety and wound healing potential of the individual is ensured by clinical practice in wound management that respects and complies with legislation, codes of practice, clinical practice guidelines and organisational policies.

Clinical decision-making in wound management

The optimal healing of the individual with a wound is facilitated by an ongoing process of clinical decision-making in order to determine the risk of wounding, wound aetiology and wound healing responses.

Best practice in wound healing

Wound management is practised according to the best available evidence for optimising healing in acute or chronic wounds.

Documentation

Documentation in the individual's record or management plan must facilitate communication and continuity of care between interdisciplinary team members and fulfil legal requirements.

Education

Education of individuals and their carers should facilitate better health care seeking behaviours. The clinician maximises opportunities for advancing self-knowledge and skills in wound management.

Research

Wound healing is a dynamic process, and the clinician must anticipate that wound management practice will change as new scientific evidence becomes available.

Education

One of the most important and significant influences of practice has been the level of education of health professionals in Australia. Wound management is part of the undergraduate training, to some extent, in medicine, pharmacy, nursing, podiatry and veterinary science. Over the past 10–15 years, a number of training courses, mostly short courses, have become available. The interest is growing in seminars, tutorials, training days and conferences with many opportunities for health professionals to participate.

Postgraduate training and courses are available in particular for nurses with Masters of

Key Points

- national guideline development began in 1996 with the formation of a pressure ulcer interest group
- in 2002 the AWMA published standards for wound management
- the standards covered interdisciplinary approach, education, documentation and more
- education was recognised as a specific influencer of practice by the development and launch of postgraduate training courses
- a Masters of Clinical Nursing specialising in wound management exists today

Key Points

- modern wound management is well accepted and developed in Australia
- a wide range of dressings are available in Australia
- there is still considerable room for improvement
- Canada has a socialised medicine system
- Canadian health care system is changing, however, with some medical products being delisted e.g. wound care products
- Canada has had a national wound care organisation since 1995 – the CAWC

Clinical Nursing specialising in wound management from University of Central Queensland. Monash University in Melbourne has a range of postgraduate courses including graduate certificate, graduate diploma and masters, all delivered by distance education.

Overview

Modern wound management practice has been well accepted in Australia and, compared with many other countries, is well developed. There are a number of multidisciplinary wound clinics in Australia and research centres undertaking basic and clinical research.

A wide range of dressings are available in Australia. There is still wide use of the simple inert non stick dressings and modern gauze based dressings.

Moist wound products available for use include:

- film dressings
- hydrocolloid dressings
- hydroactive dressings
- alginate dressings
- foam dressings
- hydrogel dressings.

In addition, a number of miscellaneous products are available, for example:

- cadexomer iodine dressings
- various silver dressings
- hypertonic saline dressings
- silicone dressings
- topical zinc
- charcoal odour absorbing dressings.

The use of bandages and compression stockings is also well established, including the use of multilayer systems.

In general, wound management practice is moving forward steadily and will increase as practitioners gain more experience with modern products. There is still, however, considerable room for improvement, and this will be achieved by education, good communication between health professionals and governmental support of modern wound management practice.

WOUND DRESSINGS: A CANADIAN APPROACH

The Canadian health care system

Canada is a large, unique and diverse country, of 31·6 million people, divided among 13 provinces and territories. Each province or territory has its own size (from 29 000 in Nunavut to 12 million in Ontario) and personality based on economics, cultural blend, resources, etc. (151).

Canada is known for its socialised medicine, which had its origins under the Canadian constitution, where the federal government was required to fund health care, and the provinces were delegated jurisdiction in the delivery of health care (152). However, many do not realise how much Canada has changed in its approach to health care over the last decade. The current national health system (Health Canada) began in the late 1950s, with a system of publicly funded hospital insurance, and completed in the late 1960s and early 1970s when comprehensive health insurance was put into place. The federal government finances about 40% of the costs, provided the provinces set up a system satisfying federal norms. The Canadian Health and Social Transfer Fund (post-secondary education, social welfare programmes and health) gives the provinces a lump sum, and the provinces can allocate the money according to the provinces' needs (153,154). All provincial systems are, thus, very similar, but to further identify the regional needs within each province or territory, multiple health regions have been created within the province or territory that are guided by their own board to deliver health care in the most effective way based on their regional needs. In recent years, the health care in Canada has been changing with the Canadian government delisting previously covered services and rationing of care. Wound care is an example for that change, with some provinces paying for the cost of wound care services and dressings, while some do not.

