# Community setting survey evaluating AQUACEL dressings

**Objective:** This study aimed to collect and analyse real-life data to characterise the initial use of Hydrofiber Technology dressings for the management of exuding wounds in France.
**Method:** An online survey of nurses provided data from patients managed with two dressings—AQUACEL Extra or AQUACEL Ribbon—as the primary dressing. At baseline, sociodemographic data, relevant medical histories and wound characteristics were recorded. The status of the wounds was then examined on days seven and 14 of management, together with scores of both clinician and patient satisfaction.
**Results:** The survey included 1093 patients with a mean age of 65.9 years, comprising 53.3% women; 615 (56.3%) patients presented with acute wounds and 478 with hard-to-heal wounds. Wounds were reported to have healed or improved in 79.4% and 88.1% of the patients after 7 and 14 days, respectively. After 14 days, the wounds were smaller ($p<0.001$), and the percentage of sloughy wound bed tissue had decreased ($p<0.001$), while the percentage of granulation tissue and epithelialisation increased significantly ($p=0.024$ and $p=0.047$, respectively). Tolerance of the dressing was good, with low levels of pain reported, both while wearing the dressing and on removal. On day 14, nurses reported a high level of satisfaction, while 70% and 42.7% of patients with acute and hard-to-heal wounds, respectively, were 'very satisfied'.
**Conclusion:** The Hydrofiber Technology dressings aided wound healing when used in the management of a wide range of acute and hard-to-heal wounds in medical and surgical indications. User satisfaction was high from both healthcare professionals and patients.
**Declaration of interest:** This is a commercially licensed paper.

**acute • chronic • hard-to-heal • hydrofibre • Hydrofiber Technology • online survey • patient satisfaction • survey-based research • wound • wound care • wound dressing • wound healing**

Wound healing is a complex process composed of different overlapping stages: the critical haemostatic and inflammatory stages, which are then followed by the proliferation and remodelling stages.[1,2] During the initial inflammatory stage, exudate provides a humid environment enriched in electrolytes, proteolytic enzymes and growth factors that contribute to wound healing.[3] However, excess exudate may impede healing, due to any number of causes, such as circulatory insufficiency or local infections. Therapeutic strategies must account for the underlying aetiology of each case, and a holistic approach must be adopted for each patient.

On assessing the wound, dressings are chosen based on three criteria: wound status (i.e., any necrosis or sloughy tissue, the stage of granulation and epithelialisation), state of the periwound skin and the quantity and consistency of any exudate.[2] Control of excess exudate is often undertaken to prevent damage to periwound skin caused by maceration of the wound margins.[4] Nonetheless, dressings that provide a moist environment have been reported to promote healing, reduce injury and pain on dressing removal and permit efficient ongoing autolytic debridement.[3,5]

In the case of acute wounds, exudate creates a local environment enriched in leucocytes, as well as different factors and nutrients capable of stimulating fibroblasts and endothelial cells.[6] When dressing newly formed wounds, retention of these factors must be balanced with the risks of excessive moisture producing maceration and excoriation of periwound skin.[7,8]

Disruption of wound closure leads to hard-to-heal wounds, increasing complications and costs for patients and health services alike.[9] Excessive exudate production in hard-to-heal wounds may lead to ongoing inflammation and infection.[10] Moreover, wound beds may contain bacterial biofilms c apable of promoting the growth of pathogenic species and their resistance to antimicrobial treatments.[11] Assisted debridement of devitalised tissue and potential biofilm may be used to reinitiate wound closure in such cases.[12,13]

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**Table 1. Sociodemographic patient profile, wound types and main comorbidities (n=1093)**

| | Acute (n=615) | Hard-to-heal (n=178) | Total (n=1093) | p-value |
|---|---|---|---|---|
| **Sex** | | | | 0.220 |
| n | 615 | 478 | 1093 | |
| Women | 318 (51.7) | 265 (55.4) | 583 (53.3) | |
| **Age, years** | | | | <0.001† |
| Mean ( SD) | 58.1 (23.4) | 75.8 (13.5) | 65.9 (21.5) | |
| Median | 60.0 | 78.5 | 71.0 | |
| Range | 7.00–99.0 | 20.0–99.0 | 7.00–99.0 | |
| **Type of wound** | | | | |
| Cyst | 102 (16.6) | | | |
| Fistula | 16 (2.60) | | | |
| Abscess | 66 (10.7) | | | |
| Dermabrasion | 32 (5.20) | | | |
| Traumatic injury | 149 (24.2) | | | |
| Surgical incision | 151 (24.6) | | | |
| Pressure ulcer | | 72 (15.1) | | |
| Lower limb ulcer or diabetic foot ulcer | | 333 (69.7) | | |
| Other | 99 (16.1) | 73 (15.3) | | |
| **Main reported comorbidities** | | | | |
| n | 285 | 369 | 654* | |
| Cardiovascular diseases | 90 (31.6) | 129 (35.0) | 219 (33.5) | 0.364 |
| Diabetes | 67 (23.5) | 146 (39.6) | 213 (32.6) | <0.001 |
| Chronic venous insufficiency | 30 (10.5) | 74 (20.1) | 104 (15.9) | 0.001 |
| Hypertension | 34 (11.9) | 58 (15.7) | 92 (14.1) | 0.167 |
| Tumour | 56 (19.6) | 28 (7.59) | 84 (12.8) | <0.001 |
| Chronic arterial disease | 13 (4.56) | 46 (12.5) | 59 (9.02) | <0.001 |
| Previous wound | 24 (8.42) | 31 (8.40) | 55 (8.41) | 0.993 |
| Obesity/overweight | 13 (4.56) | 30 (8.13) | 43 (6.57) | 0.068 |
| Neurological disease (stroke, epilepsy, etc.) | 17 (5.96) | 23 (6.23) | 40 (6.12) | 0.887 |
| Degenerative neurological disease | 8 (2.81) | 19 (5.15) | 27 (4.13) | 0.135 |

