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Original Article

A randomized controlled trial of topical tea tree preparation for MRSA colonized wounds

Rainbow L.P. Lee [a], *Polly H.M. Leung* [b], *Thomas K.S. Wong* [c,*]

[a] *School of Nursing, The Hong Kong Polytechnic University, Hong Kong*
[b] *Department of Health Technology and Informatics, The Hong Kong Polytechnic University, Hong Kong*
[c] *Faculty of Health and Social Sciences, The Hong Kong Polytechnic University, Hong Kong*

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ABSTRACT

Background: The prevalence of MRSA (Methicillin-resistant *Staphylococcus aureus*) colonized wounds in home care residents is expected to grow continuously as a result of the substantial proportion of older people requiring institutionalized care due to chronic disease and declining functional status, which contribute to more frequent skin breakdown and wound formation. Tea tree oil has been claimed to have anti-bacterial, analgesic and anti-inflammatory effects that have been suggested in many in-vitro studies to have good efficacy against MRSA. The aims of this study were to evaluate the effectiveness of 10% topical tea tree preparation to eradicate MRSA and to ascertain its influence on wound healing for MRSA-colonized wounds.
Methods: It was a randomized controlled trial, single-blind study. Those with stage II or above MRSA-colonized wounds and who had given their informed consent formed the sample. The determined sample size was based on the effect size of our previous pilot study, which was 0.46. Five outcome measurements were taken for the MRSA bacterial count and wound healing condition at baseline and at 1-week intervals during the 4-week dressing intervention period.
Results: Thirty-two participants were recruited from two non-government nursing homes, 16 in the control group and 16 in the tea tree oil group. The control group residents received routine saline gauze dressing, while the tea tree oil group residents received the 10% topical tea tree preparation dressing. In the tea tree oil group, all chronic wounds that had previously been delayed in healing were healed within 28 days without adverse reaction. MRSA was also completely eradicated in 14 (87.5%) out of 16 wounds in the group receiving the 10% topical tea tree preparation.
Conclusion: The 10% topical tea tree preparation was effective in reducing the quantity of colonized MRSA in and promoting healing of chronic wounds among elderly.

* *Corresponding author.*
E-mail address: wongks.thomas@gmail.com (T.K.S. Wong).

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1. Introduction

Older people who are institutionalized are particularly susceptible to MRSA infection due to their chronic illness, multiple exposures to antibiotics, and the presence of invasive indwelling devices leading to debilitation, immobility and compromised immune response [1,2]. Wound chronicity is a commonly found health problem among these residents. It constitutes a well known risk for MRSA colonization [3].

Two critical factors have been considered that make MRSA colonized wounds particularly prevalent in nursing home residents. The first factor is related to the wound. MRSA has the ability to disrupt the normal wound healing process, leading to prolonged wound healing. The second factor relates to persistent wound carriage with MRSA, which serves as a reservoir for MRSA infection. The relationship between colonization and the development of infection is complex. Wertheim and colleagues estimated the risk of infection in colonizers is 2–12 times higher than in those who are not colonized with *Staphylococcus aureus* [4]. In the context of nursing homes, Capitano reported that MRSA colonized residents were up to 6 times more likely to develop infection than non-colonized patients [5]. The risk of infection associated with MRSA colonization in chronic wounds might be even greater. Over time, there have been frequent reports of MRSA wounds being a source for other MRSA nosocomial infections, leading to the occurrence of bacteremia, endocarditis, and osteomyelitis [6–8]. For example, Manzur et al. demonstrated a strong and independent association between MRSA bloodstream infections and admission from nursing homes [9]. Therefore, to control the spread of MRSA from colonized residents in nursing homes, attempts must be made to eradicate MRSA wound carriage.

Over the past three decades, tea tree oil has been claimed to have anti-bacterial, analgesic and anti-inflammatory effects against MRSA [10–12]. Small human trials utilizing tea tree oil in wounds suggested that it might be effective as a topical therapy for chronic wounds such as diabetic ulcers, osteomyelitis, pressure ulcers and other wounds [13–15]. The scientific evidence to support this claim, however, has yet to be further substantiated. To this end, the research team developed a topical tea tree oil dressing model, put it into action and evaluated its effectiveness for MRSA eradication and wound healing enhancement.

