An audit to determine the clinical effectiveness of a pathway for managing wound infection.

KEY WORDS
- Wound management
- Infection risk
- Clinical pathway
- Audit

Prevention of wound infection is a key objective in the planning of care for patients with wounds. The potential for wound infection, particularly in chronic wounds that are heavily contaminated with bacteria, can be high (Bowler et al, 2001). Wound infection can negatively affect the patient experience, causing pain, delayed healing and poor clinical outcomes (Butcher, 2011). This article outlines the introduction of a clinical pathway for identifying and managing wound infection in a community nursing service. The article sets out the results of an audit to investigate the efficacy of the pathway, and discusses the importance of identifying and managing wound infection risk in patient care.

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Wound management accounts for a large proportion of community nurses' clinical workload (Dowsett, 2009); community nurses are therefore well placed to identify patients at increased risk of wound infection, make a clinical diagnosis and initiate treatment. Community nurses require access to clear and concise wound management guidance that has been developed using the best available evidence (Gottrup et al, 2013), to maintain patient safety, and to support accurate and consistent assessment, care and ongoing evaluation (Grothier and Ousey, 2014). To meet this requirement, one community services provider introduced a colour-coded clinical pathway for managing wound infection (*Figure 1*), with the aims of increasing clinicians' confidence in decision-making and ensuring patients were treated safely and consistently (Grothier and Ousey, 2014). The pathway aimed to identify patients at high risk of wound infection, including those with (World Union of Wound Healing Societies [WUWHS], 2008):

- Impaired immune response
- Comorbidities affecting tissue perfusion
- Obesity
- Poor nutrition
- Psychological factors
- Localised wound factors.

The tool aimed to prevent these high-risk patients from developing an infection. A previous pilot audit had indicated some positive results with regard to infection prevention in high-risk patients and a reduction in symptoms (Grothier and Shields, 2012). Therefore, it was felt that a further larger audit study was required to establish clinical effectiveness and risk reduction. The study was carried out within the tissue viability centre to allow for consistency in care provision and data collection. The tissue viability service is a community referral service for patients considered to be complex or non-healing within the individual expected time frame. Referrals can be made by any health professional for patients registered with a GP within the geographical area, including adults and children.

THE TOOL

To support the identification and timely intervention of patients at high risk of infection or with critically colonised wounds, the pathway encourages clinicians to use specific products prophylactically as a prevention strategy (green and amber pathways).

METHODS

Data were collected on patients presenting with a wound at the tissue viability centre between January 2013 and March 2014. Patients were classified for wound management purposes as being on one of the following pathways:

- **Red**: presenting with an established infection

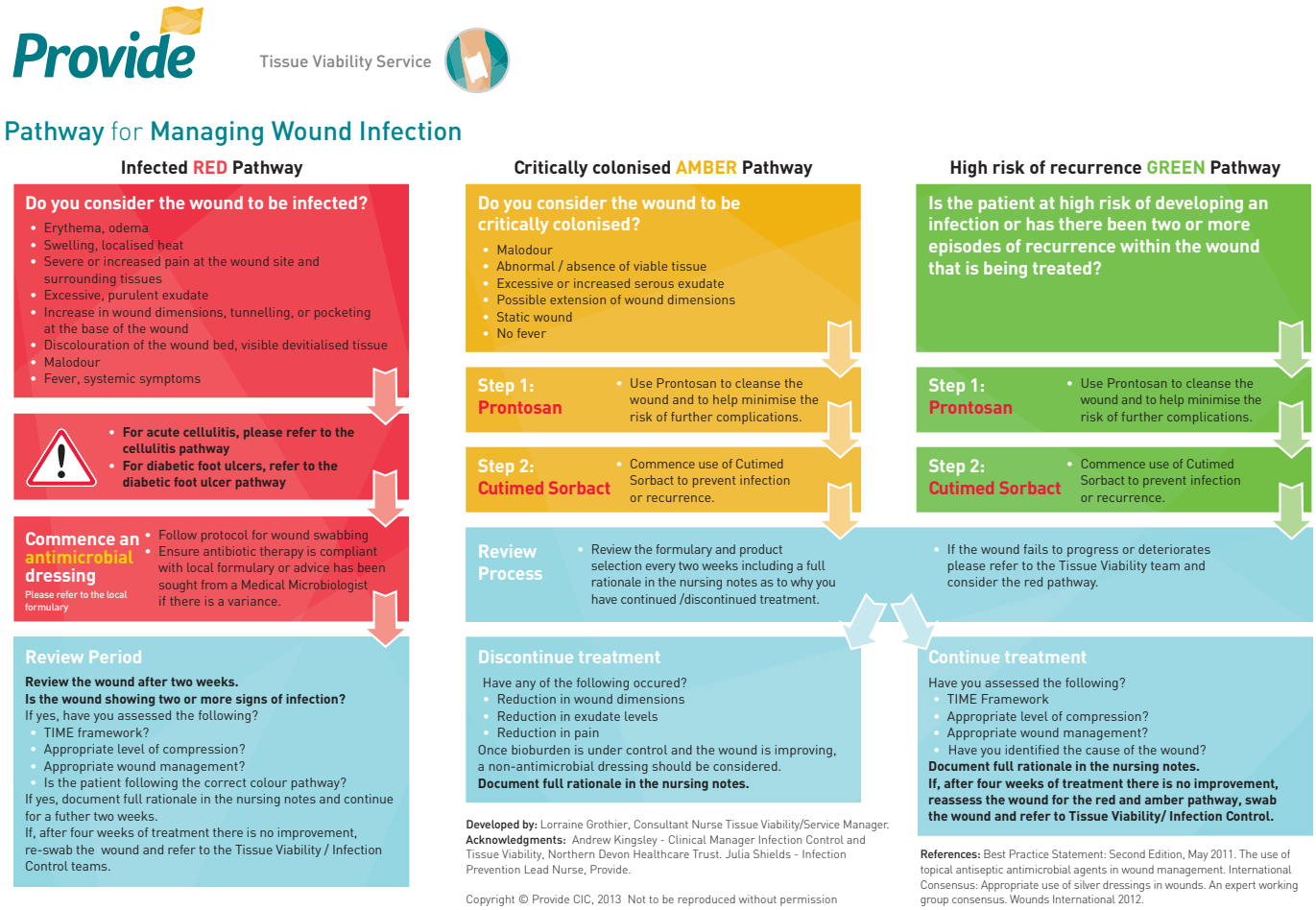

Figure 1: Pathway for managing wound infection (with kind permission from Provide CIC)

- **Amber:** presenting with wounds that were critically colonised
- **Green:** deemed to be at high risk of wound infection recurrence, defined as two or more infections in the same wound, but who did not have an infection.

Several characteristics relating to the wound and its treatment were recorded for each patient including wound type, location and duration, the location of treatment and the personnel involved in the treatment.

An audit review was undertaken on each patient, after 4 weeks, at which point each wound was re-classified if necessary onto either the red, amber or green pathways.

The sample at baseline was summarised descriptively. Substantive differences in the characteristics of wounds on different pathways at baseline were assessed. Changes in a number of wound parameters between baseline and the