*Data were collected from 654 patients; p-values are the result of $\chi^2$ tests, or †Student's t-test; SD—standard deviation

AQUACEL Extra and AQUACEL Ribbon dressings, comprise Hydrofiber Technology (sodium carboxymethylcellulose), which provides a moist wound environment by preventing dehydration of the wound bed.[13,14] They can absorb as much as 30 times their weight while maintaining their integrity, permitting their use even in highly exuding wounds.[14,15] In the presence of exudate, Hydrofiber converts into a soft gel, maintaining moisture at the surface of the wound while absorbing excess fluids and locking them away from the periwound skin.[14] This gel has also been shown to promote autolytic debridement of non-viable tissue within the wound[15] while sequestering bacteria away from the wound bed surface.[16,17]

Based on the physical properties of AQUACEL Extra and AQUACEL Ribbon dressings, together with their known clinical benefits, a prospective online survey involving 221 community nurses was conducted to investigate the conditions of use, tolerance and efficacy of these dressings for the management of both acute and hard-to-heal wounds. The responses from these health professionals provided real-life data on the characteristics of the patients and wounds managed and allowed evaluations of efficacy at seven and 14 days after application of the dressings.

## Methods

This clinical evaluation was conducted during 2016 in France. Registered nurses working throughout France

**Table 2. Initial wound characteristics at inclusion (day 0) (n=1093)**

| | Acute (n=615) | Hard-to-heal (n=478) | Total (n=1093) | p-value |
|---|---|---|---|---|
| **Initiation of care** | | | | <0.001 |
| n | 615 | 478 | 1093 | |
| First visit | 498 (81.0) | 132 (27.6) | 630 (57.6) | |
| Previously treated | 117 (19.0) | 346 (72.4) | 463 (42.4) | |
| **N° of days under medical supervision before inclusion** | | | | <0.001 |
| n | 615 | 478 | 1093 | |
| Initial care | 498 (81.0) | 132 (27.6) | 630 (57.6) | |
| <50 days | 87 (14.1) | 102 (21.3) | 189 (17.3) | |
| 50–99 days | 18 (2.93) | 87 (18.2) | 105 (9.61) | |
| 100–199 days | 6 (0.98) | 43 (9.00) | 49 (4.48) | |
| >200 days | 6 (0.98) | 114 (23.8) | 120 (11.0) | |
| **Location of the wound** | | | | 0.009 |
| n | 614 | 478 | 1092 | |
| Ventral | 410 (66.8) | 354 (74.1) | 764 (70.0) | |
| Dorsal | 204 (33.2) | 124 (25.9) | 328 (30.0) | |
| **Exudate level** | | | | 0.010 |
| n | 615 | 478 | 1093 | |
| None | 21 (3.41) | 11 (2.30) | 32 (2.93) | |
| Low | 182 (29.6) | 103 (21.5) | 285 (26.1) | |
| High | 314 (51.1) | 271 (56.7) | 585 (53.5) | |
| Moderate | 98 (15.9) | 93 (19.5) | 191 (17.5) | |
| All p-values are the result of $\chi^2$ tests | | | | |

as regular practitioners in wound care were contacted. Data were collected from 221 nurses practising in different geographic locations, which included urban and rural community settings. Completed questionnaires were also collected from 1093 outpatients with wounds managed using AQUACEL Extra or AQUACEL Ribbon dressing according to their indication—that is, moderately to highly exuding acute and hard-to-heal wounds. Throughout the study, all patients were managed in accordance with local best practice.

### Study design

This survey was conducted as a non-interventional cohort study and in accordance with local regulations. As the products have regulatory clearance, as per local legislation, no ethics committee approval was required. All patients were informed of the survey and gave their consent for the collection of their data, which was completely anonymised.

All of the nurses received training in the use of AQUACEL Extra and AQUACEL Ribbon, as well as information to familiarise them with the survey, its scoring and data anonymisation. They were asked to invite all consecutive patients managed with AQUACEL Extra or AQUACEL Ribbon dressings to participate, and all questionnaires were completed anonymously using an online form. A wide variety of wounds were observed, with all patients being managed for moderate to highly exuding wounds, including leg ulcers, pressure ulcers, surgical wounds, traumatic lesions, as well as other granulating wounds. Wounds in deeper cavities were managed with AQUACEL Ribbon dressing.

The observation period was 14 days. Assessments were recorded by the treating nurse at baseline (day 0) and subsequently on days 7 and 14 of the dressing management period.

### Baseline assessment

Sociodemographic data were collected on inclusion on day 0, along with any relevant medical history (for example, diabetes). Characteristics of each wound were collected, and previous treatments were recorded. Descriptive data were collected at the initial application, including the size and number of dressings that were used, any secondary dressings used and a categorical score of patient satisfaction at this stage. Patient satisfaction was categorised in four classes: 'very satisfied'; 'rather satisfied'; 'rather unsatisfied' and 'very unsatisfied'.