2. Design and method

This was a randomized controlled trial, single-blind study. The recruited participants were randomly assigned to either the control or Tea Tree Oil (TTO) group with the Principal Investigator being blind to the allocation. The study included the followings:

(1) Formulation of a 10% topical tea tree oil preparation as a topical therapy for older people with MRSA colonized wounds
(2) Evaluation of the possible adverse reactions to the formulated 10% topical tea tree oil preparation
(3) Evaluation of the efficacy of 10% tea tree oil preparation for eradication of MRSA and improvement in the healing of MRSA colonized wounds.

2.1. *Topical tea tree oil formulation*

The product used in this study was an oil-miscible 10% v/v tea tree oil solution packaged in 30 ml light-resistant glass bottles. The pure 100% tea tree oil was ordered from the NOW Foods Company (Bloomingdale, U.S.A.), certified by Quality Assurance International with the international standard ISO4730 [16]. A medical grade paraffin oil acting as the solvent was then used to dilute the pure 100% tea tree oil in the laboratory of the Hong Kong Polytechnic University. The topical tea tree oil preparation was prepared at 10% tea tree oil to 90% paraffin oil and its composition is listed below (Table 1).

As the chemical compositions of tea tree oil are sensitive to light, the formulated topical tea tree preparation was then put into a light-resistant glass bottle immediately. All equipment used in the preparation of the studied product had undergone the complete procedure of sterilization using an autoclave machine (Autoclave Tauttnauer Model 2540EK, U.S.A.).

2.2. *Sampling*

The study was conducted in two non-governmental organization (NGO) nursing homes. They are supported and run by two major charity groups in Hong Kong, the Yuen Yuen Institutes and the Evangelical Lutheran Church of Hong Kong. The one under the Yuen Yuen Institute contains around 150 beds for permanent residents and a few places in the day care centre. The other one, run by the Evangelical Lutheran Church of Hong Kong, contains approximately130 beds. The research team applied to these homes following the approval by the Human Subjects Ethics Sub-committee of The Hong Kong Polytechnic University. With their approval, recruitment of residents commenced using the following criteria.

2.2.1. *Inclusion criteria*

The inclusion criteria were having open chronic wounds with positivity in MRSA wound culture. The chronic wound in this

Table 1 – The chemical composition of the studied formulated 10% topical tea tree oil preparation.

Component	Study tea tree oil (%)
Terpinen-4-ol	≥30
γ-Terpinene	10–28
α-Terpinene	5–13
1,8-Cineole	≤15[3]
Terpinolene	1.5–5
ρ-Cymene	0.5–12
α-Pinene	1–6
α-Terpineol	1.5–8
Aromadendrene	Traces – 7
δ-Cadinene	Traces – 8
Limonene	0.5–4
Sabinene	Traces – 3.5
Globulol	Traces – 3
Viridiflorol	Traces – 1.5
Paraffin oil	90

study was defined as a break of skin of long duration (>6 weeks) without progress to healing through normal repair process [17]. If the resident had multiple wounds, the largest wound was nominated as the primary wound for inclusion in this study.

2.2.2. *Exclusion criteria*

The exclusion criteria were suffering from peripheral vascular disease, using systemic or topical antimicrobial treatment, having clinical signs of infection, and more than 105 MRSA bacteria per gm of wound tissue being detected from the MRSA wound surface culture. Wounds with undermining or tunneling were also excluded in the present study. Participants who have known sensitivity and allergy to tea tree oil or its major components (i.e. terpinen-4-ol, 1,8-cineole, α-terpineol, terpinolene or α-and γ-terpinene) were excluded from the study.

The estimated sample size in this study was based on the effect size of the pilot study conducted by the research team, which was 0.46. Thirty-two participants (i.e. 16 in each group) would reach 80% power at a significance level of 0.05 to detect a clinically significant difference between the control and TTO groups.

The residents of the two nursing homes with stage II or above MRSA-colonized wounds formed the sample. For residents who were cognitively capable ($n = 10$), the Principal Investigator explained the details of the study to them before they signed the consent form, while relatives signed on behalf of those who were not ($n = 26$). All participants were assured that there would be no penalty if they refused to participate or withdrew from the study at any time throughout the study period.

