

# Maggot debridement therapy for individuals with diabetic foot ulceration: a service evaluation

## KEY WORDS

- ▶ Maggot debridement therapy
- ▶ *Lucilia sericata*
- ▶ Diabetic foot ulcer
- ▶ Attitudes/knowledge
- ▶ Service evaluation

**Objective:** To examine the use of maggot debridement therapy (MDT) for individuals with diabetic foot ulcers (DFU) after a change in prescribing policy. **Method:** A self-completion survey/structured questionnaire to assess healthcare professionals' existing knowledge of MDT was given to those specialist services providing wound care treatments for DFUs. **Results:** The results showed that those responding had a basic understanding of MDT and its use. However, further education is required for the type of wounds that maggots can be applied to, and what enzymes are produced. Enablers and barriers to MDT use also included policy and procedures, time constraints and the 'yuck factor'. **Conclusion:** While there is good clinical evidence to support the use of MDT, there is a lack of evidence examining the factors that influence healthcare professionals' decisions to recommend this treatment.

Maggot debridement therapy (MDT) is used in the management of individuals with chronic, sloughy and necrotic wounds such as pressure ulcers (PU), venous leg ulcers (VLU) and diabetic foot ulcers (DFU; Naik and Harding, 2017). Several studies have identified MDT as an effective way of improving wound healing rates, due to its mode of action in terms of debridement (Sherman, 2003; Bowling et al, 2007; Tian et al, 2013; Sun et al, 2016).

The main way in which maggots are thought to aid debridement relates to the animal's mandibular 'mouth hooks' and rough body that 'scratches' the necrotic tissue and irritates the wound bed (Sherman, 2014). Furthermore, during the digestive process, the maggots secrete proteolytic digestive enzymes, which liquefy the necrotic tissue, enabling ingestion by the maggots (Sherman, 2014). The excretions and secretions of the larvae have been found to contain deoxyribonuclease, lipase, kycosidase and chemotrypsin properties that help to degrade wound eschar (Brown et al, 2012). These properties have also been found to enhance plasmin formation and induce fibrinolysis to keep wounds free from infection and reduce excessive inflammation (Van der Plas et al, 2014).

Evidence has shown that MDT is a highly

selective, safe, clinically effective and cost-effective method for rapidly debriding DFUs, increasing healing rates and reducing infection (Chadwick et al, 2015). However, personal experience working as a Podiatrist in a lower limb service in the South-West of England highlighted that MDT was not commonly being used. One of the reasons for this was an update to the regulations by the Medicines & Healthcare products Regulatory Agency (MHRA), which changed the process for obtaining MDT, as well as the responsibility for prescribing the treatment. The purpose of the service evaluation project being reported here was to examine if there has been an impact on the use of MDT following the change in the prescribing process. We also sought to explore barriers and enablers that influence Podiatrists' and Nurses' decisions in recommending MDT in the treatment of individuals with DFUs.

## METHOD

The service evaluation took place in the South-West of England during April to June 2021. The project included healthcare professionals working in the lower limb service as well as the acute care setting. The target population were registered nurses and podiatrists working within the field of

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Table 1. Evidence base for the knowledge survey

Title	Authors	Source
Five questions — and answers — about maggot debridement therapy	Claxton M et al	<i>Advances in Skin and Wound Care</i> 2003;16(2)
Larval debridement therapy	All Wales Tissue Viability Nurse Forum	The All-Wales Guidance for the use of Larval Debridement Therapy (LDT), 2013
Awareness and attitude of nurses on the use of maggot therapy in the treatment of diabetic ulcers at the Bamenda Regional Hospital, Cameroon	Cumber S et al	Public Health International 2016;1(1)
An initiative to improve wound management within community services across one Clinical Commissioning Group in England	Ivins N et al	<i>Wounds UK</i> 2018;14(5)

wound care and providing wound care management within the local service. All non-registered healthcare professionals were excluded from the sample, as they are not responsible for ordering or applying MDT.