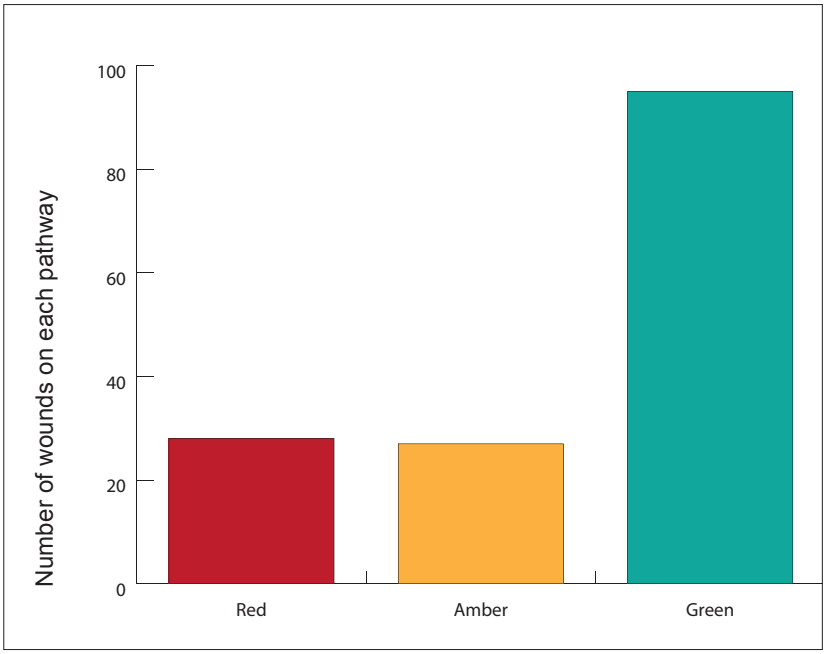

Figure 2: Number of wounds assigned to each pathway at baseline

Table 1. Baseline sample characteristics

Variable	Frequency (%)*
Treatment location	
• Community hospital	• 4 (2.7%)
• GP practice	• 2 (1.4%)
• Patient's home/residential home	• 13 (8.8%)
• Tissue viability clinic	• 128 (87.1%)
Treatment personnel	
• Health care assistant	• 18 (12.2%)
• Registered nurse	• 8 (5.4%)
• Tissue viability nurse	• 121 (82.3%)
Personnel deciding treatment plan	
• Community nurse/RGN	• 8 (5.4%)
• Tissue viability nurse	• 139 (94.6%)
Wound type	
• Leg ulcer	• 120 (81.6%)
• Pressure ulcer	• 7 (4.8%)
• Surgical wound	• 6 (4.1%)
• Wet leaking leg	• 9 (6.1%)
• Others	• 5 (3.4%)
Wound duration	
• Less than 3 months	• 34 (23.1%)
• 3–6 months	• 18 (12.2%)
• 6 months–1 year	• 29 (19.7%)
• 1–2 years	• 26 (17.7%)
• 2–3 years	• 20 (13.6%)
• 3+ years	• 20 (13.6%)
Recurrence of previous wound	
• Yes	• 59 (48.0%)
• No	• 64 (52.0%)
Wound pathway at baseline	
• Red	• 28 (19.0%)
• Amber	• 27 (18.4%)
• Green	• 92 (62.6%)
Patient currently on antibiotics	
• Yes	• 17 (11.6%)
• No	• 129 (88.4%)
Patient had antibiotics in previous 12 weeks	
• Yes	• 67 (45.9%)
• No	• 79 (54.1%)
Patient had a swab taken	
• Yes	• 61 (41.8%)
• No	• 85 (58.2%)
Exudate level	
• None	• 1 (0.7%)
• Low	• 29 (19.9%)
• Moderate	• 92 (63.0%)
• High	• 24 (16.4%)

Table 1 (cont). Baseline sample characteristics	
Variable	**Frequency (%)***
Odour level	
• None	• 94 (64.4%)
• Low	• 35 (24.0%)
• Moderate	• 16 (11.0%)
• High	• 1 (0.7%)
Frequency of dressing change (times per week)	
• 1	• 6 (10.9%)
• 2	• 86 (58.5%)
• 3–6	• 29 (19.7%)
• 7+	• 16 (10.9%)
Number of hospital admissions within last 6 months	
• 0	• 120 (82.8%)
• 1	• 19 (13.1%)
• 2+	• 6 (4.1%)

**Percentages calculated using the number of patients who had a recorded variable*

4-week audit were recorded, where applicable. The primary analysis was undertaken on wounds assigned to the green pathway at baseline, to assess the significance of any differences in characteristics of wounds remaining on the green pathway at the 4-week audit, and those re-classified from the green pathway to be on the amber or red pathways at the 4-week audit, using binary logistic regression analysis. The research hypothesis was that wound progression would be significantly associated with wound characteristics, with the expected direction of the association being that those wounds showing more diversity of improvement would be more likely to retain the green pathway classification.

RESULTS

Data were collected on 151 wounds. Four wounds were not assigned to a pathway at baseline and were deleted from further analysis, leaving 147 usable records. Over half of all wounds (92; 62.6%) were assigned to the green pathway; of the remainder, approximately equal numbers were assigned to the red (28; 19.0%) and amber (27; 18.3%) pathways (*Figure 2*).

Summary of sample at baseline

The majority of patients received treatment in a tissue viability clinic, with a nurse specialist providing treatment and making decisions about the treatment plan. Most treated wounds were leg ulcers, with an approximately even distribution of wound duration times from less than 3 months to over 3 years. Just over one third of all wounds were less than 6 months old; just over one third were 6 months to 2 years old; and the remaining wounds were 2 years or over.