2.3. *Procedures*

The participants were selected based on two indicators. Firstly, the studied wound should be at the level of stage II or above in a wound staging assessment using the pressure ulcer categorization stipulated by the National Pressure Ulcer Advisory Panel [18]. Secondly, the studied wound should be colonized with MRSA as confirmed by the positive results of MRSA wound cultures. Baseline data were collected at the first visit, and included wound assessment and measurement, relevant medical history, and a baseline wound culture to confirm the quantitative numbers of MRSA isolates (bioburden level) present on the wound surfaces. A research assistant who was a registered nurse trained for data collection assessed the wound and took the wound culture and another registered nurse who was well trained in wound dressing methods changed the dressing of the participant's wound daily. Both trainngs were conducted by the Principal Investigators.

2.3.1. *Wound dressing*

The participants were randomized into either the TTO group or the control group. In the TTO group, the wound was cleansed gently with 0.9% normal saline to remove any debris and loose necrotic tissue, and 10% topical tea tree preparation was then soaped with a dressing applicator and applied onto the wound surface. A non-adhesive pad was placed to cover the wound. The participant's wound was cleansed the same way as that for the TTO group. Their wounds did not have any tea tree preparation before they were covered by a non-adhesive pad. In other words, the dressing procedure for the control group was the same as what the nurses did everyday in the nursing homes. Nevertheless, the participants in this group were told that if the tea tree dressing model was found effective, they would be given the opportunity to receive this treatment after the present study.

2.3.2. *Adverse reactions*

Daily nurse rounds were conducted throughout the study period to assess the participants' level of consciousness, blood pressure, temperature, heart rate, respiratory rate and oxygen saturation. Inspection of skin on the whole body and surrounding the wound were performed at the same time in order to detect whether any form of allergy or adverse reaction had occurred. Participants' pain was also examined by direct verbal communication. For non-communicative participants, facial expression and body gesture were scrutinized. Adverse reactions were categorized based on the level of severity as either adverse reactions or severe adverse reactions. Adverse reaction refers to any untoward medical occurrence in a clinical investigation, which does not necessarily have a causal relationship with this treatment. It can therefore be any unfavorable and unintended sign (including an abnormal finding), symptom, or disease temporarily associated with the use of an investigation product, whether or not related to the product under investigation [19]. Severe adverse reaction refers to any untoward medical occurrence that at any dose results in death or threat to life, requires inpatient hospitalization, results in persistent or significant disability/incapacity [19]. For the purpose of this study, the Principal Investigator told the participants that the ir participation would be terminated if they had an allergic reaction to the treatment.

2.3.3. *Wound measurement*

Wound measurements were obtained by first tracing the wound and then calculating the wound healing condition using the Pressure Ulcer Scale for Healing (PUSH) tool 3.0, where surface area (wound size), exudate, and type of wound tissue are assigned different sub-scores ranging from 0 to 4 [20]. A comparison of total scores by adding together these sub-scores measured over time provides an indication of the improvement or deterioration in wound healing. A score of 0 out of 16 is an indicator of a completely healed wound. In total, five measurements were performed on all participants: before the implementation of wound dressing, the 1st week after the implementation of wound dressing, the 2nd week after the implementation of wound dressing, the 3rd week after the implementation of wound dressing, and the 4th week after the implementation of wound dressing.

2.3.4. *Wound culture*

Wound culture was performed using the wound swabbing method to obtain the MRSA isolates present on the surface of the wounds with a sterile swab stick. Before the swab stick was used, old dressings were removed and the wound be cleansed with 0.9% normal saline to remove dressing debris, exudates and loose devitalized tissue. The swab stick was

Table 2 – Demographic and wound characteristics.

