The effective management of exudate is recognised as an essential element in wound care. An optimal moist environment needs to be created and the surrounding skin protected from the risk of maceration and subsequent risk of infection. In order to achieve this, clinicians will require a clear understanding of the underlying wound aetiology and exudate production.

Recent years have seen the development of modern absorbent dressings, as opposed to the traditional gauze and absorbent pads (Queen, 2010). Many dressings now have the capacity to absorb large volumes of exudate; this is their primary function, rather than the management of exudate production. Foam dressings are also considered to be absorbent. Where exudate levels exceed the absorbency capacity of such dressings, however, subsequent peri-wound maceration has been a resulting complication (Queen, 2010).

Exudate management

Unresolved exudate can cause significant pain and discomfort, leading to complicated wound healing. Its overall negative impact on the patient's quality of life is severe (Cutting, 1999). Patients often experience anxiety, fear and social isolation due to the malodorous, unmanageable leakage from wound dressings (Tadej, 2009; Gebhardt et al, 2010).

Most frequently, chronic wounds are associated with moderate-to-high exudate levels and non-healing (Thomas, 2008). Within the UK, it is estimated that 200,000 patients have a chronic wound, resulting in costs of £2.3–£3.1 billion per year, which equates to approximately 3% of NHS expenditure (Posnett and Franks, 2007). The introduction of Commissioning for Quality, Innovation, Productivity and Prevention in healthcare (QIPP) and the Harm Free Care agenda encompass the ethos of improving patient care, while ensuring quality treatment and preventing patient harm (NHS Institute for Innovation and Improvement, 2009; Department of Health (DH), 2010). It can be argued that these current health drivers are vital prerequisites for the delivery of high-quality, effective care; however, the achievement of these national targets are currently challenged by severe economic pressures to reduce spending within the NHS by before 2015 (DH, 2011). In line with the Government agenda, in particular the Harm Free Care agenda, all clinicians have a responsibility to manage exudate effectively, therefore reducing the occurrence of harm (DH, 2009).

Clinical challenges

Clinicians face many wound management challenges every day. These may include:

- Retaining and controlling exudate levels to prevent maceration (World Union of Wound Healing Societies [WUWHS], 2007)
- Removing harmful bacteria and enzymes from the wound to reduce instances of delayed healing (WUWHS, 2007)
- Minimising patient pain and discomfort during dressing changes or when dressing is in situ (WUWHS, 2007)
- Containing costs while providing effective care.

Effective exudate management can reduce the aforementioned challenges. A clear understanding of its role, importance and position in effective wound healing is crucial for health professionals. This will enable clinicians to clearly identify any changes from the natural process of exudate production and ensure effective objectives are set in place to prevent complications due to poorly managed wound exudate.

Clinicians must also have an appreciation of the importance of exudate; the production of wound exudate is a natural part of the wound-healing continuum and is necessary to promote moist wound healing (Winter, 1962; Cutting, 2003). It facilitates the migration of vital tissue-repairing cells and provides essential growth factors and

Effective management of exudate with AQUACEL Extra

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The management of patients with highly-exuding wounds can often lead to the use of unreliable and costly treatments. Patients are frequently found to be at increased risk of infection and delayed healing, which results in a huge negative impact on their quality of life. In the political and health arena, reducing health-care costs yet maintaining high quality and productivity is high on the list. With current economic, health-care and political targets, it is crucial to address the importance of effective wound management, particularly the importance of managing exudate. Inappropriate management of wound exudate can lead to prolonged wound healing, peri-wound maceration and excoriation, and can result in deterioration of the wound.

KEY WORDS
- Exudate management
- Hydrofiber technology
- Wound dressings

ABSTRACT
The management of patients with highly-exuding wounds can often lead to the use of unreliable and costly treatments. Patients are frequently found to be at increased risk of infection and delayed healing, which results in a huge negative impact on their quality of life. In the political and health arena, reducing health-care costs yet maintaining high quality and productivity is high on the list. With current economic, health-care and political targets, it is crucial to address the importance of effective wound management, particularly the importance of managing exudate. Inappropriate management of wound exudate can lead to prolonged wound healing, peri-wound maceration and excoriation, and can result in deterioration of the wound.
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nutrients essential for wound healing (White and Cutting, 2006). Exudate facilitates wound bed autolysis of dead or devitalised tissue and transports essential cell-metabolising nutrients, growth factors and immune cells (WUWHS, 2007). Effective management of wound exudate can lead to improved patient outcomes relating to:

- Reduced peri-wound maceration
- Reduced bacterial burden on the wound bed
- Promotion of rapid granulation from the wound’s base.

