Effect of larval therapy compared to conventional wound care treatment

Abstract

This research sought to assess the efficacy of larval therapy compared to conventional wound care treatments for healing chronic wounds in adult patients. The study involved a search on various online databases. They included CINAHL, MEDLINE, EMBASE, and the Cochrane Library. A qualitative approach was adopted due to the need for greater insight into nurses' attitudes towards larval therapy for wound healing and to assess the patient-reported experience of the treatment. A total of 435 studies were initially identified and 10 studies were included in the literature review. These studies were critically appraised using established matrix appraisal tools. The findings suggested that MDT was a more effective treatment for chronic wounds in adults compared to standard wound care, significantly decreasing wound slough after one week and easing the healing process within two weeks. Nurses' experience and education had a positive correlation with their willingness to use larval therapy and patient attitudes towards the treatment were generally positive. Further investigation should be undertaken to evaluate the cost-effectiveness of larval therapy as an alternative method of wound care management, as well as its potential to improve healing outcomes for different chronic wounds. This research highlights the need for more widespread adoption of larval therapy as an effective and safer treatment for chronic wounds.

Table of Contents

Abstract 2
Table of Contents 3
1 Chapter 1: Introduction 4
1.1 Background 4
1.2 Aim 6
1.3 Objectives 6
2 Chapter 2: Methodology 7
2.1 Search Methodology 7
2.2 Search Criteria 7
2.3 Databases Used 8
2.4 Inclusion/Exclusion Criteria 8
2.5 Data Appraisal 8
2.6 Article selection process 8
3 Chapter 3: Critical Literature Review 10
3.1 Theme 1: 10
3.2 Theme 2: 14
3.3 Theme 3: 18
4 Conclusion 23
5 References 26
6 Appendix 30
6.1 Appendix I: Prisma Flow Diagram adapted from Moher et al. (2009) 30
6.2 Appendix II: Matrix - Research Critical Appraisal Tool for Research Articles 31

1 Chapter 1: Introduction

1.1 Background

Iqbal et al. (2017) defined a chronic wound as a wound that does not heal within a predictable amount of time or in an orderly manner. A wound is deemed chronic if it does not heal within three months. According to research conducted by Harding (2022), the total burden of wounds in the United Kingdom is £8·3 billion. The research also demonstrated that 80 per cent of the total costs were recorded in the community with a high rate of fragmentation of care. The study also showed that between 2012 and 2018, the prevalence of wounds increased by 71 per cent while costs increased by 48 per cent. The study recommended further research into more innovative and cost-effective wound treatment strategies.

Guest et al. (2020) stated that there were approximately 3.8 million patients with a wound managed by the National Health Service in 2018. During the year, the study showed that 70% of patients were healed where 89% had acute wounds while 49% of the patients had chronic wounds. This showed that most (51%) of the patients with chronic wounds did not heal. This demonstrates the need for more effective wound treatment strategies.

Chronic wounds are a significant morbidity issue in adult patients. Chronic wounds result from various conditions including traumatic injury, venous diseases, or poor immune systems. Additionally, chronic wounds may result from obesity, diabetes, or poor nutrition. There are various treatment methods for chronic wounds. These include debridement where the damaged tissue is removed, using topical agents like antibiotics, and adopting compression therapy and moisture balance. Other strategies include dermal grafts, using skin substitutes and adopting negative pressure wound therapy. Hyperbaric oxygen chambers can also be used to fasten the wound healing rate.

Despite the current treatment practices of treating chronic wounds, there are still gaps that need to be addressed. In particular, there is growing evidence for the potential of larva therapy as an effective alternative in the treatment of wound healing. Maggot therapy is a wound treatment strategy that uses small, sterile maggots. The maggots provide a natural form of cleaning which eliminates dead or infected tissue hence enhancing healing. The maggots secrete enzymes which fight various types of bacterial infections. According to Nigam (2021), maggot therapy has increasingly been adopted to treat wounds. The treatment was first included in NHS prescription in 2004 which triggered vast scientific and clinical research on their use. However, there is limited research that has compared larval therapy with other forms of wound treatments. Additionally, limited research has been conducted to evaluate the patient-reported experience of larval therapy on wound healing outcomes. The cultural and social acceptance of larval therapy among nursing staff in the UK is also not well understood. Further research is also necessary to evaluate the cost-effectiveness of larval therapy as an alternative method of wound care management.

This research study seeks to address these gaps by exploring the effects of larval therapy compared to conventional wound care treatments in adult patients with chronic wounds. The research will compare the healing rate of wounds treated with larval therapy to those treated with standard wound care and healing agents in adult hospital patients. The study will also explore nurses' attitudes towards larval therapy for wound healing in adult patients and assess the patient-reported experience of the treatment. The findings of this research will enable an adequate analysis of the efficacy and effectiveness of larval therapy.

1.2 Aim

This research project aims to assess the efficacy of larval therapy compared to conventional wound care treatments for healing chronic wounds in adult patients.

1.3 Objectives

Research objectives:

- To compare the healing rate of wounds treated with larval therapy to wounds treated with standard wound care treatments or healing agents in adult patients
- To explore nurses' attitudes towards larval therapy for wound healing in adult patients.
- Assess the patient-reported experience of the larval therapy treatment in adult patients with chronic wounds

2 Chapter 2: Methodology

2.1 Search Methodology

This study aimed to investigate and compare the healing rate of wounds treated with larval therapy to wounds treated with standard wound care treatments or healing agents in adult patients. To achieve the research aims and objectives, a systematic search of relevant papers was conducted in multiple electronic databases including CINAHL, MEDLINE, EMBASE, and the Cochrane Library.

This study adopted a qualitative approach due to the need for greater insight into nurses' attitudes towards larval therapy for wound healing and to assess the patient-reported experience of the treatment. Articles that relied on primary data were collected from existing literature and studies related to the topic. The collection of this data enabled a better understanding of the concept of larval therapy and its efficacy. The articles were also analyzed to determine their relevance to the study. Qualitative research allows for an in-depth look and understanding of complex phenomena, enabling the researcher to gain an in-depth insight into the complexities of the topic (Sebele-Mpofu, 2020).

2.2 Search Criteria

To identify relevant literature for the study, a list of search terms was used including chronic wounds, larval therapy, conventional wound care treatment, wound healing, adult patients, healing rate, patient-reported experience, and nurses' attitude. A combination of the keywords was used in the databases to obtain a wide range of articles related to the objective of the study. The searches utilised Boolean operators ('AND', 'OR', 'NOT') to combine the keywords and narrow down the search process to relevant articles related to the research study.

2.3 Databases Used

The databases used in this study include CINAHL, EMBASE, MEDLINE, and the Cochrane Library. These are major healthcare resources used to identify evidence-based research articles on various topics.

