Maggot debridement therapy in South-east Asia: current progress and challenges

Maggot debridement therapy (MDT) has emerged as an alternative treatment for wound management, yet its clinical application and outcomes in South-east Asian healthcare settings remain underexplored. This review examines the efficacy, protocols and clinical outcomes of MDT in South-east Asian populations. A systematic review of published literature was conducted, focusing on clinical studies reporting MDT outcomes in South-east Asian healthcare settings. Key parameters analysed include debridement success rates, treatment protocols, patient outcomes, and complications. Four primary studies were identified from Singapore, Turkey (included for regional relevance and the military healthcare context) and Malaysia. In Singapore, Gunasegaran et al (2022) reported a 71.4% debridement success rate among 14 patients with lower limb wounds containing ≥25% non-viable tissue, using *Lucilla cuprina* maggots applied for an average of three cycles (48–72 hours each); with limb salvage capacity of 64.3%. The study by Yeo et al (2022) demonstrated a reduction in slough, with an average reduction of 15% after one MDT application and 45% after two applications ($p<0.001$). Turkish military hospital data from Tanyuksel et al (2005) demonstrated complete debridement in 90.9% of 11 patients over 1–9 treatment days, with minimal pain reported. Malaysian studies referenced by Nair et al (2021) documented amputation prevention in multiple patient cohorts and qualitative wound healing improvements, with positive patient acceptance. With debridement success rates ranging from 71.4% to 90.9%, MDT demonstrates promising efficacy in South-east Asian clinical settings. However, significant variability exists in treatment protocols, duration and application methods. The limited available data highlights critical gaps in standardised protocols, comprehensive outcome reporting and adaptation strategies for tropical climatic conditions.

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Key words
- Maggot debridement therapy
- Wound management
- South-east Asia
- Clinical outcomes
- Therapeutic protocols

Maggot debridement therapy (MDT), also known as biosurgery or larval therapy, represents a biologically based approach to wound management that utilises sterile fly larvae to selectively debride necrotic tissue while promoting wound healing (Sherman, 2014). This therapeutic modality has gained renewed attention in modern medicine due to its selectivity, antimicrobial properties, and wound healing enhancement capabilities.

In South-east Asian healthcare contexts, MDT presents unique opportunities and challenges. The region's tropical climate, characterised by high humidity and temperatures, creates both favourable conditions for wound complications and potential advantages for biological therapies. Additionally, healthcare resource constraints and varying levels of wound care infrastructure across South-east Asian countries necessitate the consideration of cost-effective, accessible treatment alternatives.

The significance of MDT in South-east Asian contexts extends beyond clinical efficacy to encompass cultural acceptance, healthcare system integration, and adaptation to environmental conditions. Understanding current progress and identifying regional challenges is essential for optimising MDT implementation and establishing evidence based protocols suitable for South-east Asian populations.

Methodology

A comprehensive literature search was conducted across major medical databases to identify clinical studies reporting MDT outcomes in South-east Asian healthcare settings. Search criteria included geographic location within ASEAN member states, clinical study design with reported patient outcomes, healthcare setting implementation, and a focus on clinical applications rather than laboratory research. Specific search terms used were: "maggot

Declaration
The author has received financial support for the research, authorship and/or publication of this article from Cuprina Pte Ltd.

debridement therapy," "biosurgery," "larval therapy," "Southeast Asia," "ASEAN," "wound healing" and "clinical outcomes".

Overview of existing studies

The literature review identified a limited but significant body of evidence regarding MDT implementation in South-east Asia. All main studies met inclusion criteria, representing clinical experiences from Singapore, Malaysia and Turkey (included for its regional relevance, military healthcare context and focus on practical implementation challenges in an underrepresented region).

Quality assessment of available evidence

The available evidence demonstrates significant heterogeneity in study design, patient populations and outcome measures. All identified studies were characterised by decent sample sizes (11–54 patients) and inconsistent reporting of protocol details and adverse events. This variability limits the generalisability of findings and highlights the need for standardised research approaches in the region.

Results

Current implementation status

The implementation of MDT in South-east Asia remains limited to specialised centres and research institutions. The Gunasegaran et al (2022) and Yeo et al (2022) studies from Singapore represent comprehensive clinical experiences reported from the region, involving 14 patients and 11 patients, respectively, treated at a tertiary hospital with a specialised wound care team. Studies reported in Nair (2021) included a wider sample size, up to 27 patients with diabetes.

Country-specific approaches

Singapore has demonstrated systematic implementation of MDT within tertiary healthcare settings, utilising both bagged and free-range larval application methods. The Singapore experiences emphasise integration with specialist wound care teams and consideration of tropical climate factors in protocol selection (Gunasegaran et al, 2022; Yeo et al, 2022).

The sole MDT service provider in Singapore is a local start-up, Cuprina Pte Ltd, whose name is derived from the blow fly species *Lucilia cuprina* reared in its ISO13485-certified laboratory. The treatment is classified as a medical device Class C (device registration number: DE0012725) with approval from the Health Sciences Authority, the national regulatory body. The intervention is available for use in local hospitals and clinical settings that involve non-healing wounds containing slough or necrotic tissue.