Such management leads to an improved quality of life for the patient and clinical cost-effectiveness (WUWHS, 2007). In non-healing chronic wounds, excessive amounts of exudate are thought to prolong the inflammatory phase, impede growth factor availability and prevent or delay cell proliferation (WUWHS, 2007). Proteolytic activity is increased and this will increase the risk of infection. If wound exudate levels increase and are not effectively managed, the wound bed will become overhydrated, leading to excessive moisture forming on the peri-wound skin. This moisture, if not managed by an effective wound dressing, can lead to maceration to the skin and further tissue damage. The proteolytic enzymes and waste products within the exudate will also lead to skin stripping/excoriation and an increased risk of bacterial critical colonisation or infection (Cutting, 2002; Fletcher, 2002). In addition, unresolved exudate management in chronic wounds can lead to increased levels of certain matrix metalloproteinases, which can result in delayed wound healing (WUWHS, 2007).

Poor management of exudate levels can also lead to increased demands on the clinician’s time and resources. It can often result in daily or even twice-daily dressing changes, thus increasing costs, which have to be minimised in our healthcare climate (DH, 2009).

In contrast, however, clinicians must be aware that a wound bed with low levels of exudate managed with highly absorbent dressings can produce cell desiccation, dryness of the wound bed and delay wound healing (Dowsett and Newton, 2005). This can lead to dressing adhering to the wound bed, resulting in increased pain and discomfort to the patient, impacting on concordance and increasing the difficulty of dressing removal for the clinician. To achieve effective exudate management, clinicians must go through the following processes (Thomas, 2008):

- Identify any underlying causes of excessive exudate, such as infection, oedema or underlying medical conditions (e.g. heart failure or lymphoedema)
- Assess the patient’s health, physically and psychologically, and the impact of the wound on his/her quality life
- Make an accurate and frequent wound assessment to ensure an optimum wound-healing environment
- Prevent wound bed desiccation or overhydration by maintaining effective wound bed moisture
- Prevent peri-wound skin maceration and or excoriation.

Dressing selection and mode of action

Wound dressing selection should be tailored to the condition of the wound and peri-wound skin. The prudent selection and careful determination of wear time are also important. Thomas (2008) identified the following as some of the key characteristics of effective wound dressings:

- Absorbs and retains exudate
- Keeps harmful exudate away from healthy intact skin
- Performs effectively, even when used underneath compression therapy
- Is non-traumatic upon removal
- Is effective in both cold and warm time.

When effectively managing wound exudate, the clinician must be knowledgeable of the dressing’s fluid-handling mechanisms. This may be through the dressing’s absorptive ability, fluid retention activity or moisture vapour properties. Certain dressings may facilitate absorption through a gelling action, where the exudate interacts with the dressing material to form a gel (Thomas and Frum, 2001). The dressing material should absorb the fluid directly above the wound without ‘lateral wicking’. Such dressings have been demonstrated to be clinically and cost-effective in exudate management (Armstrong and Ruckley 1997; Guest et al, 2005).

Dressings that enable moisture vapour transmission are designed to absorb fluid and move it away from the wound bed and peri-wound skin interface, locking it in a permeable backing layer. A portion of the fluid is lost to the atmosphere by evaporation, which is known as moisture vapour transmission (White and Cutting, 2006). Wound dressings designed for exudate management may consist of polyurethane foam, alginate fibres and carboxymethylcellulose. More recently, new superabsorbent dressings have emerged that are designed to control large volumes of exudate (White and Cutting, 2006).