Approximately half of all recorded wounds were recurrences of previous wounds. A significant minority of patients had either taken antibiotics within the previous 12 weeks and/or had had a swab taken.

The sample characteristics as recorded at baseline are summarised descriptively in *Table 1*. There were gaps in variable data for a small number of patients due to incomplete data forms, and therefore percentages are calculated using the number of patients who had a recorded variable. Where data was not collected for all 147 patients, the number of patients with recorded variables is documented.

Some substantive differences in the characteristics of wounds were observed between those designated to the green, amber and red pathways at baseline. Wounds allocated to the red pathway were more likely to be associated with a current systemic antibiotic therapy than those on other pathways: 11 out of 28 red pathway wounds (39.3%) were associated with current systemic antibiotic therapy, compared with 3 out of 27 (11.1%) of amber pathway wounds and 3 out of 28 (10.7%) green pathway wounds (*Figure 3*).

More than half (15 out of 28; 53.6%) of all red pathway wounds were recurrences, compared to

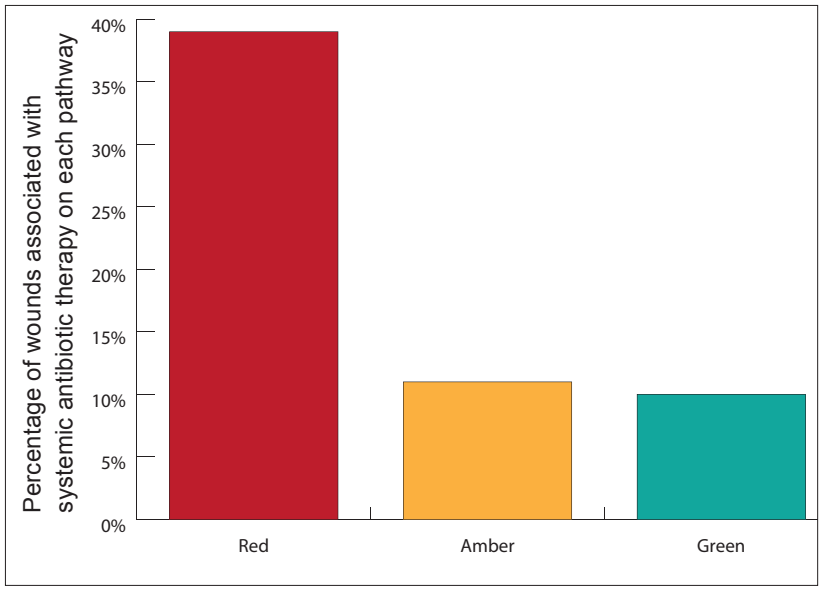

Figure 3: Percentage of wounds on each pathway associated with systemic antibiotic therapy at baseline

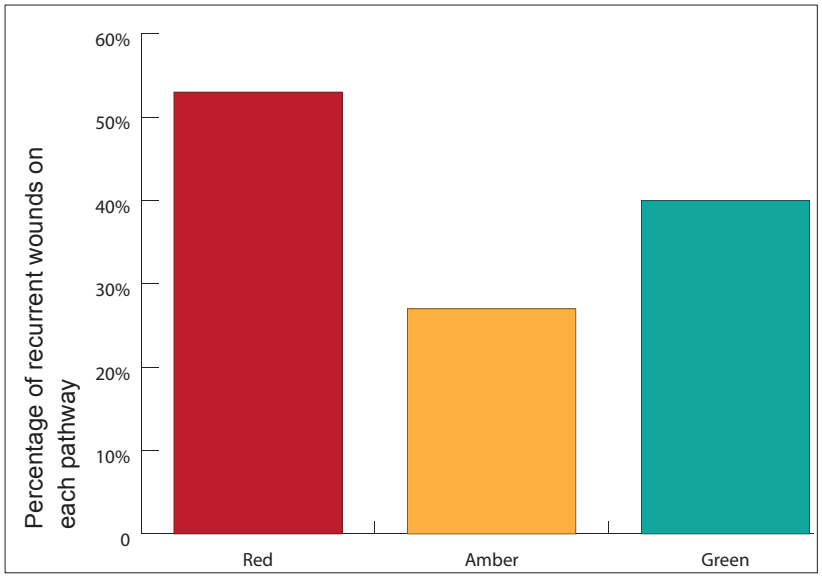

Figure 4: Percentage of recurrent wounds on each pathway

7 out of 27 (25.9%) of amber pathway wounds, and 37 out of 92 (40.2%) green pathway wounds (*Figure 4*).