Group	Demographics			Wound characteristics				
	Mean age*	Sex		Mean wound size** cm^2	Pressure ulcer	Leg ulcer	Toe ulcer	Allergic reaction
		Male	Female					
Control	79 ± 6.9	4	12	3.98	11	5	0	0
Tea tree group	81 ± 7.6	3	13	3.41	12	2	2	0

Note: Levene's Test for Equality of Variances: *$F = 0.005$, $p = 0.946$; **$F = 0.519$, $p = 0.477$.

then moved across the wound surface in a zigzag pattern. Dry wounds were swabbed using pre-moistened (with 0.9% normal saline) swab sticks. The freshly taken wound swabs were then transported to the laboratory immediately for microbiological analysis to identify the quantity of MRSA isolates colonized on the wounds. Each wound swab specimen was placed in a 10 ml sterile normal saline glass bottle for storage. The wound specimens were then sent to the laboratory immediately for culture and susceptibility testing. In the laboratory, 1 μl of the mixed wound specimen was aspirated from the normal saline glass bottle. The solution was then dipped vertically at the centre of the MRSA*Select*™ (Bio-Rad, CA, USA) agar plate by a calibrated loop. Vortex and cross-streaking were performed to ensure that all MRSA isolates on the wound swab were evenly distributed and extended towards the edge of the agar plates. The agar plates were then incubated in an inverted position aerobically at 35 °C for 18–24 h. Suspected MRSA colonies were examined and subsequently confirmed using Staphaurex (Remel, KS, USA) for coagulase production and cefoxitin antibiotic disc (Becton Dickinson, NJ, USA) for methicillin resistance. The MRSA isolates appeared as small pink colonies with clear zones on the agar plates. The quantification of MRSA isolates were read and measured by counting the number of colony-forming units on each plate with the Automated Colony Counter (Acolyte, Synbiosis, USA). A comparison of quantitative numbers of MRSA isolates (bio-burden level) throughout the study provides an indication of whether MRSA was eradicated or not. Like wound assessment, five measurements were taken for MRSA wound cultures. They were taken at baseline (i.e. before implementation of wound dressing), and at one-week intervals for four weeks (i.e. the 1st, 2nd, 3rd and 4th weeks after implementation of wound dressing) during the wound dressing intervention period.

2.3.5. *Statistical analysis*

The data collected were analyzed using the Statistical Package for the Social Sciences (SPSS) for Windows version 17. For wound characteristics and demographic information, descriptive statistics including frequency, distribution and percentages were used. On the other hand, for outcomes measures in this study such as quantity of MRSA isolates present on the wounds and PUSH scores for wound healing, inferential statistics was deployed. The difference in quantity of MRSA isolates and PUSH scores between the groups was analyzed by one-way ANOVA, whereas the difference within the groups was analyzed by ANOVA with repeated measures. The level of significance was set as 0.05, with the power of 0.8. The incidence of adverse reactions was the number of residents identified with adverse reactions such as fever, rash, pruritus, irritation, pain, inflammation and edema during the intervention period. Descriptive data yielded on adverse reactions, if any, were subject to content analysis. All analyses were carried out following the intention-to-treat principle with participants receiving not less than five days of dressing interventions counted.

3. Results

3.1. *Demographic and wound characteristics*

A total of 32 participants with the same number of MRSA colonized wounds were recruited in the study. The participants in the control group consisted of sixteen participants, four (25%) males and twelve (75%) females. The participants in the TTO group also consisted of sixteen participants, three (18.8%) males and thirteen (91.2%) females. The mean participant age in the control group was 79.4 (±6.9) and that in the tea tree oil group was 81 (±7.6) years. The mean wound size in the control group was 3.98 square centimeters, while that of the TTO group was 3.52 square centimeters. Eighteen (56.3%) pressure ulcers, twelve (37.5%) leg ulcers, and two toe ulcers (6.2%) were identified. There were eleven (68.8%) pressure ulcers and five (31.2%) leg ulcers in the control group, and twelve (75%) pressure ulcers, two (12.5%) leg ulcers and two (12.5%) toe ulcers were found in participants recruited to the TTO group (Table 2). To ensure the homogeneity of the participants

Table 3 – Means and standard deviations comparing the control and tea tree groups in terms of quantity of MRSA in CFU/ml at the time points indicated.

Quantity of MRSA in CFU/ml	*n*	Baseline		1st week		2nd week		3rd week		4th week	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Control group	16	6437	1209	8125	1821	8937	2174	9875	2610	10312	3054
Tea tree group	16	7093	1356	4531	1783	2375	1284	468	590	93	201
Total	32	6765	1307	6328	2545	5656	3768	5171	5128	5203	5610

between the two groups, Levene's test for equality of variances of age and wound size was performed. Both did not show any statistical significance ($p > 0.05$) (Table 2).