2.4 Inclusion/Exclusion Criteria

Inclusion criteria included articles published from 2013 onwards in English. The journal articles had to be from peer-reviewed journals. Any articles that were not relevant to the research topic, or those not evaluating the concept of larval therapy were excluded. The study only included quantitative papers. The date limits of the search were 2013-2023. This period was selected to ensure that recent articles were considered hence current larval therapy research is included.

2.5 Data Appraisal

The retrieved articles were critically appraised using the research design matrix. The objective of the appraisal was to evaluate the validity and reliability of the evidence. The matrix checklist assessed the trustworthiness, rigour, relevance and applicability of the evidence.

2.6 Article selection process

A pre-specified search strategy was developed to ensure that only relevant articles related to the research objective were retrieved. After the literature search was completed, a total of 435 studies were initially identified. Duplicates were removed, leaving 335 potentially relevant articles for full-text assessment of eligibility. After a thorough assessment of the 215 full-text articles, 185 were identified as being peer-reviewed and relevant inclusion in the research. Among the 185

articles, 85 were further filtered by including only the past ten years of records published from 2013 to 2023 and from academic journals only. Out of the 85, 42 records were excluded based on the criteria of infants, children, and adults below 19 years. Consequently, 10 studies were included in the literature review. These studies were critically assessed using established matrix appraisal tools to assess the quality and validity of the studies. This process is summarized in Appendix I.

3 Chapter 3: Critical Literature Review

3.1 Theme 1:

To compare the healing rate of wounds treated with larval therapy to wounds treated with standard wound care treatments or healing agents in adult patients.

The study by Gunasegaran et al. (2022) provides preliminary evidence regarding the effectiveness of Maggot Debridement Therapy (MDT). The treatment was analyzed patients with chronic wounds in a tertiary hospital. The authors found that MDT was successful in completing the debridement of 73% of wounds, with S. aureus being the most commonly isolated bacteria. Additionally, there was no recurrence of infection post-MDT and the median time for wound healing was four days. However, the study was limited to just 30 patients and did not compare MDT to conventional wound care treatments. This means that although there is some initial evidence to suggest that MDT may be an effective wound-healing treatment, further research is needed to compare MDT to conventional wound care in larger populations and to assess further the long-term effects.

Cangel et al. (2022) explored the adoption of larval therapy compared to conventional wound care treatment for adult patients with chronic wounds. The data was collected from a prospective randomized clinical trial of 72 patients. A total of 45.8% of patients were administered with 15 VAC therapy sessions within one month. A total of 54.2% were administered with six larval therapy sessions. The results demonstrated that VAC therapy group, 42.4% of patients had their wounds healed while 12.1% had all of their toes amputated. For the maggot therapy group, however, the wound healed in 92.3%. This study highlights the potential effectiveness of larval therapy in accelerating the wound-healing process. However, the limitations of the study, such as the lack of control over the patient's lifestyle, nutrition and even environmental exposure, could

have affected the external validity of the results. Further research is needed to confirm these findings. Bazaliński et al. (2019) had almost similar findings and showed that maggot debridement therapy was an effective wound treatment. The study compared the results of MDT applied to chronic wounds with those of conventional surgery. The research found that MDT was a safe and effective method for wound debridement. MDT was also associated with disinfection, and tissue growth while being more cost-effective than surgical intervention.

Tombulturk and Kanigur-Sultuybek (2021) seek to explore the level of efficacy of Maggot Debridement Therapy (MDT) with Lucilia sericata larvae in treating chronic wounds caused by diabetes, ulcers, venous leg ulcers and infected wounds. The research suggests that MDT can be an efficient, low-cost and reliable biosurgery option. The article demonstrates that the enzymes and peptides in the excretions/secretions (ES) of the larvae are responsible for the beneficial molecular effects of MDT that stimulate healing. These include antibacterial and antifungal, anti-

inflammatory, and tissue-regenerating actions, both in vitro and in vivo. The quality of evidence is discussed, as well as the limitations of the methodology employed. The findings of the article suggest that MDT with Lucilia sericata larvae could be safely used after assessment of underlying causes to improve healing.

This study by Opletalová et al. (2012) examined the efficacy of maggot debridement therapy (MDT). The study compares MDT with conventional wound care treatment in adult patients with chronic wounds. The implementation of this randomized, prospective trial among two French hospitals showed that MDT was able to significantly reduce the presence of wound slough after one week. Following the two-week duration of hospital-based care, however, MDT presented no statistically significant benefit over conventional care therapy. The findings of this study suggest that MDT is capable of providing improvements in wound healing rate in the short

term, with no difference being seen at the end of the two-week trial interval. The study was well executed, with careful control of confounding factors and a corporate, double-blinded approach to collecting and analyzing data. While the authors of this study note that MDT provides fast and reliable debridement, these results should be taken into consideration due to the study's limited sample size and the potential for incompleteness in the evenness of impact between the two treatment regimes.

The article by Sun et al. (2014) looks at the effectiveness of maggot debridement therapy (MDT) when used to treat chronic wounds. The study utilises pooled data from multiple sources, with the effects of MDT compared to conventional therapies being expressed as a relative risk (RR) and a standardized mean difference (SMD). The findings indicate that MDT had a significant and positive effect on wound healing. The combined RR was 1.79 for patients with diabetic foot ulcers and 1.70 for patients with other types of ulcers. The time to healing of the ulcers was significantly shorter among patients treated with MDT. These results suggest MDT may be a feasible alternative for the treatment of chronic ulcers. However, the methodology used in the study is limited, as the data is pooled from multiple sources and the quality of the individual studies is not discussed. Future research should aim to further assess the effectiveness of MDT against conventional therapies and examine possible adverse effects of MDT.

The article by Nezakati et al. (2020) conducted a clinical trial which showed that MDT related to the disappearance of necrotic tissue. MDT was also associated with the control of infection. The two patients healed without the need for further surgical resection or anatomical reconstruction. These findings suggest that MDT may be a beneficial therapeutic approach in the treatment of Fournier's Gangrene. The methodology used in the study appears robust, with two patients enrolled who were both given one initial surgical excision followed by MDT, rather than

multiple surgeries. Ideally, future research could include a larger sample size to further investigate the effectiveness of MDT in the treatment of Fournier's Gangrene, as well as a comparison of MDT to conventional wound healing methods. Overall, the results of the study provide promising evidence that MDT may be an effective treatment for Fournier's Gangrene.

As opposed to Nezakati et al. (2020) who evaluated the treatment through MDT only, Song et al. (2020) reviewed the therapeutic effects of using a combination of maggot therapy and moist exposed burn ointment (MEBO) for chronic wounds. The seven clinical cases described in the article indicated improved wound healing outcomes when MEBO and maggot therapy were combined. However, further research and clinical trials are warranted to better understand the combined application's mechanism of action for wound healing. Criticisms of the methodologies used by the article may include the lack of a control group in the clinical cases and the overall small sample size. Nevertheless, the article demonstrated that the combined adoption of MEBO and maggot therapy may be a promising treatment for hard-to-heal wounds.