### Phase 1

The project was designed in two phases. The intended purpose of the first phase was to interview key stakeholders of a mix of podiatrists ( $n=4$ ) and nurses ( $n=6$ ) to explore the prescribing process for MDT and how this had impacted on the service since a change in the process brought about by the MHRA directive. Invitations were sent out and one response was received that outlined the current difficulties of procurement, with the main challenge being due to licensing changes; MDT had to be prescribed by an extended prescriber, with local GPs declining to prescribe, as it was outside their scope of practice. This phase took place at the same time as staffing pressures related to the COVID-19 pandemic, which meant it was not possible to pursue this aspect of the evaluation. Although online interviews could have been conducted, due to the time between the response being received highlighting the difficulty of procurement and the submission date for the work as part fulfilment for the Masters in Wound Healing and Tissue Repair at Cardiff University, it was not possible.

### Phase 2

The second part of the project involved designing a self-completion survey to assess health

professionals' existing knowledge of MDT. A self-completion survey was developed from a range of literature, including published studies (Claxton et al, 2003; Cumber et al, 2016; Ivins et al, 2018) and Best Practice Recommendations (All Wales Tissue Viability Nurse Forum, 2013; *Table 1*).

### Procedure

Following approval for the survey by the local research team and the project's lead line manager, the survey was undertaken between 6 April and 30 June 2021. All potential participants ( $n=220$ ) were emailed and invited to undertake the self-completion survey (*Table 2*) via a link to Microsoft Forms. The gender and age of health professionals was not investigated as part of this project, as these factors were not considered to be related to the aims and objectives of the project. An overall score for the knowledge questions was used to determine the level of knowledge, with data being analysed using Microsoft Forms and presented using summary statistics. Free text answers were compared across all survey/questionnaires using a thematic approach.

### RESULTS

Of a possible 220 participants, 27 participants completed the online survey, which was a response rate of 12%, with no increase being seen after the second send-out of the survey. The participants included Podiatrists ( $n=15$ ) and Nurses ( $n=12$ ). On average, nurses had more years of professional experience as registered healthcare professionals than Podiatrists (9 years versus 6 years respectively).

Table 2. Understanding of debridement and maggot debridement therapy

What is your understanding of debridement?		What is your understanding of maggot debridement therapy?	
	<i>n</i>		<i>n</i>
Debridement of non-viable tissue	18	Debridement of non-viable tissue	25
Improving wound healing	8	Effective wound healing	5
Debridement of slough	5	Cost effective	4
Debridement of necrotic tissue	4	Proteolytic enzyme degradation	4
Debridement of biofilms	3	Correct type of fly	2
Reduction of bacterial load	3		
Sharp debridement	5		
Surgical debridement	2		
Mechanical debridement	1		
Maggot debridement therapy	5		

Table 3. Type of larvae used and larvae lifecycle

The larvae of what fly is used for debridement?		After hatching, how long does the larvae last before entering the pupal stage?	
	<i>n</i>		<i>n</i>
Don't Know	15	Don't know	17
<i>Lucilla sericata</i> (Greenbottle)	10		
<i>Phormia regena</i> (Black Blowfly)	2	5–7 days	6
<i>Callitroga macellaria</i> (secondary screw worm)	0	7–10 days	2
<i>Calliphora</i> (Bluebottle)	0	11–14 days	2
<i>Cochliomyia hominivorax</i> (screw worm)	0	14–21 days	0

**Decision-making in wound care**

Participants were asked whether they made decisions about which treatment to use on wounds. Responses from the Podiatry participants indicated that all of them made decisions about dressing choices; this was irrespective of their number of years of post-registration experience. The results for the nursing staff showed that they were more likely to make recommendations for wound care if they had more years of experience.

**Knowledge of maggot debridement therapy**

Participants were asked to provide a free-text response about what their understanding of debridement was, as well as what they understood about MDT. The responses were grouped into themes. For both questions, the most common response was 'debridement of non-viable tissue' (Table 2).

Participants were asked to indicate what type of fly was used for debridement and also how long the larvae last before entering the pupal stage. The

majority of respondents did not know the answer to either question (Table 3).