Canadian wound care practice

Canada has had a national wound care organisation since 1995 – the Canadian Association of Wound Care (CAWC). The CAWC is dedicated to the advancement of wound care in Canada by coordinating a collaborative, interdisciplinary effort among individuals and organisations involved with wound caring. The association's efforts are focused on five key areas: public policy, clinical practice, education, research and connecting with the international wound care community. The CAWC works to significantly improve patient care,

clinical outcomes and the professional satisfaction of wound care clinicians (155).

In 2000/2001, the CAWC published four pivotal articles to guide and support best practice in Canada. These articles, recently translated into French, are available in full text version on the CAWC website (http://www.cawc.net). This resource and their accompanying quick reference guides assist the health care professional in addressing patient-specific concerns that support wound healing. The CAWC has also introduced a new publication *Wound Care Canada* that is dual language (French–English) and is also fully downloadable online.

Clinical enablers

Preparing the wound bed has been recently reviewed (44), which led to a modification in the wound-healing paradigm including the epidermal edge effect to demonstrate healing of the wound (156). This paradigm supports the clinician, in not only best practice for wound management from a holistic perspective but supports dressing selection based on the guiding-practice principles of wound management: wound aetiology, patient-centred concerns and local wound care requirements (debridement requirements, infection control and moisture balance).

The CAWC has developed a longitudinal approach to wound care education with basic knowledge, skill and attitude development programme in a three-part seminar series. This programme is offered yearly at various sites across Canada to all health care professionals in both English and French.

Canada is also fortunate to have a university-based wound care programme, the International Interdisciplinary Wound Care Course (IIWCC), offered by University of Toronto that supports wound care knowledge development (157,158).

By seeding not only our country with wound care leaders, but others, we support bedside clinicians in making best practice recommendations for wound management.

Bedside practice

A brief questionnaire was sent out to wound care experts (nurses) across Canada (British Columbia to Newfoundland) in an effort to understand regional differences in wound dressing practice.

1 Does your health region pay for wound care dressings in acute care, in community care and in long-term care?
2 Who decides which dressing to use?

Acute care

It was clear by the responses that all hospitals covered the cost of dressings while the patients were in the hospital, and some had a form of high-cost dressing control or review in place for some products (i.e. VAC or biologicals).

Home care

Caring for wounds in patients who had been discharged home for community-based care was a bit different but still rang with similarities. Some regions had all dressings paid for regardless of where the care occurred, but the most common response was, as always in wound care, 'it depends!' Many provinces have a government programme that assists with the coverage of dressings for chronic wounds. Some provinces have a cost-of-living benchmark that assists low-economic patients with the cost of dressings.

Care centres

Because care centres (nursing homes and long-term care facilities) are often privately owned, there was less consistency. Some provided dressings to their residents but most seemed to look at insurance plans and families to cover costs. Some regions have programmes to support treatment that has been initiated by a wound specialist.

Who selects the dressing?

The nurse (wound care nurse or enterostomal therapist) was the most often mentioned clinician that selected the dressing; however, for surgical wounds, the surgeon was frequently mentioned. Many mentioned skilled teams that supported best practice through their skilled interventions. Care centres often relied on doctors and registered nurses for guidance. One factor that was important with dressing selection was agency inventories and product contracts; the ordering clinician needs to be aware of what is available.

Just as there is no such thing as 'one dressing for all wounds', there is no such thing as 'one way to obtain and prescribe a dressing for a wound'. Canada is a large and diverse

Key Points

- CAWC responsible for guideline and standards development
- CAWC publishes material in both English and French
- CAWC heavily involved in education
- Canada has a formal education qualification provided by the University of Toronto – the International Interdisciplinary Wound Care Course (IIWCC)
- in Canada dressing selection was mainly undertaken by nurses
- in Canada selection is influenced by facility inventory and contracts

Key Points

- dressing revolution in Japan led by ConvaTec with the launch of their hydrocolloid dressing in 1987
- at present there are seven types of modern dressings currently used in Japan
- 44% of chronic wound sufferers are still treated with gauze dressings
- some 70–80% of modern dressings used for pressure ulcers
- an ageing population and increasing number of pressure ulcers has led to a steady increase in medical costs
- Ministry of Health, Labour & Welfare has levied a penalty on hospitals that fail to establish appropriate treatment and prevention programs

country with a variety of regionally specific needs, and each region addresses its wound-related concerns according to its abilities.