3.2. Allergy and adverse reaction

There were no reports of adverse effects or allergic reactions, such as fever, rash, pruritus, irritation, pain, inflammation or edema, or of intolerance to the use of 10% topical TTO preparation (Table 2) .

3.3. Outcomes of wound culture

Mean data of the wound surface cultures in the control and TTO groups are shown in Table 3, which reports the quantity of MRSA in terms of colony-forming units per gram of wound tissue (CFU/ml). A decrease of the mean viable count of MRSA was seen in the TTO group at each time interval of the five measurements. Compared with the baseline (7093 CFU/ml), viable MRSA in wounds at the 1st (4531 CFU/ml), 2nd (2375 CFU/ml), 3rd (468 CFU/ml) and 4th weeks (93 CFU/ml) was reduced by 36%, 66%, 93% and 98%, respectively. In contrast, an increase in the mean viable count of MRSA was noted in the control group. Compared with the baseline (6437 CFU/ml), viable MRSA at the 1st (8125 CFU/ml), second (8937 CFU/ml), third (9875 CFU/ml) and fourth (10312 CFU/ml) measurements was increased by 26%, 39%, 53% and 60%, respectively. One-way ANOVA was used to identify significant differences in MRSA quantity between the control and TTO groups. The results reveal a statistically significant difference between groups at the 1st, F (1, 30) = 31.8, $p \leq 0.001$; 2nd, F (1, 30) = 108, $p \leq 0.001$; 3rd, F (1, 30) = 197.6, $p \leq 0.001$; and 4th weeks, F (1, 30) = 178.3, $p \leq 0.001$ (Table 4) in terms of eradication of MRSA. A repeated measures ANOVA with a Greenhouse-Geisser correction in the tea tree oil group determined that mean MRSA quantity differed statistically significant between the 1st, 2nd, 3rd and 4th week of dressing interventions (F(2.64, 39.62) = 140.64, $P = 0.000$). Post hoc tests using the Bonferroni correction revealed that topical tea tree oil dressing elicited a reduction of MRSA isolates on the studied wounds from the 1st week to the 4th week of dressing interventions (4531 ± 1784 CFU/ml vs 2375 ± 1285 CFU/ml vs 469 ± 591 CFU/ml vs 94 ± 202 CFU/ml respectively), which were statistically significant ($p = 0.000$ vs $p = 0.000$ vs $p = 0.000$ vs $p = 0.000$ respectively). The effect size was 0.965.

3.4. Outcomes of wound measurement

Mean data of the PUSH scores in the control and TTO groups is shown in Table 5, with increasing PUSH scores indicating deterioration in wound healing and vice versa. The baseline PUSH score of the TTO group was 7.9. The first, second, third and fourth measurements were 5.5, 5.4, 1.0 and 0 respectively. A decrease in PUSH scores was observed in the TTO group. Compared with the baseline, the percentage decreases at the first, second, third and fourth measurements were 30.4%, 31.6%, 87% and 100% respectively (Figs. 1 and 2). At the fourth measurement, all studied wounds in the TTO group showed complete healing. With regard to the control group, a decrease in the PUSH score was noticed over time. Compared with the baseline (8.1), the decrease at the first (7.6), second (6.9), third (5.5) and fourth (4.6) measurements was 6.2%, 8.6%, 17.3% and 43.2% respectively. One-way ANOVA was used to identify significant differences in PUSH scores between the control and TTO groups. The results reveal a statistically significant difference between groups at the 1st, F (1, 30) = 9.369, $p = 0.005$; 2nd, F (1, 30) = 40.8, $p = 0.000$; 3rd, F (1, 30) = 80.67, $p = 0.000$; and 4th weeks, F (1, 30) = 71.60, $p = 0.000$ (Table 6) of dressing intervention period. A repeated measures ANOVA with a Greenhouse-Geisser correction in the tea tree oil group determined that mean PUSH scores differed statistically significant between the 1st, 2nd, 3rd and 4th week of dressing interventions (F(1.97, 29.56) = 124.20, $P = 0.000$). Post hoc tests using the Bonferroni correction revealed that topical tea tree oil dressing secured an improvement in the healing of MRSA colonized wounds from the 1st week to the 4th week of topical tea tree preparation dressing interventions (5.5 ± 2.4 vs 2.5 ± 2.5 vs 0.94 ± 1.44 vs 0 ± 0 respectively), which were statistically significant ($p = 0.000$ vs $p = 0.000$ vs $p = 0.000$ vs $p = 0.000$ respectively). The effect size was 0.89.