**Table 3. Description of dressings at inclusion (day 0) (n=1093)**

| | Acute (n=615) | Hard-to-heal (n=478) | Total (n=1093) | p-value |
|---|---|---|---|---|
| **Type of dressing, n (%)** | | | | <0.001 |
| n | 615 | 478 | 1093 | |
| AQUACEL Extra | 322 (52.4) | 401 (83.9) | 723 (66.1) | |
| AQUACEL Ribbon (2.5 cm × 40 cm) | 293 (47.6) | 77 (16.1) | 370 (33.9) | |
| **Size of AQUACEL Extra initially used, n (%)** | | | | <0.001 |
| n | 322 | 401 | 723 | |
| 5 cm × 10 cm | 147 (45.7) | 126 (31.4) | 273 (37.8) | |
| 12.5 cm × 12.5 cm | 131 (40.7) | 161 (40.1) | 292 (40.4) | |
| 13.5 cm × 15 cm | 22 (6.83) | 42 (10.5) | 64 (8.85) | |
| 18 cm × 23 cm | 22 (6.83) | 72 (18.0) | 94 (13.0) | |
| **Types of dressings used before baseline, n (%)** | | | | 0.073 |
| n | 615 | 478 | 1093 | |
| 1 | 336 (54.6) | 234 (49.0) | 570 (52.2) | |
| 2 | 98 (15.9) | 86 (18.0) | 184 (16.8) | |
| 3 | 37 (6.02) | 44 (9.21) | 81 (7.41) | |
| 4 | 29 (4.72) | 31 (6.49) | 60 (5.49) | |
| 5 | 10 (1.63) | 13 (2.72) | 23 (2.10) | |
| >5 | 105 (17.1) | 70 (14.6) | 175 (16.0) | |
| **Type of secondary dressing, n (%)** | | | | <0.001 |
| n | 615 | 478 | 1093 | |
| Hydrofiber | 50 (8.13) | 23 (4.81) | 73 (6.68) | |
| Foam | 380 (61.8) | 261 (54.6) | 641 (58.6) | |
| Other | 185 (30.1) | 194 (40.6) | 379 (34.7) | |
| **Venous compression, n (%)** | | | | <0.001 |
| n | 109 | 201 | 310 | |
| No | 66 (60.6) | 40 (19.9) | 106 (34.2) | |
| Yes | 43 (39.4) | 161 (80.1) | 204 (65.8) | |
| All p-values are the result of $\chi^2$ tests | | | | |

### Subsequent applications on days 7 and 14, tolerance and user satisfaction

Dressing changes or cessation of use were noted on days 7 and 14. Categorical scores for the comfort, ease of use, as well as integrity of the dressing over time were obtained from nurses and patients. Continuous scoring (0–10) was used to score pain and the healthcare professionals' satisfaction with the dressing. For the evaluation of pain, 0 signified 'no pain' and 10 meant 'unbearable pain'. Similarly, on the user satisfaction scale, 0 indicated 'not at all satisfied' and 10 meant 'very satisfied'. The length, width and depth of the wounds were measured in centimetres and recorded on days 0, 7 and 14. The progression of tissue types in the wound bed over the course of treatment was recorded using the percentage of necrotic, sloughy, granulation tissue and new epithelial tissue on days 0, 7 and 14. Graphic representations of each of these variables and their progression were evaluated for representative subgroups of patients (by age, previously existing versus new wounds, acute versus hard-to-heal). Wounds were scored as healed on complete closure of surgical incisions or full epithelialisation of the wound bed for acute and hard-to-heal wounds.

### Statistical analysis

Statistical analyses were conducted using SAS version 9.4, with a threshold for significance set at 0.05. Quantitative variables describing the population are presented by the number of data points, mean, range and median. Qualitative variables are presented noting the number of data points and the percentages corresponding to each possible response collected. Subgroup analyses were also conducted for acute and hard-to-heal wounds. Comparisons of quantitative data

**Table 4. Dressing changes reported on days 7 and 14 (n=1093)**

| | Acute (n=615) | Hard-to-heal (n=478) | Total (n=1093) | p-value |
|---|---|---|---|---|
| **Frequency of dressing changes in days during week 1** | | | | 0.062* |
| n | 615 | 478 | 1093 | |
| <1 | 20 (3.25) | 16 (3.35) | 36 (3.29) | |
| 1 | 386 (62.8) | 278 (58.2) | 664 (60.8) | |
| 2 | 182 (29.6) | 174 (36.4) | 356 (32.6) | |
| ≥3 | 27 (4.39) | 10 (2.09) | 37 (3.53) | |
| **Frequency of dressing change in days during week 2** | | | | 0.725* |
| n | 566 | 438 | 1004 | |
| <1 | 15 (2.65) | 13 (2.97) | 28 (2.79) | |
| At least daily (no further information provided) | 7 (1.24) | 3 (0.68) | 10 (1.00) | |
| 1 | 309 (54.6) | 231 (52.7) | 540 (53.8) | |
| 2 | 194 (34.3) | 166 (37.9) | 360 (35.9) | |
| ≥3 | 41 (7.25) | 25 (5.7) | 66 (6.58) | |
| **Switch to an alternative dressing between days 0 and 14** | | | | 0.667 |
| n | 615 | 478 | 1093 | |
| No | 558 (90.7) | 430 (90.0) | 988 (90.4) | |
| Yes | 57 (9.27) | 48 (10.0) | 105 (9.61) | |
| **Type of dressing changed by day 14** | | | | 0.709 |
| n | 57 | 48 | 105 | |
| AQUACEL | 49 (86.0) | 40 (83.3) | 89 (84.8) | |
| Secondary dressing | 8 (14.0) | 8 (16.7) | 16 (15.2) | |
| **Intention to continue with AQUACEL, after day 14** | | | | <0.001 |
| n | 566 | 438 | 1004 | |
| No | 121 (21.4) | 45 (10.3) | 166 (16.5) | |
| Yes | 445 (78.6) | 393 (89.7) | 838 (83.5) | |
| **Reason for stopping the protocol after day 14** | | | | 0.001* |
| n | 121 | 45 | 166 | |
| Wound progression/healing | 110 (90.9) | 32 (71.1) | 142 (85.6) | |
| Protocol modification by another prescriber | 4 (3.31) | 3 (6.67) | 7 (4.22) | |
| Poor patient compliance | 1 (0.83) | 1 (2.22) | 2 (1.20) | |
| Patient no longer under survey nurse's care | 0 | 5 (11.1) | 5 (3.01) | |
| Wound deterioration, infection or pain | 1 (0.83) | 1 (2.22) | 2 (1.20) | |
| No improvement observed | 3 (2.48) | 3 (6.67) | 6 (3.61) | |
| Insufficient debridement | 1 (0.83) | 0 | 1 (0.60) | |
| No response | 1 (0.83) | 0 | 1 (0.60) | |

All p-values are the result of $\chi^2$ tests, except for * that result from Fisher's exact test

were performed with Student's t-test or the Wilcoxon test when comparing two groups or the ANOVA and Friedman tests when analysing repeated measures. Qualitative data were compared using the $\chi^2$ or Fisher test when comparing two variables. ANOVA was used to test for significant differences in wound healing over time and among different types of wounds. Multivariate models were used to estimate the effect of different factors on the efficacy of the dressings.