Practical challenges facing clinicians when using dressings designed for exudate management include their ability to contour to the wound bed. Effective contact with the wound bed will reduce the dead space between the two (Rogers and Chen, 2003) This will in turn assist in the reduction of potential bacterial proliferation and risk of infection. Its conformability properties will also enhance the wear time of the dressing and increase acceptability to the patient. A dressing that poorly conforms to the skin and fails to remain in situ can often lead to reduced concordance, both from the patient and the clinician (White and Cutting, 2006). It is also imperative that wound management products address the level of wound exudate, enhance patient comfort and be suitable for the type of tissue present (Wounds UK, 2010).

As already highlighted, poorly managed exudate levels can be distressing for the patient, causing tissue damage and reducing quality of life. Inappropriate wound management and dressing selection can also contribute to the problem and lead to delayed healing.

Hydrofiber technology

In recent years, the emergence of Hydrofiber technology in wound care has been of significant importance. It is available as a soft, sterile, non-woven sheet or ribbon.
dressing composed of sodium carboxymethylcellulose (Queen, 2010). The material is extremely conformable and is able to absorb a large amount of wound fluid, such as exudate with bacteria. The fluid is then transformed into a soft gel, creating a moist environment for the wound-healing process (Queen, 2010). The gel formation also assists in autolytic debridement of non-viable tissue within the wound. Hydrofiber technology is versatile and can be incorporated into a variety of dressing formats (Thomas, 2010).

Clinical evidence
Hydrofiber technology can be used in moderately-to-highly exuding chronic and acute wounds. A key feature of Hydrofiber dressings is their ability to absorb and lock in wound fluid (Dowsett, 2008). This means that wound exudate and any pathogenic bacteria that may contain is removed from the wound bed and peri-wound area, providing protection from potential maceration (Robinson, 2000; Coutts and Sibbald, 2005; Dowsett, 2008) and passive infection control (Bowler et al, 1999). Furthermore, this action can minimise the release of bacteria into the air on dressing removal (Dowsett, 2008). This unique ‘locking in’ action makes dressings using Hydrofiber technology more effective at retaining fluid than traditional gauze or alginate dressings (Collado, 2002). The Hydrofiber technology also allows dressings to conform to the micro-contour of the wound bed. (Convatec 2010). This minimises the ‘dead space’ where bacteria can grow (Hoekstra et al, 2002) and maintains an optimal moisture balance in the wound bed (Bishop et al, 2003).

Hydrofiber dressings absorb wound fluid to form a cohesive gel. The unique gelling action assists with wound autolysis, protects tender wound tissue and minimises pain associated with dressing changes (Waring and Parsons, 2000; Barnea et al, 2004; Kogan et al, 2004). It also enables such dressings to respond to different wound conditions. For example, in acute healing wounds, this creates a moist wound environment (Bishop et al, 2003); whereas in chronic wounds it maintains a moisture balance, ensuring the wound is neither too wet nor too dry (Hoekstra et al, 2002; Bishop et al, 2003).

The use of AQUACEL (Convatec Inc.) dressing is supported by 15 years of clinical experience demonstrating efficacy. There are 20 randomised controlled trials, 80+ review papers as well as scientific studies that have demonstrated evidence of wound progression toward healing (Brunner and Euberlein, 2000; Barnea et al, 2004; Ravenscroft, 2006). It is also shown to be a cost-reducing adjunct to a protocol of care (Moore and Foster, 2000; Harding et al, 2001; Dillon et al, 2007).

The newly-introduced AQUACEL Extra (Convatec Inc.) dressing is designed to provide additional benefits relating to extra strength; it is nine times stronger and has 39% greater absorbency than AQUACEL (Convatec, 2011). This, in turn, helps to facilitate easy removal, increase patient comfort during dressing changes, manage moderate-to-highly exuding wounds, and enhance dressing efficiencies (Convatec, 2011).

AQUACEL Hydrofiber (Convatec Inc.) was already included in Shropshire County’s wound care formulary; it had proved extremely effective in assisting with autolytic debridement of wounds, facilitated a moist wound environment and assisted with wound exudate control. Interestingly, however, in clinical practice where exudate levels were moderate-to-high, several layers of the Hydrofiber were frequently used.