Table 4 – One-way ANOVA comparing the control and tea tree oil groups in terms of quantity of MRSA.

Quantity of MRSA	*df*	*F*	*p*
Baseline			
Between groups	1	2.08	0.159
Within groups	30		
Total	31		
1st week			
Between groups	1	31.8	<0.001
Within groups	30		
Total	31		
2nd week			
Between groups	1	108.0	<0.001
Within groups	30		
Total	31		
3rd week			
Between groups	1	197.6	<0.001
Within groups	30		
Total	31		
4th week			
Between groups	1	178.3	<0.001
Within groups	30		
Total	31		

4. Discussion

In the present study, 10% topical tea tree preparation was used to manage chronic wounds colonized with MRSA in nursing

Table 5 – Comparison of the PUSH scores of the control and tea tree oil groups at the time points indicated.

PUSH score	Baseline	1st week	2nd week	3rd week	4th week
Control group	8.1	7.6	6.9	5.5	4.6
Tea tree group	7.9	5.5	5.4	1.0	0

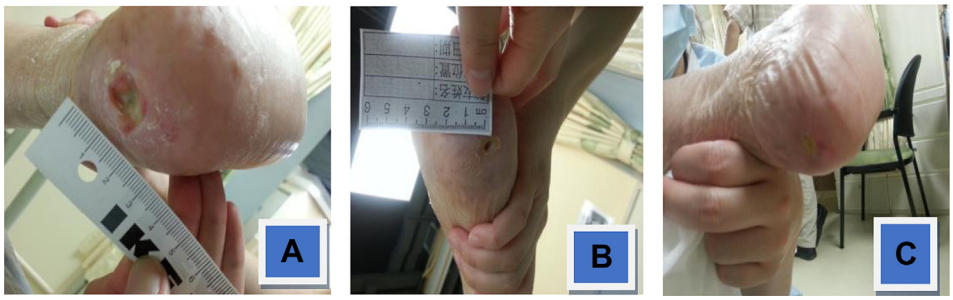

Fig. 1 – The pictures of the wound of one tea tree oil group participant who had a foot ulcer of 3 months duration. The pictures were taken on enrollment (A), 2 weeks after tea tree oil dressing intervention (B) and 4 weeks after treatment dressing intervention (C).

home residents. The results showed that 14 of 16 (87.5%) wounds in the tea tree oil group were completely eradicated of MRSA by the end of the 4-week study period. Regarding wound healing, 16 MRSA colonized wounds in the tea tree oil group were closed skin by 28 days. These suggest that 10% tea tree oil is feasible for topical wound treatment, for both MRSA eradication and wound healing improvement. The tea tress preparation is evidently an acceptable and appropriate formulation that can be used in older people and nursing home settings. Although the product we formulated is not commercially available now, pure 100% tea tree oil is available at low cost over the counter and through pharmaceutical suppliers. Thus tea tree oil's market value for chronic wound management is finite.

Throughout the world, the growing problem of antimicrobial resistance and the global emergence of multi-drug-resistant organisms in acute healthcare settings and in the community, including nursing homes, have caused concern to our healthcare policy makers. There is no doubt that MRSA is one of the most important antimicrobial-resistant bacteria in Hong Kong. The annual report of the Hong Kong Hospital Authority stated that the number of patients with MRSA for 2009 was estimated to be about 7000 [21]. Even if only 10% of the MRSA infections were prevented, the number of lives saved and unnecessary operations avoided would exceed the benefits associated with preventing all other sentinel events combined. The Chief Executive further explained that it was the reason why Hong Kong Public Hospitals have adopted MRSA infections as a key performance indicator for the assessment of patient safety [22]. In addition, pharmaceutical investment in antimicrobial agents has declined in the past decade, leading to a decreasing number of new antimicrobial drugs approved for marketing. In this regard, the necessity of seeking a non-antibiotic strategy for MRSA wound treatment becomes paramount. Furthermore, limited treatment options are hampering MRSA containment. Wound chronicity lengthens the period of infectivity, leading to spread of infection and adding challenges to infection control, which is another key concern. In effect, both concerns translate to increasing the direct and indirect healthcare cost and high morbidity and mortality in our healthcare system.