## Results

### Patient population

In total, 1093 patients were evaluated (Table 1); the population was evenly distributed between men and women (53.3% women), with a mean age of 65.9 years. Patients with acute wounds (n=615; 56.3%) presented most often with surgical incisions, traumatic injuries and cysts (24.6%, 24.2% and 16.6%, respectively). Among those who presented with a hard-to-heal wound, 69.7%

**Table 5. Evolution of the wound at day 7 and day 14**

| | Acute (n=615) | Hard-to-heal (n=478) | Total (n=1093) | p-value |
|---|---|---|---|---|
| **State of the wound, day 7** | | | | <0.001 |
| n | 615 | 478 | 1093 | |
| Healed | 35 (5.69) | 7 (1.46) | 42 (3.84) | |
| Improved | 491 (79.8) | 335 (70.1) | 826 (75.6) | |
| No change | 75 (12.2) | 114 (23.8) | 189 (17.3) | |
| Deteriorated | 14 (2.28) | 22 (4.60) | 36 (3.29) | |
| **State of the wound, day 14** | | | | <0.001 |
| n | 566 | 438 | 1004 | |
| Healed | 142 (25.1) | 35 (7.99) | 177 (17.6) | |
| Improved | 387 (68.4) | 321 (73.3) | 708 (70.5) | |
| No change | 29 (5.12) | 66 (15.1) | 95 (9.46) | |
| Deteriorated | 8 (1.41) | 16 (3.65) | 24 (2.39) | |
| **State of periwound skin, day 0** | | | | <0.001 |
| n | 615 | 478 | 1093 | |
| Healthy | 275 (44.7) | 55 (11.5) | 330 (30.2) | |
| Irritated | 204 (33.2) | 170 (35.6) | 374 (34.2) | |
| Dry | 36 (5.85) | 105 (22.0) | 141 (12.9) | |
| Macerated | 92 (15.0) | 145 (30.3) | 237 (21.7) | |
| Other | 8 (1.30) | 3 (0.63) | 11 (1.01) | |
| **State of periwound skin, day 7** | | | | 0.003 |
| n | 580 | 471 | 1051 | |
| Significant improvement | 222 (38.3) | 130 (27.6) | 352 (33.5) | |
| Partial improvement | 178 (30.7) | 184 (39.1) | 362 (34.4) | |
| No change | 166 (28.6) | 142 (30.1) | 308 (29.3) | |
| Limited deterioration | 9 (1.55) | 12 (2.55) | 21 (2.00) | |
| Significant deterioration | 5 (0.86) | 3 (0.64) | 8 (0.76) | |
| **State of periwound skin, day 14** | | | | <0.001 |
| n | 424 | 403 | 827 | |
| Significant improvement | 216 (50.9) | 151 (37.5) | 367 (44.4) | |
| Partial improvement | 94 (22.2) | 141 (35.0) | 235 (28.4) | |
| No change | 110 (25.9) | 99 (24.6) | 209 (25.3) | |
| Limited deterioration | 3 (0.71) | 11 (2.73) | 14 (1.69) | |
| Significant deterioration | 1 (0.24) | 1 (0.25) | 2 (0.24) | |
| All p-values are the result of $\chi^2$ tests | | | | |

had lower limb ulcers and diabetic foot ulcers, and 15.1% presented with pressure ulcers. Of the 72 patients with pressure ulcers, 59 presented with severe stage III or IV pressure ulcers. The mean age of patients diagnosed with hard-to-heal wounds was significantly greater than that of patients with acute wounds (75.8 versus 58.1 years, $p<0.001$). Medical history was collected from 654 patients; >30% had diabetes, and diabetes, chronic venous insufficiency and chronic arterial disease were significantly more frequent among those patients being managed for a hard-to-heal wound (Table 1).

### Description of the wound and any prior dressings

Wound characteristics are presented in Table 2. In total, 463 wounds (42.4%) had already been treated with dressings. Some 51% of patients with hard-to-heal wounds had been under medical supervision for more than 50 days, compared with only 4.98% of patients presenting with acute wounds. In terms of dressings, foam dressings (21.4%) or a combination of different dressing types (33.5%) were the most frequently used prior to inclusion in the study.

### Initial application of the AQUACEL dressing

In the majority of cases (66.1%), independent of wound type, AQUACEL Extra dressing was used initially rather than AQUACEL Ribbon dressing, which is adapted to cavity wounds (Table 3). This distribution was more pronounced among patients with hard-to-heal wounds (83.9%) compared with those with acute wounds (52.4%). Hard-to-heal wounds required venous compression more frequently than acute wounds (80.1% versus 39.4%). Although more than half of the patients (52.2%) used a single dressing, many used both primary and secondary dressings. Whereas the choice of secondary dressings differed significantly between the groups ($p<0.001$), foam dressings were the most frequently used in both groups (61.8% of acute wounds versus 54.6% of hard-to-heal wounds).