Parizad et al (2021) also evaluated the effectiveness of a combination of interventions. The article by Parizad et al (2021) presents a case report that examines the benefits of using surgical debridement, maggot therapy, negative pressure wound therapy, and silver foam dressing combined to treat a diabetic foot ulcer (DFU). The article demonstrates that this combination therapy was successful in helping the patient to achieve complete wound healing in three months and ten days. The authors highlight the importance of multimodal care and interdisciplinary treatment in wound management and point to the potential usefulness of this combination therapy for the management of DFU in the future. Furthermore, the article demonstrates the effectiveness of combining conventional treatment approaches with newer, innovative therapies for the successful management of difficult and complex DFUs. This has important implications for the

management of DFUs in the future. It provides evidence of the potential benefit of using more modern and less conventional treatments in the management of DFUs.

The article by Masiero et al. (2019) evaluated the adoption of MDT for treating wounds in vitro. The authors sought to identify effective combinations of medicinal larvae and topical agents for improved wound healing. The larvae studied included Cochliomyia macellaria. The topical agents studied included honey, hydrogel and essential fatty acids. The results showed that hydrogel and 10% papain gel had the lowest interference in terms of larval weight and survival rate. Honey, EFA and collagenase were found to be useful in preparing beds for dry wounds. This study offers promising results as to the effectiveness of larval therapy in wound healing, but further research is needed to assess its efficacy in a clinical setting. The results suggest that further research into MDT should be conducted to confirm its practical relevance for treating chronic wounds.

The majority of the articles reviewed have evaluated the effectiveness of MDT without considering the unique characteristics of the patients. However, Zhang et al. (2022) examined the use of Maggot debridement therapy (MDT) to treat chronic wounds in a tropical climate. People living in tropical climates are exposed to unique climatic conditions hence may have different results when treated with MDT. The study analyzed 14 patients. The study results recorded a lower NVT among 11 of the 14 patients. A total of 10 patients achieved successful debridement. However, 5 patients underwent amputation within the same admission. The study concluded that patients accepted MDT. This study does have limitations, such as the short duration of follow-up, and a lack of a control group to compare outcomes with conventional treatments.

3.2 Theme 2:

To explore nurses' attitudes towards larval therapy for wound healing in adult patients.

Jaila and Bongkiynuy (2016) investigated the attitude of nurses towards maggot therapy (MT) when used to treat diabetic ulcers. The findings revealed that although 46.7% of nurses were aware of MT, the attitude was mixed, with an almost equal level of positive and negative responses. The results pointed to the Internet as being the main source of awareness, indicating that education and awareness campaigns are key for the successful adoption of the therapy. The results of this study have policy implications and suggest that increased education and lobbying are needed to raise awareness of MT in the nursing community.

This article by Fairey & Holloway (2022) analyzed the use of MDT for diabetic foot ulcers (DFU). The results indicated that healthcare professionals had a basic understanding of maggot therapy. From the survey, enablers and barriers to the implementation of MDT were identified. Such attributes identified included policy and procedures, time constraints, and the 'yuck factor'. Overall, the study supported the use of MDT, but more research is needed to explore factors influencing healthcare professionals' decisions to recommend MDT. The study is limited because the survey was provided in only those specialist services providing wound care treatments for DFUs, suggesting the results may not be generalisable to other services or wider populations. Thus, further studies are required to ascertain nurses' attitudes towards larval therapy for wound healing in adult patients.

This study by Hopkins et al. (2022) explored nurses' attitudes towards larval debridement therapy (MT). The study held a focus group and conducted an anonymous web-based survey. The research also adopted in-depth interviews where specialist and generalist nurses were interviewed. Results showed that MT was more highly regarded by specialist nurses. The results showed that non-specialist nurses reported a greater level of wariness towards MT. These findings demonstrate the need for improved training and education about MT for all nurses.

Although the survey provides an important direction for future research, its reliance on the Nursing Times online platform and social media may have led to a skewed demographic of respondents. Further research should consider strengthening the methodologies to ensure a balanced sample size and a representative sample of participants.

Bazaliński et al. (2022) examined the perceptions and readiness of nurses to apply Maggot Debridement Therapy (MDT) to treat chronic wounds. The study sample included 290 nurses. Results indicated that the perception and readiness to undertake MDT in this group of nurses was relatively average; maggots in the wound produced negative emotions. However, further research revealed that knowledge of MDT was linked to higher motivation levels, demonstrating the importance of understanding the method before undertaking it. The methodology of this study, which was based on questionnaires, was effective in exploring the attitudes of nurses to MDT. Despite this, more qualitative research is needed to gain a more in-depth understanding, of the relation to the emotions felt, regarding seeing maggots in the wound. Although the results of this study provide insight into nurses' attitudes, further research across different healthcare professionals and age groups is encouraged to gain a better understanding of the wider context.

Pajarillo et al. (2021) aimed to investigate the perceptions of health professionals' perceptions of MDT. The findings of the study revealed that the most common factors preventing greater acceptance of MDT were insurance reimbursement restrictions, aspects of stigmatisation, and the 'yuck' factor. Studies on MDT have suggested that it is an effective and safe intervention for wound management and healing. This study supports this evidence, providing insight into one of the key factors preventing MDT from becoming a more widely accepted approach: the 'yuck' factor. Overcoming this factor will require a re-framing of MDT,

placing it in the context of a modern, evidence-based wound treatment, rather than a traditional, less effective intervention. In addition, the small size of the sample used in the study limits the generalizability of the results. Nevertheless, it provides an important insight into the factors hindering healthcare professionals' acceptance of MDT, which must be understood if it is to become a more widely used approach to wound care in the future.

Mita et al. (2022) explored nurses' attitudes towards larval therapy for wound healing in adult patients. The study found that nurses' perceived level of stress had a significant effect on the willingness to undertake biodebridement, with a higher level of stress correlating with a lower readiness. The research found also that the level of professional experience and education affected nurses' willingness to undertake larvae therapy. The article presented a thorough and well-structured examination of nurses' attitudes regarding biodebridement using Lucilia sericata larvae. Despite employing a survey of a relatively small and homogenous sample, the authors produced findings that appear to support the notion that nurses' experience and education have a positive correlation with their willingness to utilize larval therapy. Moreover, the results of the study indicated a connection between nurses' perceived level of stress and the likelihood they would use larval therapy, a higher level of stress correlated with a lower level of readiness to undertake biodebridement. However, the study is limited by its small sample size and lack of a comparative control group. Furthermore, it would have been beneficial if the authors had provided more detail regarding the survey questionnaire, as there is currently a lack of information regarding the specifics of the tools utilized. Additionally, the results of the study did not account for any potential external factors, such as differences in healthcare facilities, which could have influenced the nurses' responses. The article provided an informative analysis of nurses' attitudes towards larval therapy for wound healing, and the results of the study suggest

that nurses' experience, education and perceived level of stress have a significant effect on their willingness to utilize this new intervention. Further research is needed to more accurately evaluate the impact of nurses' attitudes towards larval therapy and to determine any additional external factors that could influence their willingness to use this new intervention.