In Malaysia, however, Nair et al (2021), suggest a broader adoption potential, with referenced studies indicating successful amputation prevention outcomes. One example includes successful amputation prevention in 11 selected patients using medicinal larvae as a natural remover of necrotic and infected tissue. Meanwhile, a case-controlled study from December 2005 to May 2007 at Hospital Kuala Lumpur, reported treating 25 patients with infected diabetic foot wounds using *L. cuprina* larvae, compared with 29 control patients with the same condition who received conventional debridement. While both treatments showed equivalent effectiveness for wound healing, MDT significantly reduced amputation rates, with all 25 patients in the treatment group avoiding amputation, demonstrating the therapy's particular value in limb preservation for diabetic foot complications. However, limited protocol details and system-level integration information restrict comprehensive assessment of Malaysian approaches.

Success rates and outcomes: clinical effectiveness data

Available data demonstrate promising clinical effectiveness, with debridement success rates ranging between 71.4% and 90.9%. The Gunasegaran et al (2022) study reported successful debridement in 71.4% of patients with lower limb wounds containing ≥25% non-viable tissue, while the Turkish military hospital experience achieved complete debridement in 90.9% of treated patients (Tanyuksel et al, 2005).

Another crucial application of MDT was recorded in diabetic foot ulcers, a condition prevalent among obese patients. It was found that – in addition to a reduction in slough, with an average reduction of 15% after one MDT application and 45% after two applications ($p<0.001$) – the mean pain score was 3.3 (on a visual analogue scale) and no significant complications were reported. Notably, pain was manageable with standard analgesia protocols (Yeo et al, 2022).

Malaysia based studies, as stated previously, collectively highlighted that MDT via *L. cuprina* is an effective, safe and affordable alternative treatment that reduces healthcare costs and manpower requirements. It is particularly relevant for younger diabetic patients by helping to retain their productivity and quality of life through limb preservation (Nair et al, 2021).

Patient outcomes

Patient outcomes varied significantly across the studies. The Gunasegaran et al (2022) study documented amputation rates of 35.7% despite successful debridement in the majority

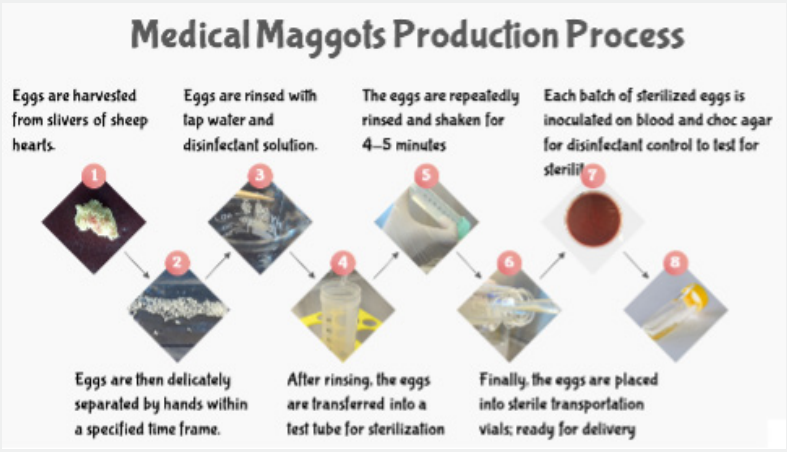

Figure 1

Figure 1. Medical maggots production process at Cuprina Pte Ltd.

of cases, suggesting that MDT effectiveness may be influenced by underlying wound severity and patient comorbidities. In the Yeo et al (2022) study, the wound closure rate was 45.5% (five out of 11 patients), with a limb salvage rate of 90.9% (10 out of 11 patients), indicating that most patients avoided major amputation during the follow-up period. Malaysian referenced studies reported amputation prevention in a total of at least 25 patients across these two distinct cohorts, demonstrating the clinical effectiveness of MDT in managing intractable diabetic wounds (Nair et al, 2021).

Cost-effectiveness analysis

With regards to cost-effectiveness, the data are not thoroughly discussed in these studies. However, the potential for reduced amputation rates and shortened healing times suggests favourable economic implications, particularly relevant in the resource-constrained healthcare settings typical of South-east Asia. Hence, the total healthcare cost can potentially be lower than usual due to the shorter patient journey.

Technical considerations

Treatment protocols

Protocol variability represents a significant challenge in current South-east Asian MDT practice. The Singapore studies utilised *L. cuprina* maggots applied for 48–72 hours per cycle over an average of three cycles, while the Turkish experience employed 1–9 days' treatment durations without specified species or application details (Gunasegaran et al, 2022; Yeo et al, 2022; Tanyuksel et al, 2005).

Application methods

Two primary application methods are documented: bagged maggots (contained within specialised dressings) and free-range larvae (direct application to wound surfaces). The Singapore studies utilised both methods, though effectiveness was observed as comparable between the two (Gunasegaran et al, 2022; Yeo et al, 2022). Studies in Nair et al (2021) utilised primarily free-range larvae prepared by the Institute for Medical Research (IMR). Application method selection was influenced primarily by wound characteristics, patient acceptance and clinician preferences.