There were no substantive differences in the locations of wounds on different pathways, with 77–85% of wounds on each pathway being leg ulcers.

CHANGES TO DESIGNATED WOUND PATHWAYS BETWEEN BASELINE ASSESSMENT AND 4-WEEK AUDIT.

The following analysis was undertaken on the 128 patients who remained on the pathway at the 4-week audit; patients no longer on the pathway were not included as it would be expected that removal of a patient from the pathway would be for a positive wound outcome.

Of the 92 wounds assigned to the green pathway at baseline, 79 (85.6%) were still on a pathway at the 4-week audit. Of these 79 wounds, 70 (88.6%) remained on the green pathway, 5 (6.4%) had been transferred to the amber pathway and 4 (5.1%) had been transferred to the red pathway.

Of the 27 wounds assigned to the amber pathway at baseline, 20 (69.0%) were still on a pathway at the 4-week audit. The majority (15; 75.0%) of these wounds had transferred to the green pathway at this point, indicating an improvement in status, with only four (20.0%) remaining on the amber pathway and one wound (5.0%) being transferred to the red pathway.

Of the 28 wounds assigned to the red pathway at baseline, 24 (85.7%) were still on a designated pathway at the 4-week audit. The majority (15; 62.5%) of these wounds had transferred to the green pathway at this point, indicating a strong improvement in status. A further three wounds (12.5%) had been transferred to the amber pathway, also indicating status improvement. Six wounds (25.0%) remained on the red pathway.

The progress of all wounds between baseline and 4 weeks, for those wounds remaining on the pathway after 4 weeks, is summarised in *Table 2*.

The status of 80 out of 128 (62.5%) wounds were unchanged, the status of 38 wounds improved (29.7%), and the status of 10 wounds (7.8%) worsened. 118 out of 128 wounds (92.2%) did not experience deterioration in status over the 4-week period.

Progress in wound parameters from baseline to 4-week audit

The majority of wounds as assessed by the tissue viability staff showed improved healing progression over the 4-week period, with only 7% of all wounds reported to be indicating decreased wound healing. An improvement was represented by a decrease in symptoms. Symptoms included pain, malodour and exudate; a reduction was observed in more than half of all wounds. The parameter in which the greatest proportions of wounds were seen to improve was exudate level (Gottrup et al, 2013): decreased levels

were reported in about two thirds of all wounds, with a further quarter showing no change.

Changes in wound characteristics from baseline (where applicable) are summarised in *Table 3*.

Analysis of wounds assigned to green pathway at baseline

Of the 79 wounds that were assigned to green pathway at baseline, the characteristics of those which remained classified as being on the green pathway at 4 weeks ('static' wounds) were compared with the characteristics of those which were transferred to either the amber or red pathways ('deteriorating' wounds).

No significant associations were found between wound status (i.e. static or deteriorating) and any of the following characteristics: wound location (classified as leg ulcer or other); wound duration (less than 1 year, or 1 year or more); whether or not the wound was a recurrence of a previous wound; or whether or not the patient had taken antibiotics at any time in the previous 12 weeks. However, while none of the 14 non-leg ulcer wounds changed status, 9 out of 64 (14.1%) leg ulcers did so.

An uncontrolled logistic regression analysis identified a significant association between improvement in specific wound parameters (considered to be represented by the number of parameters for which an improvement was recorded) and wound status (P=0.003; odds ratio = 0.11; 95% confidence for odds ratio: [0.03, 0.49]. Hence the wound pathway classification, which is a summary measure of wound characteristics, appears to be consistent with expectations from the analysis of individual characteristics, in that the fewer improving parameters are recorded, the less likely it is that the wound pathway is downgraded from the 'static' (i.e. green) state. A logistic regression analysis to investigate the significance of any relationship between wound status and wound progression could not be conducted, as all wounds whose pathway status was reduced from green to either amber or red were recorded as not having wound healing progression.