An evaluation of AQUACEL Extra was undertaken by the author to evaluate its properties when addressing problems associated with poor exudate management, its impact on the patient’s quality of life and its clinical effectiveness alongside its cost-effectiveness.

Clinical experience with AQUACEL Extra
Patient 1
Mr A is a 47-year-old man who, following surgery for a perianal cyst 6 years ago, still had a non-healing cavity. He was an obese man, whose weight problems were further exacerbated by being unable to exercise due to the chronic wound. Despite being under the care of his GP and a consultant, he was informed that he may have to ‘live with this wound’. He was referred to the tissue viability service by a television company that was filming his plight with this chronic and embarrassing condition. This patient’s quality of life had been dramatically affected, from embarrassment to the loss of masculinity.

The clinical wound care objectives in this case were to:
- Effectively manage the exudate
- Reduce peri-wound maceration
- Reduce the bacterial burden on the wound
- Promote rapid granulation from the base of the wound upwards.

The wound
On initial assessment, the patient’s wound was filled with 100% slough and the peri-wound skin was excoriated and inflamed. The treatment being used was a simple, low-adherent dressing and pad. This was being changed up to three times per day due to the high levels of exudate (see Figure 1). Mr A had previously used super-absorbent dressings, but these proved unsuccessful as they were difficult to secure and he also reported they felt ‘stiff and uncomfortable’.

On examination, the wound bed was showing clinical signs of critical colonisation and high exudate levels. For this reason, AQUACEL Ag (Convatec Inc.) was used to pack the cavity and AQUACEL Extra laid on top of the wound to assist with management of the exudate levels and peri-wound skin excoriation and breakdown. It was necessary to apply Cavilon barrier foam to the gluteal cleft that was excoriated by the excessive moisture. A secondary dressing of Mepilex Border was also used.
Results
Following 24 hours of treatment, the patient reported that the wound dressing did not ‘leak’ and that it ‘felt comfortable’. On dressing change, it was clear that the AQUACEL Extra dressing had retained the exudate and that the peri-wound excoriation was resolving. Four days after initiating this treatment, there was no longer any need to apply Cavilon barrier foam to the gluteal cleft. After a further ten days of treatment (see Figure 2), the AQUACEL Extra dressing was changed to AQUACEL dressing, as the wound exudate levels had become low-to-moderate. The wound tissue was now 100% granulation and the wound had decreased in size by 50%. Dressing change could now be performed every third day. Most importantly, the patient reported positive psychological and social results, increased comfort, no pain on dressing change and increased self-esteem, as in his words ‘I do not have to worry about the risk of discharge running down my leg’.

Three months after commencing treatment with AQUACEL the patient’s wound was completely healed (see Figure 3), something that had not occurred for 6 years.

Discussion
AQUACEL Ag dressing, in conjunction with AQUACELExtra, was the ideal choice for the management of this wound. Due to the broad spectrum and sustained antimicrobial activity of AQUACEL Ag dressing during the wear time, and the increased absorbency and extra strength of the AQUACEL Extra, the following was achieved:

- Exudate levels were effectively managed.
- The frequency of dressing changes was reduced
- Excoriation to the peri-wound skin and gluteal cleft was resolved
- The patient did not experience any pain during or after his dressing change, and his quality of life was dramatically improved
- The dressing remained in place and was easily removed on dressing change
- A moist wound environment and autolytic debridement was achieved
- The wound size was reduced, leading to complete healing.

Patient 2
Mrs D is a 74-year-old woman who underwent abdominal surgery for endometrial cancer. Unfortunately, this procedure was followed by abdominal dehiscence due to infection. After 4 weeks of topical negative pressure therapy, the open abdominal wound was at a stage to receive daily packing (see Figure 4).

The woman was obese and had a large abdominal pannus. She also had diabetes, which was controlled with oral medication. Her nutritional status was compromised due to her reduced appetite following surgery.

Wound-related problems
The exudate levels were high, and the peri-wound skin and skin surrounding the abdominal pannus was red and excoriated. Management of the high exudate levels was proving to be problematic for the nurses despite a superabsorbent secondary dressing. The dressing was being changed daily, but there was still a problem with exudate strikethrough. AQUACEL was the primary dressing choice and several layers were applied to increase absorbency.