Summary of the Canadian approach

It is good to remember that dressing is only one part of a complex treatment plan required to heal a wound. However, that one aspect of our wound care practice remains complicated with the ever-increasing variety of wound care products. How do clinicians choose the correct dressing? This is the question many health care professionals want the answer to. Most dressings fall into a category that describes its benefits, indications and contra-indications, and it is up to the wound clinicians to not only select the best product for our patient but to teach other clinicians the cost-effective use of wound care dressings (159).

Education needs to revolve not only around the wound-healing paradigm, removing the cause and patient centred concerns, but also around regional wound care practices and resources in order to give clinicians a framework for best practice in wound care.

THE DEVELOPMENT OF DRESSING USAGE AND WOUND CARE GUIDELINES IN JAPAN

Introduction of modern dressings

Prior to the introduction of a moist-environment-type dressing in 1987 by ConvaTec (a Bristol-Myers Squibb Company), basic wound care involved the use of an antiseptic cleanser where the professionals' main objectives were to prevent infection and keep the wound dry to promote epithelialisation. Thus, the introduction of a hydrocolloid modern dressing (Duoactive or DuoDERM Varishesive, Granuflex) that provided a moist environment for wound healing sent reverberations throughout the medical community in Japan.

Impressed by the initial results, the enterostomal therapist (ET) nurses revolutionised the use of a moist or 'modern' dressing in Japan. This spurred on competition by other companies to introduce new types of modern dressings to Japan to meet the growing demand.

Polyurethane film dressings first received approval as an official medical supply for use in Japan in 1992. Subsequently, several dressing types followed, starting with alginate dressings in 1993, hydrogel dressings in 1995, polyurethane foam dressings in 1996, sulfadiazine silver-lined dressings in 1997 and hydrofibre and hydropolymer dressings in 2000. At present, there are seven types of modern dressings currently used in Japan.

Modern dressings market

Uniquely characteristic to the Japanese market is that 44% of most of the chronic wound patients are still treated with gauze dressings, compared with only 16% who are treated with modern dressings.

The modern dressings market has been increasing yearly from $24·2 million in 1994 to $41·8 million in 2003 (exchange rate based on 1 US dollar = 110 yen). Some 70–80% of modern dressings are used for pressure ulcer treatment, with less than 10% being used for diabetic foot and venous ulcer patients. This ratio is the same as the chronic wound demographics in Japan.

Hereafter, all data will accordingly focus on pressure ulcers as the predominant group.

Actual conditions of modern dressing usage for pressure ulcers

Pressure ulcer care penalty system

The population of Japan's ageing society has reached an unprecedented number, and according to estimates, one-quarter of the population will be 65 years of age, or older, by 2015. Along with an ageing society, the ratio of bedfast patients is also rapidly increasing to the point where in 2000, 13·0% of this demographic group were bedfast. The occurrence of pressure ulcers in a hospital setting is 4–9%, and 14% in a home setting has been reported. The fact that 70% are reported to be stage III or IV [National Pressure Ulcer Advisory Panel (NPUAP) classification] has led to a steady increase in pressure ulcer and medical treatment costs.

The concern over pressure ulcers has reached a level where the Ministry of Health, Labour and Welfare has introduced a penalty that is levied on hospitals that fail to comply with the recently implemented legislation that requires all hospitals to meet the following criteria based on risk assessment, wound assessment and treatment:

- to establish a team of pressure ulcer specialists to prevent and treat pressure ulcers;
- to establish a risk and wound assessment and management protocol for pressure ulcers;

Key Points

- products are reimbursed
- type of dressing covered by reimbursement is determined by the depth of the pressure ulcer
- usage is limited to three weeks at present. After this time the patient must cover the full costs of their dressings
- nearly 80% of Japanese facilities use modern wound care products
- guidelines for treatment and prevention of pressure ulcers put in place in 1998
- guideline based on colour of wound
- in Japan wound dressings handled as prescription materials
- Japan has progressed rapidly regarding modern dressings but significant development opportunities remain

- to provide adequate support surfaces for pressure ulcer patients.

This legislation came into effect as of 1 October 2002, where hospitals that do not meet the above criteria, five points [55 cents (exchange rate based on 1 US dollar = 110 yen)] per patient will be excluded from the basic admittance insurance coverage that the hospital can claim. For example, this will amount to approximately $165 000 (exchange rate based on 1 US dollar = 110 yen) per year of lost revenue for an 800-bed hospital.