3.3 Theme 3:

Assess the patient-reported experience of the larval therapy treatment in adult patients with chronic wounds

McCaughan et al. (2015) explored 18 adult patients' experiences of venous leg ulceration and their attitudes towards larval therapy as a treatment. The overall conclusion of the study was that, although patients often hold unrealistic expectations of larval therapy, they are willing to try it as they struggle to heal their ulcers. A total of 5 participants who underwent maggot therapy were included in the study. The improvements that were recorded initially were not sustained. Furthermore, two of the patients reported extreme pain. The primary research method employed by the study was a semi-structured interview, which was found to be an effective way of exploring patient experience and attitudes towards larval therapy. However, there have been critiques of semi-structured interviews being more suited towards qualitative data collection, and therefore quantitative data may not adequately capture the nuances of patient attitudes. Furthermore, this study only involved a small sample size, so the findings may not be generalisable. The study found that the majority of the participants were willing to work through their feelings of squeamishness to be potentially healed of their ulcers. How the participants were able to overcome this feeling and what motivated them to do so should be further explored. Ultimately, more research should be conducted to assess the long-term impact of larval therapy in the treatment of chronic wounds, as

well as explore how patients can be adequately informed and supported when considering this type of treatment.

Da Silva et al. (2020) researched to provide insight into the patient's perspective throughout the process of Larval Therapy (LT). Data was collected through oral histories of 6 chronic wound patients who experienced LT. Results indicated that the patients found LT to be beneficial, providing a sense of belief, and acceptance, reduction in pain, healing of the wound and decrease of bad odour. Furthermore, it highlighted the importance of informing the patient about what LT consists of, helping in gaining acceptance for the treatment. However, LT can be subject to severe criticism due to its use of animals which can bring up some uneasiness. The methodologies used in the study were considered appropriate for the context. Oral histories were deemed suitable to collect data from the patient's point of view. The findings of this article strengthen the importance of patient-centric care and how a lack of patient engagement can lead to unsuccessful treatments or low adherence rates. Patient feedback can be an important criterion for assessing the effectiveness of treatment. However, results should be taken with caution considering the small sample used and the biases of people who decided to take part in the study.

Nezakati et al. (2020) study aimed to explore the impact of larval therapy using Lucilia sericata for treating chronic wounds. A total of ninety patients were selected. They were placed under either control or intervention groups. The intervention group were treated with larval therapy in addition to standard treatment. At different points, both groups were evaluated for the presence of Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, and Enterococcus bacteria. They were also evaluated to determine the extent of wound healing and the reduction of necrotic tissue. The results revealed that the intervention group showed a significant reduction in the presence of S. aureus, P. aeruginosa, and E. coli. Additionally, the rate of wound healing and the

reduction of necrotic tissue significantly increased in the intervention, more than in the control group. These findings suggest that larval therapy is a promising treatment for chronic wounds and has the potential to improve participants' quality of life. Additionally, the findings highlight the need for further research in this field. For example, future studies should focus on the role of different types of larvae, examine the costs associated with larval therapy, and assess the long-term effects of larval therapy on wound healing. Furthermore, additional research should consider other factors that may influence the success of larval therapy such as the timing of treatment, the type of bacteria present, and patient characteristics. Overall, this study highlights the potential of larval therapy in the management of chronic wounds.

Nigam et al. (2022) explored public attitudes towards maggot therapy in treating chronic wounds. The research utilised a mixed-methods approach, involving a small focus group to discuss opinions and views, as well as an anonymised web-based survey. The focus group identified four key themes concerning the acceptability of maggot therapy. The survey demonstrated that only 36% of participants would accept MT as first treatment for a chronic wound, with an increase in acceptability when the severity of the wound was taken into account. The most commonly expressed fears and worries were the potential sensation of the therapy and the sense of disgust accompanying it. Despite the initial apprehension, the survey results suggested that knowledge and understanding of maggot therapy were related to the potential acceptability of the treatment, indicating that information and education are key factors in public attitude. These findings are further supported by studies that have highlighted the improved efficacy of the treatment and the level of patient satisfaction by those who have received it. However, further research was proposed to better understand the public understanding of maggot therapy and perceptions of its advantages

and disadvantages in treating different types of wounds and in different contexts to enable knowledge-driven decisions about care.

Gunasegaran et al. (2022) discuss the clinical outcomes and patient acceptance of MDT. The study focused on a tertiary hospital in Singapore. The study included 14 adult patients with lower limb wounds who were unable to tolerate sharp debridement or had nonviable tissue (NVT) covering at least 25% of their wound bed. A total of 3 patients were administered with Maggot therapy. The other participants were treated with free-range larvae (FRL) therapy. Overall, 11 out of 14 patients experienced a reduction of NVT, and 10 of 11 achieved successful debridement. However, 5 patients were subjected to amputation. Additionally, 60% of these patients failed to achieve successful debridement. The research suggested that MDT can influence the healing of chronic wounds and potentially reduce the need for amputation.

In previous studies, MDT has been recognised as an effective treatment for necrotic tissue removal. Gunasegaran et al. (2022) provide a timely contribution to this research by examining the patient experience and use of MDT in a humid tropical climate. The findings of the study suggest that MDT is quite well-accepted by patients. Furthermore, the study demonstrates the need for more research to identify the optimal type of MDT and to gain a better understanding of patient experiences.

Morozov and Sherman (2019) surveyed 576 patients with chronic arterial insufficiency and trophic ulcers in the Tver region of Russia to assess the psychological barriers associated with maggot therapy. Patients were asked to rank images of maggots and gangrenous wounds in terms of repulsiveness, with 59.6% of respondents ranking maggots as more repulsive than the wounds. This suggests that wide education and support are required for patients to be comfortable with a maggot therapy program. The survey methodology used in this study is noteworthy for its strength

due to the large sample size, which brings greater validity to the results. In addition, the survey used six images to aid patient responses, allowing for greater clarity in ranking repulsive items. However, there could be drawbacks to this method, such as patient respondents perceiving the images to be more repulsive than they are. Furthermore, no statistical analyses were used in this study, which could have helped to further quantify and explain the differences in responses. Overall, the findings of this study suggest a clear emotional barrier to the acceptance of maggot therapy, indicating the need for comprehensive education and emotional support for patients before any intervention. Despite the strengths of the survey methodology used by Morozov and Sherman (2019), further research is required to more objectively quantify and explain emotional perceptions of maggot therapy as well as other patient-reported experiences.