### Renewal of AQUACEL dressings on days 7 and 14

On day 7, for the majority of cases (60.8%), wound dressings were changed daily: 62.8% of patients had acute wounds and 58.2% had hard-to-heal wounds (Table 4). The wound dressing protocol was halted for only 4.67% of patients, for a variety of reasons. No patients were switched from AQUACEL dressing to another primary dressing, and only 2.47% of patients were switched to an alternative secondary dressing. On day 7, nurses reported 51 cases for which the management with AQUACEL dressing was to be terminated, including 82.3% who were reported to have either healed or improved such that alternative dressings were then more appropriate.

On day 14, in most cases (53.8%), wound dressings were changed daily. Between days 7 and 14, 105 of the 1093 patients were reported to have been switched to an alternative dressing; in the majority of these cases, use of the primary dressing, AQUACEL dressing, was ceased (84.8%; Table 4). Of the 89 wounds that had ceased to be dressed with the AQUACEL dressing by day 14, 54 (60.7%) were reported to have healed or improved, with wound deterioration or infection being reported in only seven cases (two acute wounds and five hard-to-heal wounds). Subsequently, the intention to continue management with AQUACEL dressing on day 14 was reported by nurses for 78.6% of acute wounds compared with 89.7% of hard-to-heal wounds.

### Efficacy evaluation on days 7 and 14

Some 79.4% and 88.1% of wounds were reported to have healed or improved after 7 and 14 days, respectively. The state of the periwound skin was evaluated as significantly or partially improved in 67.9% of cases on day 7 and 72.8% of cases on day 14. In <2% of wounds, periwound skin was scored negatively (limited/significant deterioration) at the end of the evaluation period (day 14). Patients with acute wounds were more frequently observed to have experienced a significant improvement in periwound