Duration variations

Treatment duration ranges from 48–72 hours per cycle to continuous applications of 1–9 days. This variability likely reflects differences in wound characteristics, treatment protocols and institutional preferences, rather than evidence-based optimisation.

Regional challenges

Protocol standardisation issues

The absence of standardised protocols represents a primary challenge for MDT implementation in South-east Asia. Variations in maggot species, application methods, treatment duration, and outcome measures limit comparative assessment and evidence synthesis. Development of region-specific standardised protocols is essential for advancing MDT adoption.

Environmental factors

Tropical climate conditions in South-east Asia present unique considerations for MDT implementation. High humidity and temperatures may influence maggot survival, activity, and treatment effectiveness. The Singapore study specifically highlighted the need for further research on optimal MDT protocols in tropical countries with high humidity (Gunasegaran et al, 2022). This suggests that, while MDT is increasingly popular due to its high selectivity and speed, optimal protocols for tropical environments require further investigation (Sun et al, 2014).

Healthcare system integration

Integration of MDT within existing healthcare systems requires specialised training, infrastructure development, optimised insurance coverage (especially for outpatient use) and the establishment of regulatory framework. Current evidence suggests successful integration within tertiary care settings, but expansion to broader healthcare contexts requires systematic planning and resource allocation.

Cultural considerations

Patient and healthcare provider acceptance of MDT may be influenced by cultural factors, including perceptions of biological therapies ('yuck' factor) and traditional wound care practices (Pajarillo, 2021). Research indicates that, while a majority of participants with non-healing chronic wounds reported negative emotions associated with MDT, more than half indicated that they were pleased with the outcome of treatment and were willing to undergo repeat treatment if indicated (Mumford and Nigam, 2024). Similarly, studies conducted in Singapore and Malaysia noted generally positive patient acceptance following reported improvements (Gunasegaran et al, 2022; Nair et al, 2021; Yeo et al, 2022).

Future perspectives

Research needs

Critical research priorities include standardised protocol development, larger-scale clinical trials, cost-effectiveness analyses and adaptation strategies for tropical environments. Studies indicate that MDT is often used as a last-resort therapy over more conventional treatments, despite mounting evidence of its benefits, suggesting the need for research to address implementation barriers (Sun et al, 2014). Systematic review evidence highlights the need for well designed, randomised, controlled trials with standardised outcome measures to establish definitive clinical guidelines (Mohd Zubir et al, 2020).

Standardisation opportunities

Development of South-east Asia-specific MDT protocols should consider regional climate factors, healthcare infrastructure and patient populations. Standardisation efforts should encompass maggot species selection, application methods, treatment duration and outcome measures to facilitate evidence synthesis and quality improvement. Harvey et al (2021) suggest that future protocol development should integrate modern production techniques **[Figure 1]** with evidence-based clinical practices to optimise therapeutic outcomes while maintaining safety standards.

Implementation recommendations

Successful MDT implementation requires multifaceted approaches including in healthcare provider training, patient education, regulatory framework development and quality assurance systems. Research on the perceptions of healthcare professionals regarding MDT suggests that provider education and acceptance are critical implementation factors (Mohd Zubir et al, 2020).

Establishment of regional centres of excellence could facilitate knowledge transfer, protocol development and training programmes. Collaboration between healthcare institutions, research organisations and regulatory bodies is essential for systematic MDT advancement.

Conclusion

MDT in South-east Asia demonstrates promising clinical outcomes with debridement success rates of 71.4-90.9% in reported studies. However, implementation remains limited to specialised centres, with significant variability in protocols and outcome reporting. Addressing these multifaceted barriers is essential for enhancing clinical implementation and expanding therapeutic utilisation of MDT in contemporary wound care practice.

Key recommendations

- **Protocol standardisation**: develop evidence based, region-specific MDT protocols addressing tropical climate considerations and healthcare system constraints.
- **Research expansion**: conduct larger-scale clinical trials with standardised outcome measures to establish definitive effectiveness and safety profiles.
- **Training programmes**: establish comprehensive healthcare provider training programmes to ensure safe and effective MDT implementation.
- **Regulatory framework**: develop appropriate regulatory guidelines for MDT practice, including quality assurance and safety monitoring systems.
- **Patient education**: implement systematic patient education programmes to address cultural concerns and improve acceptance rates.

Future direction

The future of MDT in South-east Asia depends on coordinated efforts to address current challenges while building upon demonstrated clinical success. Integration of MDT within comprehensive wound care programmes, supported by robust research evidence and standardised protocols, offers significant potential for improving patient outcomes in resource-constrained healthcare environments. Leveraging neighbouring countries to supply sterile maggots, i.e. Singapore (Cuprina) and Malaysia (IMR), could possibly enhance quality of life while improving patients' healthcare experience.

Nevertheless, continued research focus on tropical climate adaptations, cost-

effectiveness assessments and healthcare system integration will be essential for realising the full therapeutic potential of MDT in South-east Asian populations. Collaborative regional initiatives could accelerate progress and establish South-east Asia as a centre of excellence for tropical wound care innovation.

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