Results from the study demonstrate that larval therapy has promising outcomes for the treatment of chronic wounds. Patients experienced reduced bad odour, pain, and an increase in wound healing. There was a reduction in the presence of Staphylococcus aureus, Pseudomonas aeruginosa, and Escherichia coli bacteria. However, public opinion and attitude towards larval therapy are mixed and educational efforts are needed in certain cases. Patients' acceptance of MDT is also affected by feelings of squeamishness and revulsion to maggots. This demonstrates the need for extra psychological support and education to create awareness of the treatment. Further research should be conducted to understand the optimal application of the therapy, its cost-effectiveness, and long-term effects.

4 Conclusion

The first objective of this research was to compare the healing rate of wounds treated with larval therapy (MDT) to wounds treated with standard wound care treatments or healing agents in adult patients. The research suggests that MDT is a more effective treatment approach for chronic wounds in adults as compared to standard wound care. MDT significantly reduced the presence of wound slough after one week and eased the healing process within two weeks. The findings from the randomized clinical trial further demonstrated the effectiveness of MDT, with healing rates of 92.3% compared to 42.4% in standard wound care (VAC therapy) treatments. Furthermore, the combination of MDT and MEBO, as well as other combinations of MDT with additional treatments, were also found to be promising therapeutic approaches.

The second objective was to explore nurses' attitudes towards larval therapy for wound healing in adult patients. The review found that nurses' experience and education had a positive correlation with their willingness to use larval therapy and that the level of perceived stress had a significant effect on their readiness to undertake the therapy. The research findings showed that MDT was embraced and accepted by wound specialist nurses, with generalist nurses reporting a greater level of wariness towards it. This demonstrated the need for improved training and education about MT for all nurses. The objective of this literature review was therefore achieved. The review revealed that nurses can have positive and negative attitudes towards larval therapy, depending on their level of experience and education, and that greater levels of education and awareness are needed to encourage acceptance of the treatment.

The third objective was to assess the patient-reported experience of the larval therapy treatment in adult patients suffering from chronic wounds. Patients felt disgusted and discomfort when considering larval therapy as a treatment option. However, overall patient attitudes towards

the treatment are generally positive, especially given its potential to provide relief from a difficult condition. Patients report relief from pain, decreased bad odour, and increased wound healing following treatment. Although some patients are initially apprehensive about the treatment, they are generally willing to work through their feelings and try the therapy to be potentially healed. Educational efforts are needed to help ensure patient acceptance and reduce feelings of squeamishness. Overall, these findings suggest that, with the proper education and support, patients can have a positive feeling and acceptance towards larval therapy.

- **Limitation**

One limitation of this research was the lack of consensus among studies as to the effectiveness of larval therapy. This was because different studies used different methods when evaluating the efficacy of larval therapy, making research comparison challenging. Furthermore, the studies often had different research designs, samples and outcomes, meaning it was difficult to synthesise the results. Another limitation was the lack of research looking into the cost implications of larval therapy. As larval therapy can be more expensive than standard healing methods, the potential for financial savings that may result from its use should be explored. Finally, there was a lack of consideration of the potential ethical concerns that may arise from the use of larval therapy, such as patient distress.

- **Implications and Recommendations**

The findings of this research point to the efficacy of larval therapy as an efficient and safe treatment for wound healing, providing promising results when compared to conventional wound care treatments. These results and findings suggest that larval therapy is a viable treatment option for chronic wounds, particularly in adults.

The Nursing and Midwifery Council (NMC) Code is the professional standard that nurses, midwives and nursing associates should adhere to. The Code is based on four main themes. They include prioritizing people, practising effectively, preserving safety and promoting professionalism and trust. The research demonstrates that nurses should be aware of the potential benefits of larval therapy and ensure they are adequately trained in its administration to ensure patient safety. The Code stipulates the need to adopt a patient-centred approach to care. Based on the findings, patients have limited knowledge concerning maggot therapy hence nurses should inform and educate the patients during care delivery. Additionally, nurses should not only educate patients about the potential benefits of the therapy but also be open to having conversations about implications and possible risks. This will assist in reducing patient reluctance and negative perceptions surrounding larval therapy. Based on the Code, nurses should promote professionalism hence the need for apprenticeship programmes and educational opportunities to encourage accessibility to maggot therapy for those with chronic wounds. Additionally, further study should be undertaken to evaluate the cost-effectiveness of larval therapy as an alternative method of wound care management, as well as its potential to improve healing outcomes for different chronic wounds. This will help inform and improve decision-making in healthcare settings. This research highlights the need for more widespread adoption of larval therapy as an effective and safer treatment for chronic wounds.

5 References

Bazaliński, D., Kózka, M., Karnas, M., & Więch, P. (2019). Effectiveness of chronic wound debridement with the use of larvae of Lucilia sericata. *Journal of clinical medicine*, *8*(11), 1845.

Bazaliński, D., Przybek Mita, J., Ścisło, L., & Więch, P. (2022). Perception and readiness to Undertake maggot debridement therapy with the use of Lucilia sericata larvae in the group of Nurses. *International Journal of Environmental Research and Public Health*, *19*(5), 2895.

Cangel, U., Sirekbasan, S., & Polat, E. (2022). Comparison of Larval Therapy and Vacuum-Assisted Closure Therapy after Revascularization in Peripheral Artery Disease Patients with Ischemic Wounds. *Evidence-Based Complementary and Alternative Medicine*, *2022*.

da Silva, S. M., Millions, R. M., de Cássia Almeida, R., & da Costa, J. E. (2020) Larval therapy from the patient's perspective. ESTIMA, Braz. J. Enterostomal Ther.18: e3020

Fairey, C., & Holloway, S. (2022). Maggot debridement therapy for individuals with diabetic foot ulceration: a service evaluation. *Wounds UK*, *18*(4).

Guest, J. F., Fuller, G. W., & Vowden, P. (2020). Cohort study evaluating the burden of wounds to the UK's National Health Service in 2017/2018: update from 2012/2013. *BMJ open*, *10*(12), e045253.

Gunasegaran, N., Seah, V. Q. H., Ang, S. Y., Aloweni, F., Goh, W. T., Liew, A. Y. J., ... & Chong, T. T. (2022). Maggot debridement therapy in the tropics–Preliminary outcomes from a tertiary hospital. *Journal of Tissue Viability*, *31*(3), 544-551.

Harding, K. G. (2022). Chronic wounds: a clinical problem requiring ownership and coordination. *British Journal of Dermatology*, *187*(2), 133-134.