Costs

The annual spend for this local organisation in 2011/12 for products associated with treating wound infection before the introduction of the

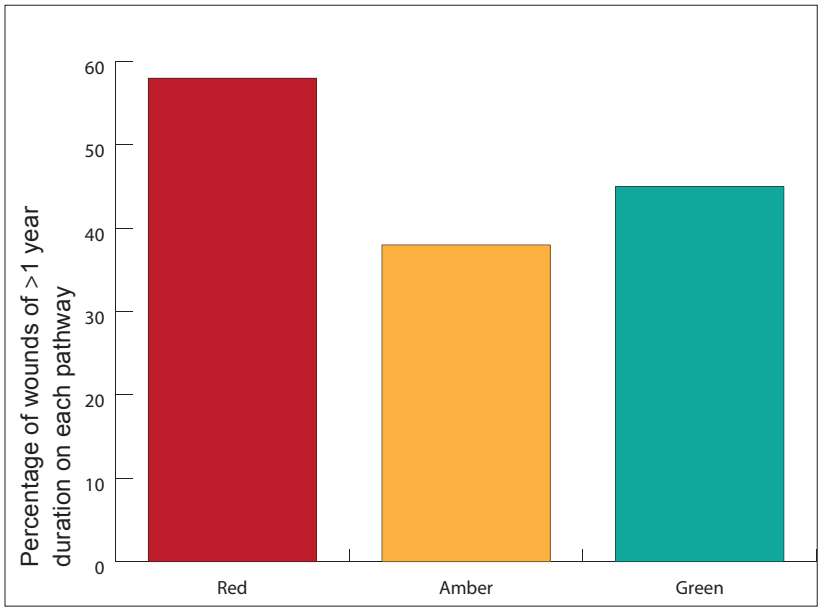

Figure 5: Percentage of wounds in excess of 1 year duration on each pathway

Table 2. Summary of pathway changes in 4 weeks from baseline assessment for all wounds

Wound pathway at baseline (frequency)	Wound pathway after 4 weeks frequency		
	Red	Amber	Green
Red	8	3*	15*
Amber	1**	4	20*
Green	4**	5**	70

**Represents an improvement in status*

***Represents a deterioration in status*

Table 3. Changes in wound parameters over 4-week period

Wound parameter	Frequency (%)*		
	Increase	Decrease	Stayed the same
Exudate Level	10 (7.8%)	85 (66.4%)	33 (25.8%)
Erythema, oedema	6 (17.6%)	18 (52.9%)	10 (29.4%)
Malodour	8 (19.5%)	22 (53.7%)	11 (26.8%)
Pain	12 (16.9%)	45 (63.4%)	14 (19.7%)
Swelling, localised heat	5 (22.7%)	14 (63.6%)	3 (13.6%)
Wound size	12 (10.9%)	66 (60.0%)	32 (29.1%)
% of slough / necrosis	17 (25.0%)	40 (58.8%)	11 (16.2)
Fever, systemic symptoms	0 (0.0%)	3 (42.9%)	4 (57.1%)
Wound healing progression	75 (58.6%)	9 (7.0%)	44 (34.4%)

**Percentages calculated using the number of patients who had a recorded variable*

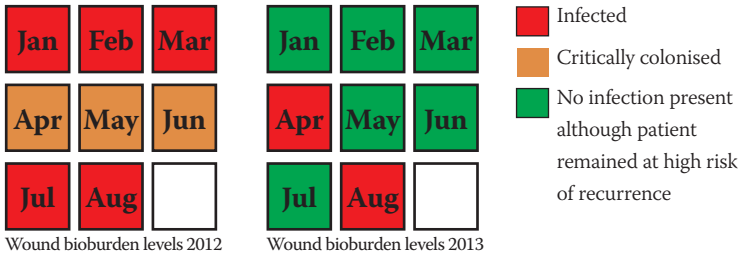

Figure 6: Case study wound incidence of infection Jan–Aug 2012 and Jan–Aug 2013

colour-coded pathway was reported in excess of £130,000 inclusive of silver, iodine and honey dressings. Following introduction of the pathway, this figure reduced to £68,447 during 2013/14 for products used to treat active wound infection (red pathway), suggestive that practice has improved for appropriate treatment of infected wounds.