The overall aims of treatment were to provide continued granulation tissue production while reducing exudate strikethrough. It was also important to provide a moist wound environment and to manage patient discomfort.
wound environment while protecting the peri-wound area, and to prevent the need for the use of several layers of a Hydrofiber dressing. Finally, it was imperative to reduce excoriation of the peri-wound area and the abdominal pannus while ensuring non-adherence and pain-free dressing change. Importantly, the clinicians needed to achieve this with cost-effectiveness in mind.

Clinical management
Before the AQUACEL Extra evaluation, the patient's abdomen was dressed daily with AQUACEL and a superabsorbent secondary dressing (Flivasorb). Despite the daily dressings, there was still exudate strikethrough to the secondary absorbent pad. Due to the high levels of exudate, barrier foam was applied to the peri-wound skin and the abdominal pannus. This was to treat the excoriation of the skin and to prevent further tissue breakdown. AQUACEL was used to promote the production of granulation tissue; however, district nurses were applying two to three layers to assist with absorbency. This resulted in increased dressing costs. The patient complained of pain on dressing change and was also extremely distressed with the soiling of clothing and bed clothes from the exudate strikethrough.

Treatment regimen
AQUACEL Extra was commenced and the dressings were applied daily. Following only 4 days of treatment, there was no strikethrough. The granulation tissue continued to be present and most importantly the excoriated skin was now greatly improved. Only one layer of the AQUACEL Extra was required and it not only provided increased management of exudates, but also maintained its shape and strength within the wound bed. The patient has seen the difference in her surrounding skin (see Figure 5) and reported that it no longer felt painful and sore. Most importantly, she was now confident to socialise outside her home as she no longer had to worry about stained clothing and, ultimately, the risk of embarrassment.

Final clinical outcomes
There was no longer the need to use more than one layer of Hydrofiber dressing. The number of dressing changes had decreased. Most importantly, the woman's peri-wound and abdominal pannus excoriation had resolved and the wound bed continued to improve and decrease in size (see Figure 6). From the aspect of the patient's quality of life, she experienced no pain on dressing change. Clinicians found that the dressing was easily applied and removed, and was cost-effective.
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ulcer (European Pressure Ulcer Advisory Panel, 2009). The wound bed was 4 cm in depth and showed evidence of yellow discolouration, slough and some granulation tissue (see Figure 7).

Wound-related problems
The patient presented with high levels of exudate, which led to daily packing of the cavity with AQUACEL Hydrofiber and Mepilex foam dressings. The high levels of exudate were not always retained within the dressing and, on occasion, the wound had to be redressed twice-daily, resulting in the increased risk of peri-wound stripping due to the high fragility of the patient’s skin. Nursing time and resources were also increased. The woman was often extremely agitated on dressing change due to her underlying dementia, so having to redress twice-daily was having a negative impact on her quality of life.

Aim of treatment
The aim of the treatment plan was to continue to encourage autolysis of the devitalised tissue and promote granulation tissue production while absorbing excessive fluid and reducing exudate strikethrough. It was also important to provide a moist wound environment via the gelling action of the Hydrofiber dressing and to protect the peri-wound skin from damage. It was important to reduce the need for twice-daily dressing changes in order to improve the patient’s quality of life and reduce her distress. The need for non-adherence and pain-free dressing change were also identified alongside cost-effectiveness in terms of dressing resources and staff time.

Clinical management
Before using AQUACEL Extra, the patient’s pressure ulcer was often dressed twice-daily with AQUACEL and Mepilex adhesive foam. If this was not performed twice-

Patient 3
Mrs F is an 80-year-old woman with a history of dementia and type 2 diabetes controlled with oral medication. She is a patient within a nursing home and, following a recent chest infection, had developed skin damage to her sacrum. On first referral to the tissue viability service, Mrs F presented with a grade 4 pressure ulcer (European Pressure Ulcer Advisory Panel, 2009). The wound bed was 4 cm in depth and showed evidence of yellow discolouration, slough and some granulation tissue (see Figure 7).