Hopkins, R. C., Williams, S., Brown, A., Humphreys, I., Clifford, R., & Nigam, Y. (2022). Evaluating nursing opinion and perception of maggot therapy for hard-to-heal wound management. *Journal of Wound Care*, *31*(10), 846-863.

Iqbal, A., Jan, A., Wajid, M. A., & Tariq, S. (2017). Management of chronic non-healing wounds by hirudotherapy. *World Journal of plastic surgery*, *6*(1), 9.

Jaila, S., & Bongkiynuy, N. (2016). Awareness and attitude of nurses on the use of maggot therapy in the treatment of diabetic ulcers at the Bamenda Regional Hospital, Cameroon. *World*, *1*(1), 6-9.

Masiero, F. S., Silva, D. G., Luchese, M., Estércio, T., Pérsio, N. V., & Thyssen, P. J. (2019). In vitro evaluation of the association of medicinal larvae (Insecta, Diptera, Calliphoridae) and topical agents conventionally used for the treatment of wounds. *Acta tropica*, *190*, 68-72.

McCaughan, D., Cullum, N., Dumville, J., & VenUS II Team. (2015). Patients' perceptions and experiences of venous leg ulceration and their attitudes to larval therapy: an in-depth qualitative study. *Health expectations*, *18*(4), 527-541.

Mita, J. P., Bazalinski, D., Sztembis, R., Kuberka, I., & Wiech, P. (2022). Perceived stress and readiness to undertake biodebridement in the group of nurses undertaking prevention and treatment of chronic wounds. *Frontiers in public health*, *10*, 1090677.

Morozov, A. M., & Sherman, R. A. (2019). Survey of patients of the Tver region of Russia regarding maggots and maggot therapy. *International Wound Journal*, *16*(2), 401-405.

Nezakati, E., Hasani, M. H., Zolfaghari, P., Rashidan, M., & Sohrabi, M. B. (2020). Effects of Lucilia sericata maggot therapy in chronic wound treatment: A randomized clinical trial. *Chronic Wound Care Management and Research*, *7*, 11-17.

Nigam, Y. (2021). The principles of maggot therapy and its role in contemporary wound care. *Nursing Times*, *117*(9), 39-44.

Nigam, Y., Williams, S., Humphreys, I., Clifford, R., & Brown, A. (2022). An exploration of public perceptions and attitudes towards maggot therapy. *Journal of Wound Care*, *31*(9), 756-770.

Opletalová, K., Blaizot, X., Mourgeon, B., Chêne, Y., Creveuil, C., Combemale, P., ... & Dompmartin, A. (2012). Maggot therapy for wound debridement: a randomized multicenter trial. *Archives of dermatology*, *148*(4), 432-438.

Pajarillo, C., Sherman, R. A., Sheridan, R., & Kazis, L. E. (2021). Health professionals'

perceptions of maggot debridement therapy. *Journal of Wound Care*, *30*(Sup9a), VIIi-VIIxi.

Parizad, N., Hajimohammadi, K., & Goli, R. (2021). Surgical debridement, maggot therapy, negative pressure wound therapy, and silver foam dressing revive hope for patients with diabetic foot ulcer: a case report. *International Journal of Surgery Case Reports*, *82*, 105931.

Sebele-Mpofu, F. Y. (2020). Saturation controversy in qualitative research: Complexities and underlying assumptions. A literature review. *Cogent Social Sciences*, *6*(1), 1838706.

Song, M., Bai, X., Wang, D., Wang, Q., Pan, L., He, P., ... & Wang, S. (2022). Combined application of moist exposed burn ointment and maggot therapy in wound healing. *Journal of Wound Care*, *31*(Sup10), S41-S52.

Sun, X., Jiang, K., Chen, J., Wu, L., Lu, H., Wang, A., & Wang, J. (2014). A systematic review of maggot debridement therapy for chronically infected wounds and ulcers. *International journal of infectious diseases*, *25*, 32-37.

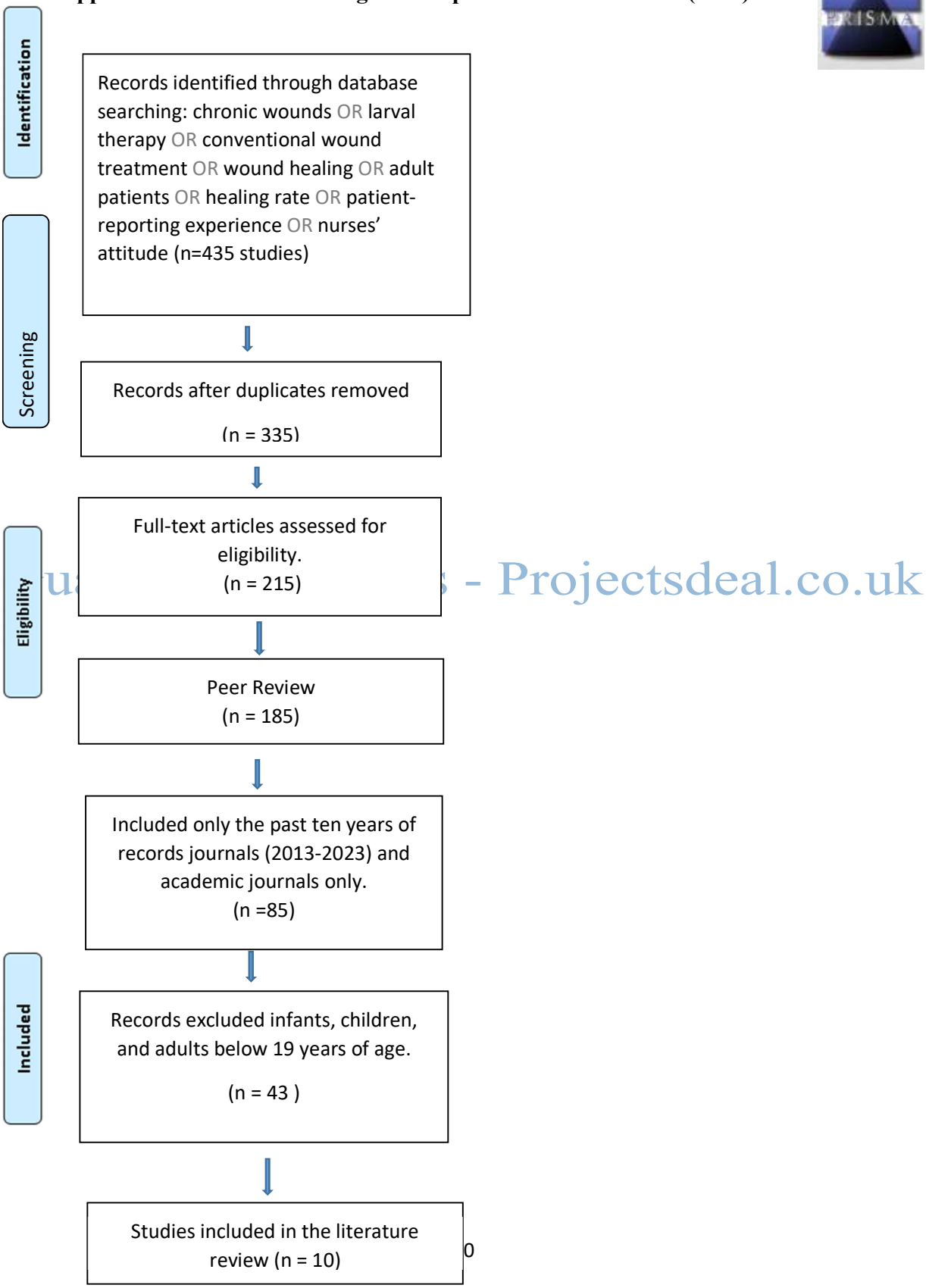
Tombulturk, F. K., & Kanigur-Sultuybek, G. (2021). A molecular approach to maggot debridement therapy with Lucilia sericata and its excretions/secretions in wound healing. *Wound Repair and Regeneration*, *29*(6), 1051-1061.