**Indications for use of maggot debridement therapy**

Respondents were asked to indicate what types of wound MDT were appropriate for; multiple responses were allowed. There were seven different wound aetiologies listed, including non-healing wounds, post-traumatic wounds, arterial/ ischaemic ulcers, PUs, VLU and DFUs, all of which were suitable for MDT. The frequency of responses showed that MDT would be appropriate for DFUs (*n*=21), non-healing surgical wounds (*n*=16), PUs (*n*=15), post-traumatic ulcers (*n*=14) and VLUs (*n*=12); seven participants responded with 'don't know'.

**Benefits of maggot debridement therapy and mode of action**

We also asked participants to provide a free-text response about the suggested benefits of MDT and

**Table 4. Benefits of larvae used and how they debride**

What are the benefits of maggot debridement therapy?		How do larvae debride?	
	<i>n</i>		<i>n</i>
Quick and effective debridement	13	Breakdown tissue with enzymes	18
Encourages healing	6	Consume dead tissue	4
Removes necrotic tissue that may not be suitable for sharp debridement	2	Digging deep	1
Provides antimicrobial protection	2	With tiny mouths	2
Pain free	1	Don't know	3
Don't know	1		

another asked them to describe how larvae debride. *Table 4* summarises the responses and shows that the most common perception of benefit was that it was a quick and effective form of debridement. The majority of respondents suggested that MDT worked by breaking down tissue using enzymes.

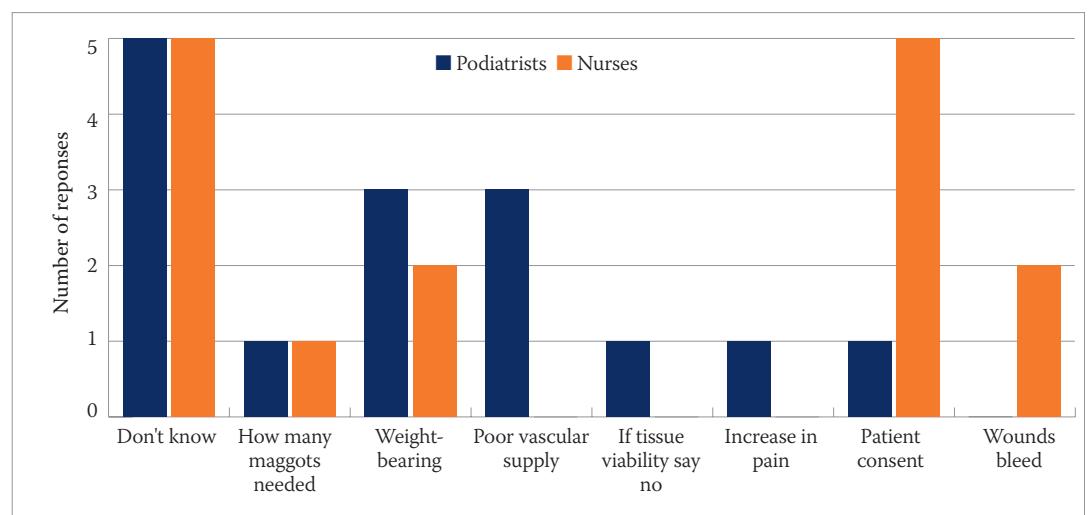
**Maggot debridement therapy secretions and actions**

Respondents were asked to choose the combination of enzymes that MDT produces. The correct response was trypsin, chymotrypsin, collagenases. The majority of respondents did not know the answer (*n*=23) with only 3 participants (2 Podiatrists and 1 Nurse) providing the correct response. Participants were also asked how ammonia, which is secreted by larvae, is beneficial to wound healing. There were 10 respondents who indicated they did not know; seven indicated ammonia is antibacterial and five suggested it lowered pH levels.

With regards to how the mechanical process of the larvae improve wound healing rates, the free-text responses indicated that this was related to the removal of devitalised tissue (*n*=12). Other responses included stimulation of cell production (*n*=4) and removal of biofilm, removal of slough and increased blood supply (*n*=2 for each response).