Within the amber and green elements of the pathway, an additional spend of £88,517 was noted on products that could be safely used for prolonged periods of time (Haycocks et al, 2011). However, for 2013/14, the total cost of dressings remained at £38,657 under the allocated budget of £1.2 million, despite activity increasing by 42% within all services accessing dressing products paid for within this budget (Provide Knowledge Management, 2015).

DISCUSSION

The audit findings suggest that the pathway is effective in preventing patients with wounds considered to be at high risk of infection—on the green pathway—from entering the red pathway. It is apparent that the majority of wounds either move towards green pathways or stay the same, particularly those already on green at initial assessment. The audit findings suggest that infection or critical colonisation was prevented over a 4-week period in nearly 90% of high-risk patients initially assigned to the green pathway. Using a polyhexamethylene biguanide (PHMB) cleanser and a dialkylcarbamoylchloride (DACC) dressing product prophylactically, even for longer periods, has had no detrimental effect on the patients treated in this audit and is suitable for patients of all age groups. Using this pathway approach, more interactive antimicrobial dressing products are reserved for active treatment for established wound infection. Therefore, the potential for resistance or any other potential negative effects are reduced.

The financial costs associated with wound management are also an important consideration and need to be viewed within the context of appropriate practice and patient outcomes (National Prescribing Centre [NPC], 2012). The audit data suggest that managing patients appropriately and preventing infection reduces the use of expensive antimicrobials and other dressings used for symptom management such as super absorbents to manage increased levels of exudate. Investing in patient safety potentially reduces the costs associated with unplanned admission to secondary care, or the need for increased clinical intervention in the community.

CONCLUSION

The National Institute for Health and Care Excellence (NICE, 2015) is developing guidelines on antimicrobial stewardship and antimicrobial resistance, which will recommend prudent prescribing. This is necessary as few new antibiotics are being developed and there is a need to ensure that resistance to current treatment is minimised (NICE, 2015). Identifying patients who are at increased risk of wound infection and developing and implementing safe effective prophylactic treatment at the earliest possible stage of care can help to reduce the need for systemic antibiotics. The impact of implementing the pathway has demonstrated an increase in staff awareness within the tissue viability team of the risks associated with wound infection and their responsibilities with regard to developing the most appropriate care plan. Early detection and intervention ensures patient safety remains a high priority. A further study is planned to review the use of the pathway in clinical practice by generalist nurses and to establish if knowledge and confidence in decision-making has been maintained since its implementation.

CASE STUDY

The patient is a 66-year-old, immunosuppressed male who initially presented to the Tissue Viability team in February 2007 with non-progressing lesions to his left leg. Past medical history comprised lymphoma, a course of radiotherapy in 2010, multiple allergies and psoriasis, which is being treated by the Dermatology team. There had been recurrent episodes of wound infection, which

required silver antimicrobial dressings, antibiotics and regular wound swabs. Dressings were changed three times per week and compression bandaging was used to control venous hypertension and the subsequent high levels of exudate. Due to the patient's underlying disease, it was imperative that he remained free from infection. Although healing is desirable, the main objective for the nursing team was to maintain the patient's safety and comfort. Preventing the need for repeated use of antibiotics also reduces the risk of development of antibiotic resistance and other associated complications, i.e. Clostridium difficile infections. It was therefore decided to enter the patient onto the pathway in January 2013.

Retrospective data pertaining to incidence of infection was obtained from the patient's nursing records between the period of January to August 2012 and compared with the same period in 2013 (*Figure 6*). During the 2012 period, the wound remained either critically colonised or infected. However, during the same period in 2013, there was a significant reduction in the periods of infection (April and August); for the remainder of the treatment period, the wound remained infection free.

Additionally, there was a reduced spend on primary dressings of £447.53. For the patient, effective prophylactic management of wound bioburden has improved the potential for healing (*Figures 7* and *8*). This has led to the patient now being able to participate in his own care, including one dressing change plus removal and re-application of compression hosiery, promoting independence and quality of life. Clinic appointments have reduced to weekly. WUK

Figure 7: Appearance of case study wound in February 2012

Figure 8: Appearance of case study wound in March 2013

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