**Fig 1.** Mean wound length

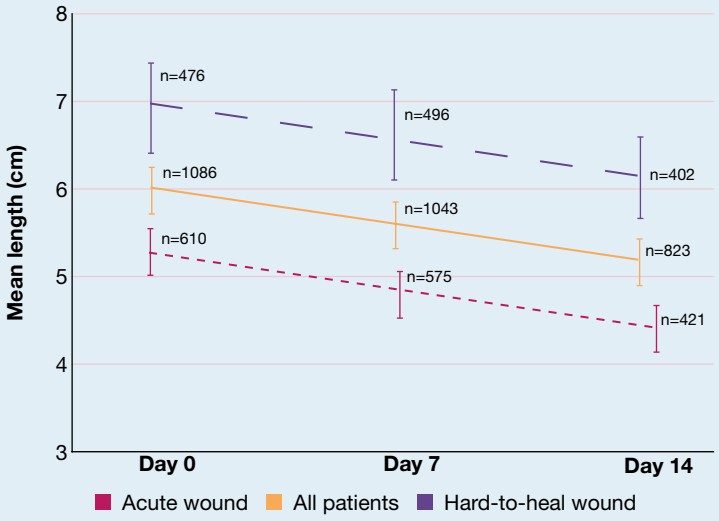



**Fig 2.** Mean wound width

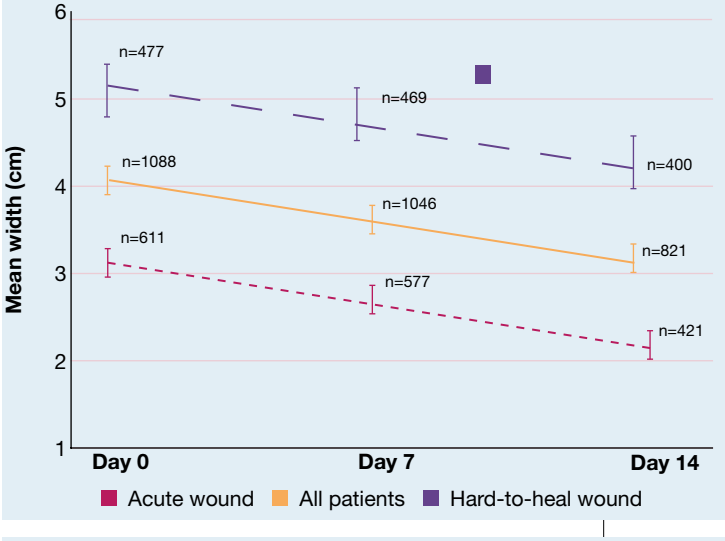



**Fig 3.** Mean wound depth

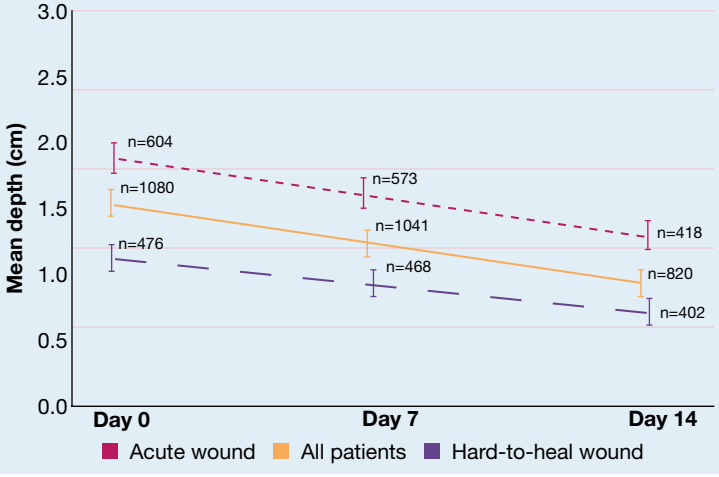


**Fig 4.** Percentage of sloughy tissue

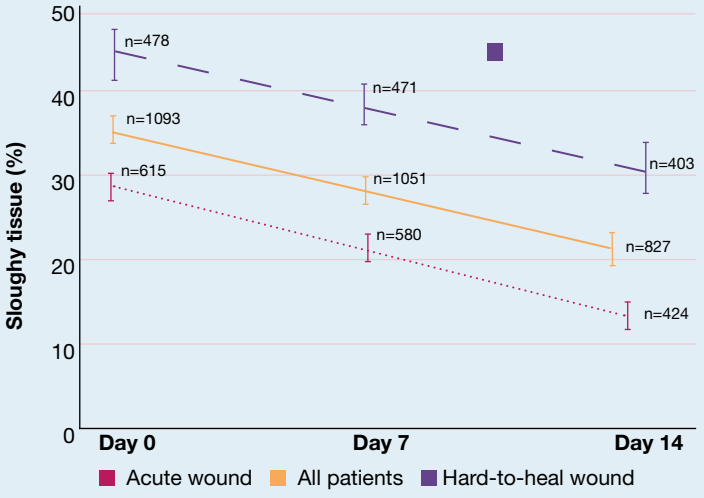



**Fig 5.** Percentage of granulation tissue

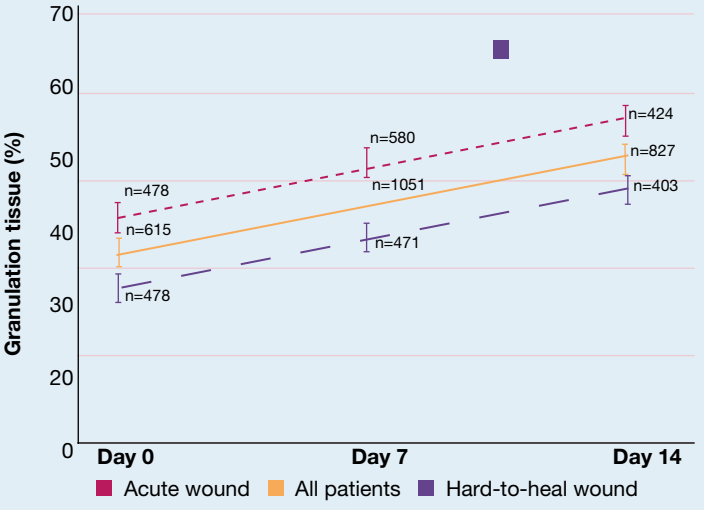
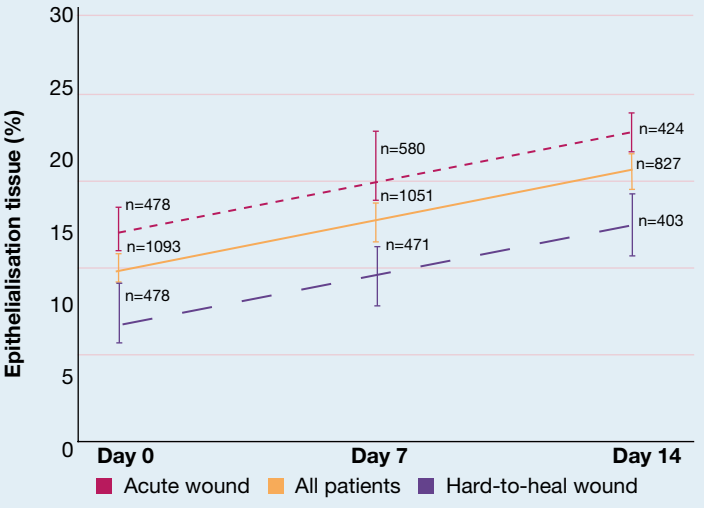



**Fig 6.** Percentage of epthelialisation tissue




skin (38.3% at day 7; 50.9% at day 14), compared with those with hard-to-heal wounds (27.6% at day 7; 37.5% at day 14; *Table 5*).

After 14 days, there was a statistically significant ($p<0.0001$) reduction in the mean wound length (22.8%), width (20.3%) and depth (39.4%) (Fig 1–3, respectively; Table 6). Wound volumes were thus also reduced; while small wound depths were reported for 748 patients at baseline, only 471 patients reported any measurable difference in wound depth on day 14. Similarly, the percentage of different tissue types observed in the wound beds changed over time. Necrotic tissue had a tendency to decrease in both acute and hard-to-heal wounds, and a statistically significant decrease in the percentage of sloughy tissue was observed ($p<0.001$, n=631; Fig 4). In contrast, the percentage of granulation tissue ($p=0.024$, n=598; Fig 5) and epithelialisation ($p=0.47$, n=207; Fig 6) increased significantly over the course of the survey.

### Ease of use and pain management

In 97% of cases, nurses responded positively or very positively with regard to ease of application, capacity to adapt to the wound, durability over the 14 days of the trial and ease of removal of AQUACEL dressings. Tolerance to the dressing was good, as reflected by the average score for pain evaluated by the patients on a scale from 0 (none) to 10 (very painful) (Table 7). The mean score (standard deviation, SD) on day 7 while wearing the dressing was 1.16 (1.59) among patients with acute wounds (n=615) and 1.72 (2.01) among those with hard-to-heal wounds (n=478). Mean pain evaluation scores on removal of the dressing on day 7 were 1.23 (1.63) and 1.56 (2.03) for patients with acute and hard-to-heal wounds, respectively. Moreover, there was a significant reduction in pain while wearing the dressing and during removal of the dressing over time between days 7 and 14 ($p<0.001$). On day 14, mean pain evaluation scores wearing the dressing were 0.93 (1.52) among patients with acute wound compared with 1.29 (1.69) in those with hard-to-heal wounds, while the mean pain scores on removal of the dressing were 0.88 (1.38) and 1.23 (1.76) for patients with acute and hard-to-heal wounds, respectively.