**Contraindications and precautions for use of maggot debridement therapy**

There were two questions that examined respondents' knowledge of when MDT is not recommended and precautions to take before use. *Figure 1-2* summarise the responses for the Podiatrists and Nurses separately. For non-recommendation of MDT, most respondents across both professions did not know, indicating more education was needed in this area of MDT. For responses to precautions before use of MDT, the results are shown in *Figure 2*. Varied responses were given, with nurses seeming to take patient consent into consideration, but again



**Figure 1. Responses to when is maggot debridement therapy not recommended**

Figure 2. Precautions before use of maggot debridement therapy

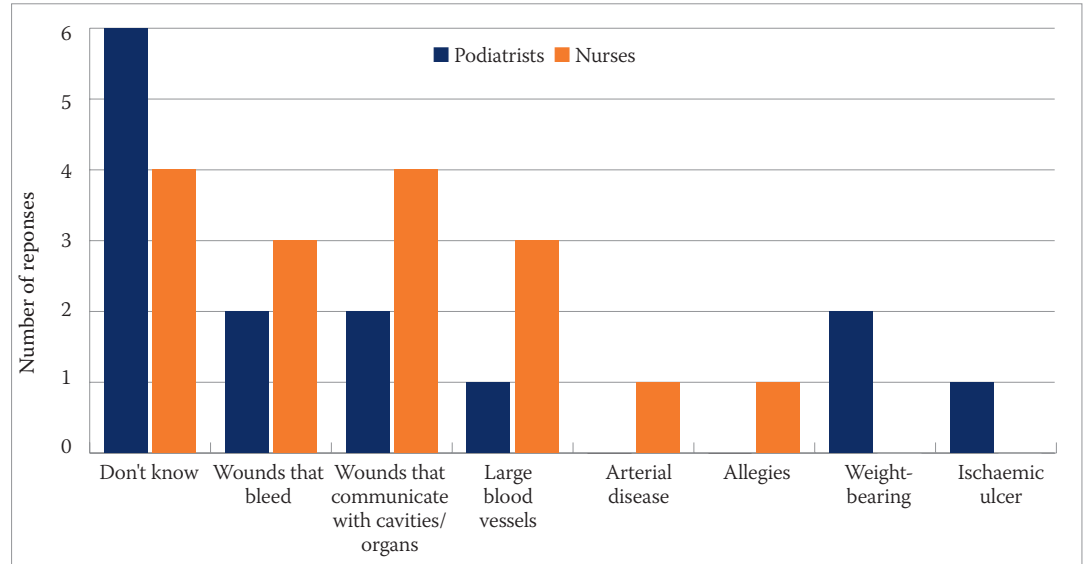
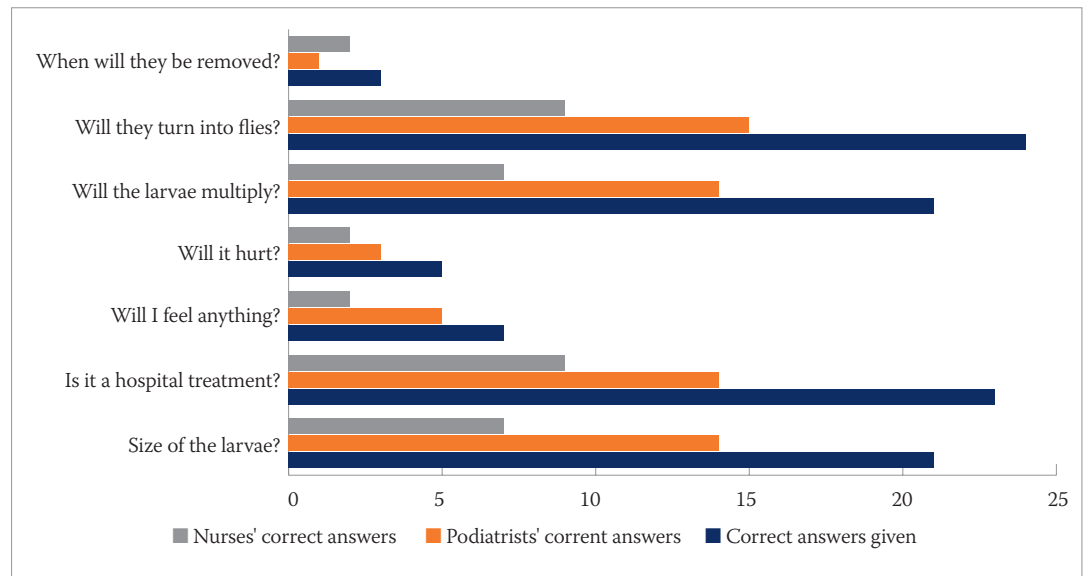