Yusuf, M. A., Ibrahim, B. M., Oyebanji, A. A., Abubakar, F., Ibrahim, M., Ibrahim Jalo, R., ... & Abbas, M. A. (2022). Maggot debridement therapy and complementary wound care: a case series from Nigeria. *Journal of Wound Care*, *31*(11), 996-1005.

Zhang, J., Gao, C., Sun, X., Wang, L., Hu, Z., Li, G., ... & Wang, A. (2022). Maggot treatment promotes the healing of diabetic foot ulcer wounds possibly by upregulating Treg levels. *Diabetes Research and Clinical Practice*, *184*, 109187.

6 Appendix

6.1 Appendix I: Prisma Flow Diagram adapted from Moher et al. (2009)



6.2 Appendix II: Matrix - Research Critical Appraisal Tool for Research Articles

Research Critical Appraisal Tool: Adapted from J. Garrard (2007)

	Research title	Authors	Location of study	Research Methodology	Sample size	Aims and objectives	Main findings	Strength of research	Weakness of research	Implication for practice
1	Maggot Debridement Therapy in the Tropics - Preliminary Outcomes from a Tertiary Hospital	Nanthakumahrie Gunasegaran, Vivian Qian Hui Seah, Shin Yuh Ang, Fazila Aloweni, Wee Ting Goh, Angela Yi Jia Liew, Wei Xian Tan, Hsien Ts'ung Tay, and Tze Tec Chong	Singapore	A retrospective analysis of medical records at a tertiary hospital in Singapore between January to August 2021 regarding the use of maggot debridement therapy (MDT).	14 patients	To evaluate the efficacy, clinical outcomes and patients' acceptance of MDT at a tertiary hospital in Singapore.	A reduction of necrotic tissue (NVT) was observed in 11 out of 14 patients, and ten of these 11 patients achieved successful debridement (at least 25% reduction in NVT). Five out of 14 patients had to undergo	The study provides a preliminary assessment of the efficacy of MDT at a real-world setting and revealed that there is potential for wound healing through successful debridement and to reduce	This is a small sample size, retrospective and observational study, with limited information available on the patients' medical histories and deep wound pathologies or on the specific MDT technique used.	The article supports the adoption of maggot therapy in treating chronic wounds. Further studies are needed to identify the optimal MDT methods in tropical countries with high humidity, as well as specific indications for MDT therapy and guidelines for the application of MDT, in order to ensure

							amputation within the same admission due to poor wound healing, and MDT was well-accepted by the patients and they felt some improvement in their wounds.	the need for amputation.		better patient outcomes.
2	Comparison of Larval Therapy and Vacuum-Assisted Closure Therapy after Revascularization in Peripheral Artery Disease Patients with	Ugur Cangel, Serhat Sirekbasan and Erdal Polat	Turkey	Prospective randomized clinical trial	72 patients (63 males and nine females)	To compare the outcomes of vacuum-assisted closure (VAC) and maggot debridement therapy (MDT) following peripheral revascularization to	In the VAC therapy group (n=33), 14 patients (42.4%) had their feet amputated, 5 (15.1%) had a toe amputated, and 4	The study was conducted on a large sample size.	There is limited information on the location of the study and the demographic characteristics of the participants.	Larval therapy may be considered a more effective treatment for postrevascularization ischemic wounds than VAC therapy when major amputation is not required. Furthermore, further research is

	Ischemic Wounds					accelerate the wound healing pr	(12.1%) had all of their toes amputated. In the larval therapy group (n=39), the wounds healed in 36 patients (92.3%), and 3 (7.7%) had a toe amputated.			needed to better elucidate the demographic characteristics of participants and the location of the study.
3	Effects of Lucilia sericata Maggot Therapy in Chronic Wound Treatment: A Randomized Clinical Trial	Nezakati E, Hasani MH, Zolfaghari P, Rashidan M, Sohrabi MB	Shahroud, Iran	Randomized clinical trial	90 patients	The study was conducted to investigate the effect of Lucilia sericata maggot therapy in chronic wound treatment.	Larvae of L. sericata have the highest effects on P. aeruginosa and had the least effect on the growth of Enterococcus. Also,	This randomized clinical trial had a large sample size, which allowed for robust evaluation of the effects of maggot	the study only focused on the effects of maggot therapy and did not consider any other interventions or treatments that may have been used in	The results of this study support the use of maggot therapy as a viable and effective treatment option for chronic ulcers. As maggot therapy is a relatively low cost treatment, it could be a

							our results showed larvae of L. sericata therapy can significantly improve wound healing rate.	therapy. Additionally, the results of the study showed that maggot therapy had significant effects in terms of wound healing and reduction in infection.	conjunction with maggot therapy.	useful option for patients who may not be able to afford more expensive treatments. Further research should be done to assess the effects of maggot therapy when used in conjunction with other interventions or treatments.
4	Awareness and Attitude of Nurses on the Use of Maggot Therapy in the Treatment of Diabetic Ulcers at the Bamenda Regional Hospital, Cameroon	Samuel Nambile Cumber, Kuhvinyoh Boris Limnyuy, Jackson Jr Nforbewing Ndenkeh and Shalom Jaila.	Bamenda Regional Hospital, Cameroon.	A hospital based descriptive study design was used.	43 nurses were randomly selected.	To determine the nurses' awareness and attitude on the use of maggot therapy in the treatment of diabetic ulcers in Bamenda Regional Hospital.	46.7% of nurses were aware of maggot therapy, and their attitude towards MT was both positive and negative at almost equal	The research is timely and the authors were able to provide a clear description of the results and implications for practice	A low sample size of nurses was used	With the divided awareness and attitude towards the use of maggots in the treatment of diabetic ulcers in this health facility, there is thus the need to increase awareness amongst the