Delayed wound healing in chronic wounds due to MRSA colonization has contributed to adverse patient outcomes. In nursing homes, it may not be limited to having a profound effect on residents' sense of well-being, comfort and quality of life, but also contributes to more demand for resources for wound management practice and rising costs to our healthcare system for treatment for complications associated with non-healing wounds [23]. In addition, many long-term care facilities in western countries refuse to admit elderly people with MRSA-colonized wounds due to the manpower needed to apply restrictive isolation precautions, and this may compromise their ability to access appropriate healthcare.

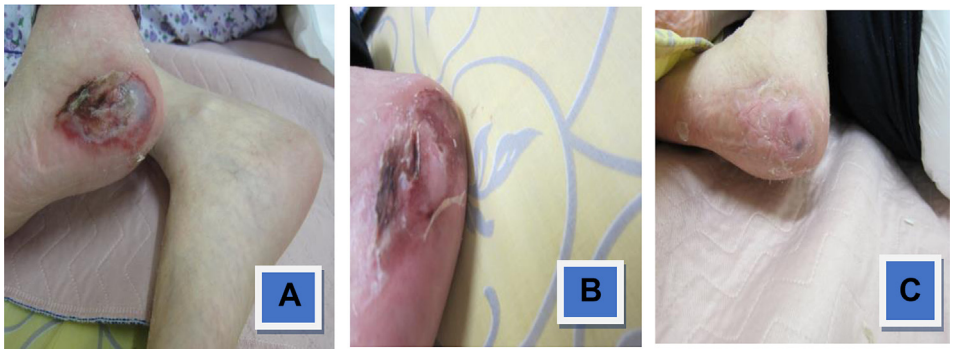

Fig. 2 – The pictures of the wound of another tea tree oil group participant who had a foot ulcer of 3 months duration. The pictures were taken on enrollment (A), 2 weeks after tea tree oil dressing intervention (B) and 4 weeks after treatment dressing intervention (C).

Table 6 – One-way ANOVA comparing the control and tea tree oil groups in terms of PUSH scores.

PUSH score	*df*	*F*	*p*
Baseline			
Between groups	1	0.59	0.810
Within groups	30		
Total	31		
1st week			
Between groups	1	9.37	<0.005
Within groups	30		
Total	31		
2nd week			
Between groups	1	40.81	0.000
Within groups	30		
Total	31		
3rd week			
Between groups	1	80.67	0.000
Within groups	30		
Total	31		
4th week			
Between groups	1	71.60	0.000
Within groups	30		
Total	31		

The evidence provided in the present study of tea tree oil's antibacterial and anti-inflammatory properties for MRSA eradication and wound healing enhancement confirms its value as a topical treatment in the context of MRSA containment and chronic wound management. In addition, tea tree oil is a natural product, so the threat of antimicrobial resistance can be avoided by reducing antibiotic use. As a result, lower healthcare costs and improved quality of life for nursing home residents can be achieved.

5. Conclusion

The 10% topical tea tree preparation formulated by the research team was successful in eradicating MRSA from colonized wounds, and was able to promote and achieve recovery in chronic wounds that had shown a delay in healing. Promoting wound healing and eradicating MRSA from wound surfaces are two crucial management strategies to prevent the acquisition, carriage and dissemination of MRSA among residents living in nursing homes and long-term care facilities. The benefits are not limited to these institutions, but could also extend to acute care settings and communities. Although there have been many in-vitro studies on tea tree oil and *S. aureus*, there are only a few published human studies in the scientific literature, particular on older people. Little is known about the pharmacology of tea tree oil in the human body, thus conducting more research in this area to further demonstrate the efficacy and patient tolerance of tea tree oil as a topical treatment is of paramount importance.

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