### User satisfaction

Exudate management was judged as very good by the majority of the patients on days 7 and 14 (61.0% and 63.1%, respectively). On day 14, 70.0% of patients who presented with acute wounds responded overall as 'very satisfied' compared with patients who presented with a hard-to-heal wound, of whom 42.7% responded as being 'very satisfied' and 54.3% as 'rather satisfied'. Among nurses, the mean satisfaction scores (0–10) given for use in both acute and hard-to-heal wounds were high on days 7 (8.30) and 14 (8.64) (Table 8).

**Table 6. Size of wounds and wound bed changes between days 0 and 14**

| | Acute (N=615) | Chronic (n= 478) | Total (n=1093) | P |
|---|---|---|---|---|
| **Percentage length reduction, days 0 to 14** | | | | <0.001 |
| n | 419 | 401 | 820 | |
| Mean (SD) | 27.8 (34.1) | 17.5 (28.9) | 22.8 (32.1) | |
| Median | 33.3 | 10.0 | 20.0 | |
| Range | -300 –100 | -200 – 100 | -300 – 100 | |
| **Percentage width reduction, days 0 to 14** | | | | 0.001 |
| n | 415 | 398 | 813 | |
| Mean (SD) | 25.3 (40.1) | 16.1 (38.3) | 20.8 (39.5) | |
| Median | 25.0 | 0 | 12.5 | |
| Range | -400 – 100 | -500 – 100 | -500 – 100 | |
| **Percentage depth reduction, days 0 to 14** | | | | <0.001 |
| n | 324 | 267 | 591 | |
| Mean (SD) | 45.7 (47.7) | 31.7 (43.0) | 39.4 (46.1) | |
| Median | 50.0 | 0 | 40.0 | |
| Range | -400 – 100 | -100 – 100 | -400 – 100 | |
| **Percentage reduction of necrotic tissue, days 0 to 14** | | | | 0.633 |
| n | 54 | 73 | 127 | |
| Mean (SD) | 78.3 (123) | 70.4 (60.6) | 73.7 (91.9) | |
| Median | 100 | 100 | 100 | |
| Range | -800 – 100 | -300 – 100 | -800 – 100 | |
| **Percentage reduction of sloughy tissue, days 0 to 14** | | | | <0.001 |
| n | 289 | 342 | 631 | |
| Mean (SD) | 67.2 (41.3) | 40.5 (70.5) | 52.8 (60.4) | |
| Median | 83.3 | 50.0 | 62.5 | |
| Range | -150 – 100 | -500 – 100 | -500 – 100 | |
| **Percentage increase of granulated tissue, days 0 to 14** | | | | 0.024 |
| n | 306 | 292 | 598 | |
| Mean (SD) | 56.3 (169) | 92.0 (216) | 73.8 (194) | |
| Median | 0 | 21.4 | 12.5 | |
| Range | -100 – 1400 | -100 – 1900 | -100 – 1900 | |
| **Percentage increase of epithelialised tissue, day 0 to day 14** | | | | 0.047 |
| n | 111 | 96 | 207 | |
| Mean (SD) | 129 (304) | 58.6 (182) | 96.6 (256) | |
| Median | 20.0 | 0 | 4.21 | |
| Range | -100 – 1900 | -100 – 900 | -100 – 1900 | |

SD—standard deviation; all p-values are the result of Student's t-tests

### Correlating conditions

A greater improvement at the end of the survey was observed less frequently among those followed up for only 7 days compared with those followed up for 14 days (OR=0.03, 95% CI [0.02; 0.05]). A greater improvement was found to be more probable for patients <70 years old (OR=2.17, 95% CI [1.24; 3.81]), for patients with a history of arterial hypertension (OR=2.71, 95% CI [1.06; 6.95]) and for acute wounds compared with hard-to-heal wounds that had occurred >200 days earlier (OR=2.53, 95% CI [1.17; 5.49]). For patients with diabetes and specific conditions due to their chronic disease, the improvement rate was not statistically significant (OR=0.69, 95% CI [0.37; 1.29]).

## Discussion

This large-scale survey captured data from 1093

**Table 7. Pain evaluation when dressing is in place and dressing removal, using a scale from 0 (none) to 10 (very painful), over 14 days**

| | Acute (n=615) | Hard-to-heal (n=478) | Total (n=1093) | p-value |
|---|---|---|---|---|
| **Day 7, pain evaluation, dressing in place** | | | | <0.001 |
| n | 580 | 471 | 1051 | |
| Mean (SD) | 1.16 (1.59) | 1.72 (2.01) | 1.41 (1.81) | |
| Median | 0 | 1.00 | 1.00 | |
| Range | 0 – 8.00 | 0 – 10.0 | 0 – 10.0 | |
| **Day 14, pain evaluation, dressing in place** | | | | 0.002 |
| n | 424 | 403 | 827 | |
| Mean (SD) | 0.93 (1.52) | 1.29 (1.69) | 1.11 (1.62) | |
| Median | 0 | 1.00 | 0 | |
| Range | 0 – 8.00 | 0 – 8.00 | 0 – 8.00 | |
| **Day 7, pain evaluation, dressing removal** | | | | 0.003 |
| n | 580 | 471 | 1051 | |
| Mean (SD) | 1.23 (1.63) | 1.56 (2.03) | 1.38 (1.83) | |
| Median | 1.00 | 1.00 | 1.00 | |
| Range | 0 – 9.00 | 0 – 9.00 | 0 – 9.00 | |
| **Day 14, pain evaluation, dressing removal** | | | | 0.001 |
| n | 424 | 403 | 827 | |
| Mean (SD) | 0.88 (1.38) | 1.23 (1.76) | 1.05 (1.59) | |
| Median | 0 | 0 | 0 | |
| Range | 0 – 8.00 | 0 – 8.00 | 0 – 8.00 | |

SD, standard deviation, all p-values are the result of Student's t-tests

patients, 53.5% of whom were being managed for highly exuding wounds. Broadly inclusive, nurses were asked to recruit all consecutive patients managed with AQUACEL Extra or AQUACEL Ribbon dressing, thus permitting the collection of data for 615 acute and 478 hard-to-heal wounds of various aetiologies. After 14 days, 88.1% of wounds (n=1004) were reported to have healed or improved, with reductions in wound size and granulation observed. The state of periwound skin was also found to have improved in 72.8% of cases (n=827). In addition, these real-world data revealed high levels of user satisfaction from the perspective of both the clinicians and patients, with 58.1% of patients reporting that they were 'very satisfied'.