							levels, with the internet being the main source of awarenes s.			nurses on its importance in the treatment of diabetic ulcers.
5	Evaluating Nursing Opinion and Perception of Maggot Therapy for Hard-to-Heal Wound Manageme nt	Ruth Cn Hopkins, Sharon Williams, Amy Brown, Ioan Humphreys , Rebecca Clifford and Yamni Nigam	United Kingdo m	Mixed-methods study includin g a focus group, an anonymi sed web-based online survey and in-depth intervie ws	Focus group size not specifie d, anonym ised web-based survey distribu ted through social media targetin g all nurses and in-depth intervie ws held with speciali st and generali	The aim of this study was to evaluate the feelings and opinions of nurses regarding the use of Maggot Therapy (MT).	Awarenes s of MT among all nurses was extremely high. MT was much more highly regarded by wound specialist nurses than non-wound specialist nurses. The latter exhibited a greater level of reluctanc e, with almost one-third of these	This study used multiple methods to evaluate the feelings and opinions of nurses regarding the use of Maggot Therapy, including focus groups, web-based surveys and in-depth interview s.	The focus group size was not stated, and the survey was distributed through social media, which may have made it difficult to reach nurses who did not use social media.	Better education and training in MT is needed for all nurses, to address issues with acceptance and willingness to treat or help treat patients with hard-to-heal wounds suitable for MT.

					st nurses		nurses surveyed finding maggots disgusting and the idea of MT making their skin crawl. In-depth interviews revealed a lack of knowledge about MT as a prime concern.			
6	Perception and Readiness to Undertake Maggot Debridement Therapy with the Use of Lucilia sericata Larvae in the Group of Nurses	Dariusz Bazaliński Joanna Przybek Mita, Lucyna Ścisło, Paweł Więch	United Kingdom	Diagnostic survey	290 nurses	To assess the readiness to undertake MDT in a group of qualified nurses.	The perception and readiness to implement the method in the tested sample is at the average (standard) level. The image of	The research tool used was a scientific research protocol, providing an accurate assessment of the perception and readiness	It is challenging to measure the readiness of a nurse to use a certain treatment especially determining a percentage	This study emphasizes the importance of providing nurses with accurate information on MDT to improve and increase their perception of it, which can ultimately lead to better

							maggots in the wound causes negative emotions among medical personnel. The higher the knowledge of the MDT method, the greater the motivation to implement it in practice.	to implement MDT in the group of nurses.	of readiness	implementation, improved healing outcomes and tissue revitalization in patients treated for chronic wounds.
7	Perceived Stress and Readiness to Undertake Biodebridement in the Group of Nurses Undertaking Prevention	Joanna Przybek Mita, Dariusz Bazaliński1 ,Rafał Sztembis, Izabela Kuberka, and Paweł Więch1,7*	Rzeszów, Poland	Diagnostic Survey	290 nurses	The aim of the study was to assess the intensity of perceived stress in the group of nurses dealing with wound care in the	There were statistically significant differences in the score in the MDT10 scale in	The authors used a diagnostic survey method, which is an effective way of gathering detailed	The study was conducted in only one location, which limits the generalizability of the results. Furthermore, the	The findings suggest that nurses should be made aware of the potential effects of stress on their ability to undertake biodebridement and should

	and Treatment of Chronic Wounds					perspective of implementing wound debridement using Lucilia sericata larvae.	the categories of people with different stress levels and the highest readiness to implement MDT was observed in the category of people with the lowest perceived level of stress.	and meaningful data about the level of stress experienced by nurses in the group. In addition, the sample was relatively large, consisting of 290 nurses.	study did not investigate the long-term effects of the perceived stress on the nurses and their ability to undertake biodebridement.	take steps to reduce their stress levels, in order to be better equipped to undertake the procedure. Companies should focus on providing training to reduce stress levels and to enhance nurses' professional development.
8	Patients' perceptions and experiences of venous leg ulceration and their attitudes to larval therapy: an in-depth	Dorothy McCaughan, Nicky Cullum, Joanne Dumville	United Kingdom	Qualitative study, using semi-structured interviews alongside a randomized	18 people (12 men, 6 women)	To explore patients' experiences of venous leg ulceration and of the acceptability of larval therapy as a treatment.	majority of the participants were willing to try larval therapy and able to overcome feelings of	The qualitative approach of interviewing and providing data for this research was	The small sample size contributed to a lack of depth in the findings and may have limited the capacity to	Health care professionals should be aware of patients' potential unrealistic expectations of larval therapy, and should be understanding

	qualitative study			controlled trial Sample size: 18 people (12 men, 6 women)			squeamishness as a result of their strong desire to heal their ulcers, however the initial improvements in the condition of the ulcers were not sustained, and two participants experienced severe pain.	beneficial in exploring the lived experiences of those with venous leg ulcers and in better understanding the acceptability of larval therapy.	uncover important nuances and nuances in how participants viewed the use of larval therapy.	and supportive if a longed-for cure does not occur. The use of larval therapy should be assessed for appropriateness for each individual, and thorough counselling should be provided regarding the potential risks and benefits.
9	Survey of patients of the Tver region of Russia regarding maggots and maggot therapy	Artem M Morozov and Ronald A Sherman	Russia	administered a survey consisting of six images	576 subjects	To understand the psychological barriers that may exist among patients regarding the use of	Nearly 60% of subjects considered the images of maggots to be more repulsive than	The study included a large sample size that was equal in representation of male and	The research relied on subjective responses and there are limitations to self-reported surveys in	More education and support will need to be conducted to address patient fears and anxiety if patients are to be comfortable

						maggot therapy	images of gangrenous wounds.	female subjects.	comparison to other research designs.	with a maggot therapy programme
10	Maggot Debridement Therapy in the Tropics – Preliminary Outcomes from a Tertiary Hospital	Nanthakumahrie Gunasegaran, Vivian Qian Hui Seah, Shin Yuh Ang, Fazila Aloweni, Wee Ting Goh, Angela Yi Jia Liew, Wei Xian Tan, Hsien Ts'ung Tay, and Tze Tec Chong.	Singapore	Quantitative observational study	14 patients	The aim of the study was to describe the clinical outcomes and patients' acceptance of Maggot Debridement Therapy (MDT) at a tertiary hospital in Singapore.	10 out of 14 patients achieved successful debridement (at least 25% reduction in non-viable tissue (NVT)), 5 out of 14 patients had to undergo amputation, and MDT was quite well accepted by the patients.	The study provides preliminary data for the outcomes of using MDT in the tropics.	The number of patients in the study was relatively small, and further research is needed to compare the efficacy of different types of MDT with regards to environmental conditions.	The study shows that MDT can potentially facilitate wound healing through successful debridement and reduce the need for amputation.