Figure 3. Number of correct responses to case study questions



Box 1. Correct responses to case study questions

- Q How big are the larvae?
- A 1cm
- Q Do I need to go to hospital for these treatments?
- A No
- Q What do they feel like?
- A Tickling sensation felt
- Q Will the larvae therapy hurt?
- A Increase in pain
- Q Will the larvae multiply?
- A No
- Q Will the larvae turn into flies?
- A No
- Q When will the Larvae be removed?
- A 4 days

most respondents reported they did not know, highlighting again more education was required in this area.

CASE STUDY QUESTIONS

A series of eight questions, based around a case of a patient with Type Two diabetes with a DFU, were developed. The questions related to queries an individual might have about their treatment. Box 1 lists the correct responses and Figure 3 shows the number of correct responses provided by the participants divided by profession.

Responses given in Figure 3 showed that Podiatrists seemed to have a better understanding of the questions given, but overall more in-depth

knowledge is needed across both professions.

An open-ended question asked participants to comment on what patients cannot do while they are receiving MDT. Table 5 summarises the responses; the most common theme was avoiding placing in water, followed by avoiding pressure on the area.

Experience of using maggot debridement therapy

Of the total number of respondents (n=27) only 11 reported that they had used MDT; this equated to 7 Nurses and 4 Podiatrists.

Perceptions of maggot debridement therapy

Respondents were asked, "When the words maggot

Table 5. What can patients not do while maggot debridement therapy is *in situ*?

What can the patient not do while maggot therapy is in situ?	Frequency of responses
Place in water	13
Place pressure to area	7
Don't know	6
Place to direct heat	3
Patient to dress wound	2
Ambulate	1
Rest	2
Rollerskate	1

therapy are used, what does this bring to mind?"; the free-text responses elicited a number of themes including: maggots help to debride ( $n=5$ ), hard-to-heal wound ( $n=3$ ), yuck/gross ( $n=3$ ) and expensive, wound care ( $n=2$  for each). Other terms used with more negative connotations were labour-intensive, flies and dirt and death ( $n=1$  in each instance).

#### Obtaining maggot debridement therapy

Equal responses were made for knowing how to obtain MDT through the local service, (Yes  $n=13$ , No  $n=14$ ). Regarding being confident in recommending MDT, two-thirds ( $n=18$ ) of respondents reported not having the confidence to do so.

#### Changes/improvements required

Responses from participants indicated that further education or training was needed and that local protocols for use of MDT should be clearer.

#### DISCUSSION

The results of this evaluation identified that both Podiatrists and Nurses had a good general understanding of MDT and the reason for its use as a treatment modality in wound management. Regarding the questions about MDT, which required a more in-depth knowledge, the results showed that nurses had a better understanding on species of fly that was used to harvest the larvae, what wound aetiology could have larvae applied, and on how many days the larvae are kept *in situ*. These questions highlighted a number of gaps in knowledge for both Podiatrists and Nurses. For example, sensation (e.g. would the maggots or pain be felt during treatment).

One of the main barriers this service evaluation

highlighted was the lack of knowledge on how to obtain MDT, with almost half the respondents reporting that they were not aware of the procedure. On further discussion with the Nurses from the local tissue viability service, no protocol or policy existed on how to obtain MDT. An existing pathway was available and indicated that, if patients were suitable for MDT, then recommendations by Tissue Viability, Vascular, Plastics and Podiatry needed to be sought and procurement made via a separate budget. This is likely to have acted as a barrier, as no clear process or procedure was in place.