This survey does have some inherent limitations. In particular, no comparative group was included for this observational cohort study, and patients were followed up for only 14 days. As recruitment was limited to outpatients, this may have led to some bias with regard to more severe wounds that might be treated with AQUACEL dressings. Moreover, no information on broader aetiological treatments was collected, that is, glycaemic treatment or glycaemic control for diabetes patients. However, patients were recruited from across France, in both urban and rural settings.

The observations presented here demonstrate the role of Hydrofiber Technology dressings in the management of a wide range of wounds. This technology wicks exudate vertically from the wound bed, together with an instant gelation of the material that provides support for new tissue development while protecting periwound skin. While the capacity of these dressings to absorb exudate has previously been reported,[14,18] in this survey, the dressings also appear to have favoured autolytic debridement, reducing the percentage of necrotic or sloughy tissue while promoting an increase in epithelialised tissue. Indeed, although complete wound healing was achieved less frequently in hard-to-heal than acute wounds (7.99% versus 25.1%, respectively), 81.29% of hard-to-heal wounds had healed or improved by day 14. Hard-to-heal wounds that had developed <200 days prior to the study baseline were less likely to heal than acute wounds during the 14 days of management as monitored in this survey (OR=2.53, 95% CI [1.17; 5.49]). However, further exploration of the data revealed that, even during this short two-week period, healing or improvement occurred in 109 of the 134 wounds that had originated >100 days prior to the survey, including 74 of 94 wounds that had originated at >200 days prior to initiation. These results suggest that, even in previously stagnant hard-to-heal wounds, AQUACEL dressings promoted wound healing for many of these patients.

User pain scores remained low throughout the survey, both when wearing the dressing and during its removal, which may account for the high levels of patient satisfaction. Less pain during dressing removal is likely to lead to a reduction in patient anxiety, thus promoting patient compliance and ultimately improving wound healing.[19]

While this survey recruited a large number of patients, future comparative studies are warranted. In particular, prescribers would benefit from the results of a more thorough exploration of the known autolytic debridement capacities of the AQUACEL Extra or AQUACEL Ribbon dressings, as well as the collection and analyses of data to assess the influence of treatments for concurrent conditions, such as diabetes.

## Conclusion

This survey of over 1000 outpatients has demonstrated the benefits of using Hydrofiber Technology for the treatment of a wide range of acute and hard-to-heal wounds in medical and surgical indications. Healthcare professional satisfaction was high, based on exudate management, wound bed debridement and periwound skin integrity. Patient satisfaction was also high, in line with their pain evaluation scores, which were low, both when wearing the dressing and during its removal. In fulfilment of the primary clinical goal, 88.1% (1004) of wounds had healed or

**Table 8. User satisfaction on study dressing application**

| | Acute (n=615) | Hardot-heal (n=478) | Total (n=1093) | p-value |
|---|---|---|---|---|
| **Patient satisfaction on application** | | | | <0.001 |
| n | 615 | 478 | 1093 | |
| Very good | 290 (47.2) | 169 (35.4) | 459 (42.0) | |
| Good | 293 (47.6) | 274 (57.3) | 567 (51.9) | |
| Average | 31 (5.04) | 30 (6.28) | 61 (5.58) | |
| Not good | 1 (0.16) | 5 (1.05) | 6 (0.55) | |
| **Nurse satisfaction on day 7 (0–10 scale)** | | | | <0.001* |
| n | 615 | 478 | 1093 | |
| Mean (SD) | 8.59 (1.18) | 7.93 (1.37) | 8.30 (1.31) | |
| Median | 9.00 | 8.00 | 8.00 | |
| Range | 4.00–10.0 | 3.00–10.0 | 3.00–10.0 | |
| **Nurse satisfaction on day 14 (0–10 scale)** | | | | <0.001* |
| n | 566 | 438 | 1004 | |
| Mean (SD) | 8.94 (1.11) | 8.26 (1.28) | 8.64 (1.23) | |
| Median | 9.00 | 8.00 | 9.00 | |
| Range | 3.00–10.0 | 3.00–10.0 | 3.00–10.0 | |
| **Overall patient satisfaction** | | | | <0.001 |
| n | 566 | 438 | 1004 | |
| Very satisfied | 396 (70.0) | 187 (42.7) | 583 (58.1) | |
| Rather satisfied | 159 (28.1) | 238 (54.3) | 397 (39.5) | |
| Rather unsatisfied | 9 (1.59) | 13 (2.97) | 22 (2.19) | |
| Not at all satisfied | 2 (0.35) | 0 | 2 (0.20) | |

SD—standard deviation; p-values are the result of Fisher exact tests and *Student's t-tests

improved following 14 days of treatment with AQUACEL Extra or AQUACEL Ribbon as part of a holistic therapeutic approach, which is essential for patients with wounds. **JWC**

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**Reflective questions**

- What are the efficacy, tolerance and user satisfaction of Hydrofiber Technology dressings?
- Are there existing data on wound reduction and periwound skin evolution after 14 days application of Hydrofiber Technology dressings?
- Can a survey conducted in more than 1000 patients be representative of real-world patients with wounds?
- In parallel to wound evaluation, are pain at application or dressing removal and user satisfaction criteria to consider?

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