Wound-related problems
The patient presented with high levels of exudate, which led to daily packing of the cavity with AQUACEL Hydrofiber and Mepilex foam dressings. The high levels of exudate were not always retained within the dressing and, on occasion, the wound had to be redressed twice-daily, resulting in the increased risk of peri-wound stripping due to the high fragility of the patient’s skin. Nursing time and resources were also increased. The woman was often extremely agitated on dressing change due to her underlying dementia, so having to redress twice-daily was having a negative impact on her quality of life.

Aim of treatment
The aim of the treatment plan was to continue to encourage autolysis of the devitalised tissue and promote granulation tissue production while absorbing excessive fluid and reducing exudate strikethrough. It was also important to provide a moist wound environment via the gelling action of the Hydrofiber dressing and to protect the peri-wound skin from damage. It was important to reduce the need for twice-daily dressing changes in order to improve the patient’s quality of life and reduce her distress. The need for non-adherence and pain-free dressing change were also identified alongside cost-effectiveness in terms of dressing resources and staff time.

Clinical management
Before using AQUACEL Extra, the patient’s pressure ulcer was often dressed twice-daily with AQUACEL and Mepilex adhesive foam. If this was not performed twice-
dally, the result would be exudate strikethrough and risk of excoriation or maceration of the peri-wound skin. Due to the high levels of exudate, Cavilon barrier foam was applied. This was to protect against potential excoriation of the skin and prevent further tissue breakdown. It was necessary to pack the cavity with AQUACEL to allow the dressing to follow the contour of the wound bed. AQUACEL dressing did facilitate the production of granulation tissue; however, the nursing staff were using it to both pack the wound cavity and to lay on the top of the wound itself in order to assist with exudate absorption. This resulted in increased dressing costs and nursing time.

New treatment regimen

Daily AQUACEL Extra dressings were applied. Following only 2 days of treatment, there was no exudate strikethrough to the outer foam dressing. The granulation tissue continued to be present and the AQUACEL continued to encourage autolysis of the devitalised tissue. Only one layer of AQUACEL Extra was required, and not only did it provide increased management of the exudate but it also kept its shape and strength within the wound bed. It was easily applied and removed, still maintaining its original shape. Most importantly, the patient’s distress was reduced as the dressing no longer needed to be changed twice-daily.

Final clinical outcomes

There was no longer the need to use more than one layer of Hydrofiber and the number of dressing changes decreased due to the increased absorbency of AQUACEL Extra. There was no longer the requirement to apply barrier film protector to the peri-wound skin, facilitating increased cost-effectiveness. The wound bed continued to improve and decrease in size. The clinicians found the dressing easy to apply and remove. They were already informed and educated in the use of a Hydrofiber, and so there was no need to re-educate or retrain staff on its use. The dressing was both clinically- and cost-effective.

Within 31 days the wound had significantly decreased in width, length and depth (see Figure 8) and the dressing was now applied every third day. After 14 days, the exudate levels were low-to-moderate and the AQUACEL Extra was changed to AQUACEL, as the clinician no longer needed a higher absorbency capability.

Conclusion

The need for a higher level of wound dressing absorbency has been discussed, as well as the importance of clinical effectiveness alongside cost-effectiveness. Dressings with inadequate absorption abilities can leave patients with leakage, restricting their lifestyle and impacting heavily on their quality of life. From the clinical evaluations undertaken by the author, it is clear that AQUACEL Extra has the ability to manage moderate to high levels of exudate effectively. In turn, this resulted in reduced wound dressing changes, a reduction in nursing time/resources, a reduction in costs and most importantly reduction in patient discomfort and distress.

It is vital when selecting dressings to absorb and manage wound exudate that the product’s components and its mode of action are fully understood in order to ensure correct selection. It is clear that some dressings have a very limited ability to absorb and manage moderately-to-highly exuding wounds and some superabsorbent dressings, although effective, are expensive.

The choice of AQUACEL Extra was influenced by its increased fluid handling capacity and increased strength. This in turn reduced the overall costs related to dressing products and nursing time. Its ease of use, contouring and its ability to treat a range of wound aetiologies ensured its versatility. The positive and rapid results achieved in practice and the aforementioned factors have led to the inclusion of AQUACEL Extra within the county’s wound care formulary.

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