Modern dressings and the insurance system

As of 1 April 2001, the cost of modern dressings, covered by the insurance system, which could be invoiced for reimbursement, was standardised nationwide. This reimbursement fee depends upon the amount of dressing used for the category of 'Dressing for Skin Breakdown' declared by the companies selling the dressings.

The type of dressing that the insurance system covers is determined by the depth of the pressure ulcer. The period in which the insurance covers the dressings is also an additional problem. At present, it is limited to only 3 weeks, after which the users must cover the full cost themselves.

Current use of modern dressings

In 1999, Ohura *et al*. (160) conducted a national survey to determine the extent of use of modern dressings in Japan. According to their findings, 159 of the 205 (78%) facilities that participated in the study used modern dressings.

Of all the modern dressings used, hydrocolloid dressings were the most widely used (all 159 facilities). Second were the polyurethane film dressings, used in 134 facilities, followed by alginate dressings that were used in 80 facilities, with hydrogel dressings being used in 24 facilities and polyurethane foam dressings in 19 facilities. From these results, it was found that hydrocolloid dressings, which were the first modern dressing to be introduced in Japan, were used by all the facilities surveyed (160).

Modern dressing and the national guideline

In 1998, the Ministry of Health and Welfare created a pressure ulcer prevention and treatment guideline (161). This guideline was developed by a panel of expert opinions based on their experience and not scientific-based evidence. In this guideline, the proper selection and use of dressings are classified by the colour of the wound.

Developed by Fukui (162) in 1993, this colour system separately categorises shallow and deep pressure ulcers and classifies the healing process into four phases. The colour of a wound from an acute condition progressively changes from black-to-yellow to red-to-white phase.

According to the guideline, modern dressings are recommended for shallow pressure ulcers and deep pressure ulcers in the red-to-white phase. However, at present, there are no detailed selection standard criteria.

Modern dressings and prescription authority

In Japan, dressings are handled as prescription materials and can only be prescribed by physicians. In 1998, a survey conducted by Ohura *et al*. (163) revealed that pressure ulcer treatment is handled 40% by nurses, 40% by physicians and nurses and 7% by physicians only, and the remainder by others.

The actual state of the situation is that although the nurses do not have the authority to write prescriptions, they select most of the dressings to be used for the patients and the physicians only write the prescription.

Future outlook

Although the history of modern dressings in Japan is a mere 20 years old, 79% of the facilities began using them within the first 10 years after their introduction, and its demand still remains high.

However, concerning pressure ulcer, these dressings that have been introduced face the following problems:

- Insurance plan only covers it for 3 weeks. Thus, stage III or IV pressure ulcers cannot receive full coverage, as they normally take 6 months to 1 year to heal.
- Nurses only select dressings and do not have the authority to issue prescriptions. This authority still remains the physicians' sole responsibility.
- In Japan, owing to strict standards implemented by the government, at present, there are no modern dressings that are

effective for treating infected wounds. As a result, traditional topical ointments must be used in combination with gauze during the entire healing period.
- We do not have adequate guidelines for pressure ulcer dressing usage. The present guideline is a based upon a panel of expert opinions and does not necessarily use the best scientific-based evidence.

Recent studies and approaches have been developed to rectify this situation. In order to promote the proper use of modern dressing, Sanada *et al*. (164) performed a cost-effectiveness analysis between traditional topical ointments with gauze and modern dressing.

The results provide evidence that for stage II and stage III pressure ulcers, there was a significant reduction in the overall cost of treatment using modern dressings.

Based on this evidence, the Japanese Society of Pressure Ulcers, realising the need to ease the modern dressing restrictions, submitted a petition to the Ministry of Health, Labour and Welfare.

The society also increased the courses to educate nurses to become wound care specialists and is currently revising the national guideline using scientific-based evidence.

CONCLUSION

Wound care dressings and practice are slowly but surely becoming a global practice. Technologies and practice do change – but change takes time! This review has provided insight into the development of three different geographical areas, with three different health care systems, but the ultimate outcome remains the same, that is the proliferation of moist wound healing and best practice.

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Key Points

- Japanese Society of Pressure Ulcers petitioned the Japanese government regarding easing modern dressings restrictions
- Society has also developed a number of education courses
- moist wound healing is slowly but surely becoming a global practice

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