The results related to participants' experience of using MDT indicated that less than half of the sample had used MDT. This was despite some of the participants having over nine years of clinical experience. This might be explained by the finding that over half of the sample reported not having the confidence to recommend MDT. It was not possible to determine this correlation in the current evaluation but it would be interesting to study this further to explore whether healthcare professionals have a higher level of self-reported confidence with other wound care treatments.

Responses from the survey to a question about what the word 'maggot' meant to them generated terms such as 'death', 'gross', 'dirt and flies', these types of attitudes and beliefs tend to be named the 'Yuck Factor' (Sherman, 2003). Limited literature on healthcare professional attitudes to MDT exists; however, the results of the current survey suggest that the 'Yuck Factor' perceptions continue. This evaluation also identified a more positive trend towards considering the benefits of MDT in terms of debridement. A number of responses mentioned that, because of the requirement for daily dressing changes, this can be seen as time-consuming. In

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combination with existing time constraints placed on services and staff members, this may be a barrier to recommending the use of MDT

This study has made a contribution to the existing knowledge in terms of barriers and enablers to MDT use on DFUs. It has also informed of the impact the change of protocol has placed onto stakeholders' recommendations and supply of MDT to those patients treated in the community. The wider context of healthcare professionals' education requirements within the local lower limb services treating DFUs has also been raised. The service evaluation supports the limited published evidence that knowledge of MDT on DFUs is poor but has demonstrated that education is strongly needed, with better protocols and pathways needed so practitioners know how to obtain MDT.

## Limitations

We acknowledge that, although the online survey was sent out twice, the response rate was low, and it was based on a convenience sample on a range of healthcare professionals. It should be noted that the project was undertaken during the COVID-19 pandemic, which was a barrier to individuals being able to participate. Additionally, following commencement of this evaluation, it came to light that a change in regulations from the MHRA was a significant barrier to the supply of MDT because the change meant that MDT must be prescribed by an extended prescriber, who are healthcare professionals that have had specialist training to enable prescribing of medicines for any medical condition, of which there are limited numbers in the local service. This meant that the intention to undertake a series of interviews with key stakeholders was not possible. Lastly, the findings are based on an unvalidated questionnaire using self-reporting of practice, therefore the findings

are not necessarily more widely generalisable.

## CONCLUSION

It is estimated that by 2025, five million people are likely to be diagnosed in the UK with diabetes, and at some point, 15% of this population will have a DFU (NICE, 2019). This is likely to bring a significant financial burden on the NHS, with treatment costs being estimated at £300 million a year (Posnett and Franks, 2019). It is well documented that MDT is an effective wound modality for DFUs by improving healing rates, and reducing infection and colonisation (Naik and Harding, 2017).

The main aim of this study was to examine the use of MDT for individuals with DFUs by engaging with key stakeholders via interviews and a survey. The results of the survey have provided valuable local insight into MDT treatment on DFUs. The findings indicate that participants had a good understanding of what debridement is and the purpose of using MDT. However, knowledge of the type of larvae used and the lifecycle of the larvae was poorer. The majority of respondents were aware of the types of wounds MDT could be used for and the main benefit being for quick and effective debridement. The specific actions of MDT knowledge levels were much poorer in terms of what enzymes the larvae produce. However, responses to the mechanical process of larval debridement showed a good understanding. Regarding contraindications and precautions when the maggots were removed (whether they hurt/would the patient feel anything), our results showed that in-depth education was needed over both groups. There are some indications that perceptions of MDT are still predominantly negative (e.g. the 'Yuck Factor' persists and they are also seen as labour-intensive, as well as being associated with 'dirt' and 'death'). However further exploration of this is needed, as the sample size in the service evaluation was small.

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## Declaration of interest

This work was undertaken in part fulfilment for the Masters in Wound Healing and Tissue Repair at Cardiff University. There were no external sources of funding for this study. The author has no conflicts of interest to declare.