



NACE and A&AA Response to Parliamentary Inquiry into Red Imported Fire Ants in Australia (*Solenopsis invicta* Buren)

The National Allergy Centre of Excellence (NACE) is Australia's peak allergy research body. Insect, drug, food, and respiratory allergy experts have joined the NACE to help build tools and infrastructure to accelerate research and improve the lives of five million Australians living with allergic disease.

Allergy & Anaphylaxis Australia (A&AA) is a registered charity and Australia's only national support organisation, dedicated to helping individuals and carers alike in managing allergy and the risk of anaphylaxis. A&AA listens, guides and educates Australians living with allergic disease and advocate on their behalf to ensure their voice is heard.

This response addresses the expected human health impacts if red imported fire ants (RIFA) spread across Australia. This response is informed by a recently conducted review of the international literature from RIFA endemic areas.

Summary and key points

About RIFA

- RIFA is a small and resilient invasive ant species with aggressive behaviour and venomous stings.
- RIFA are typically found in colonies of 250,000 ants or more.
- In endemic areas, up to 600 RIFA colonies per acre have been reported.
- RIFA are often found near human activity and communities.

RIFA and human health impacts

- Approximately a third of the total human population living in RIFA endemic areas are stung each year.
- Those with restricted mobility (very young, very old or with mobility impairments) are at most risk of being stung multiple times by a single ant and by multiple ants simultaneously.
- The most frequent reaction to an undisturbed RIFA sting is a sterile 1 to 2 mm small blister (pseudo pustule) on the skin.
- Of those stung, (25%) will develop allergic sensitisation (elevated specific immunoglobulin E) to RIFA venom.
- Approximately 20% of RIFA stings cause a large local reaction, characterised by extreme itchiness and a large, raised, red welt at the sting site.
- Approximately 0.5% to 2% RIFA stings cause a systemic allergic reaction which can range from skin symptoms (generalized hives or welts and swelling) to life-threatening anaphylaxis (drop in blood pressure, loss of consciousness, difficulty breathing, persistent cough and collapse).
- Of those stung, up to 7.5% will seek medical assistance, ranging from pharmacists and general practitioner (GP) consultations to hospitalisation.
- Of those who seek medical attention, 16% do so due to systemic reactions.



- The health impact estimates if RIFA were to become endemic in Australia in 2023 are staggering. The potentially exposed Australian population would be 26 million (98.5%). If it is assumed that one third of the exposed population is stung per year, this will mean that approximately 8.6 million people are stung each year. Of those 2.1 million people (a quarter of those stung) would develop allergic sensitisation, and around 43,000 to 174,000 (0.5% to 2% of those stung) may develop systemic allergic reactions which will require medical attention. There would be up to 652,000 people that will seek medical consultation due to RIFA stings each year, and most of these consultations would be due to local reactions.
- All RIFA-related human health impacts are preventable.

RIFA health care costs

- Published estimates of economic costs of RIFA on human health are scarce.
- Potential health care costs of RIFA stings include:
 - Local reactions, which will require treatment by pharmacist or GP, and other allied health consultation fees,
 - Systemic reactions including anaphylaxis which may lead to ambulance service use, emergency department care, hospitalization, and out-of-hospital health care (physician visits, specialist visits, pathology tests and prescriptions, including provision of two ongoing adrenaline auto-injectors) costs.
 - The net value of the lost wellbeing (mental health impacts, disability, and premature death in rare cases).

Key recommendations

- A coordinated and widespread RIFA eradication program is needed. The eradication funds should be made available immediately to increase the effectiveness of the program to avoid future increases in eradication costs
- Coordinated eradication measures are crucial to avoid substantial health and well-being impacts, and healthcare costs, for the Australian population.
- Ongoing funding to support permanent biosecurity surveillance for RIFA is required to ensure rapid identification and eradication of future RIFA incursions.
- In the event of continued spread of RIFA, urgent public health awareness campaigns, and health systems supported will be needed to manage the increased healthcare utilisation.

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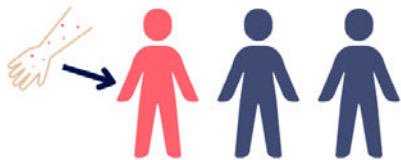
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POTENTIAL HUMAN HEALTH IMPACTS OF RED IMPORTED FIRE ANTS



RED IMPORTED FIRE ANT (SOLENOPSIS INVICTA)

Small, coppery brown-coloured and resilient invasive ants with aggressive behaviour and venomous stings. Often found in close proximity to human communities.



ONE-THIRD^{1,2}

of the population residing in endemic areas experiences ant stings each year. Individuals with limited mobility are most at risk of multiple stings.

A QUARTER^{3,4}

of those stung develop allergic sensitization, characterized by elevated specific Immunoglobulin E levels triggered by this ant's venom.



ONE IN FIVE⁵

of those stung may develop a large reaction, which is extremely itchy and a large, raised, red welt appears at the sting site.

0.5% TO 2%^{2,5,6}

of those stung may develop anaphylaxis, a life-threatening allergic reaction that requires medical treatment.



UP TO 7.5%⁵

of those stung will seek medical attention.

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Current knowledge on human health impacts and costs caused by Red Imported Fire Ants (*Solenopsis invicta* Buren)

About red imported fire ants

The RIFA is a small ant (2 to 6 mm), coppery brown in colour with a darker abdomen, that is native to South America.¹ RIFA are typically found in colonies of 250,000 ants or more.² In endemic areas up to 600 RIFA colonies per acre have been identified.² RIFA are often found near human activity and communities.³ The preference of RIFA to set in locations near human activity and settlements increases the likelihood of human encounters and of being stung.

1. Summary of the available evidence of RIFA-human health impacts

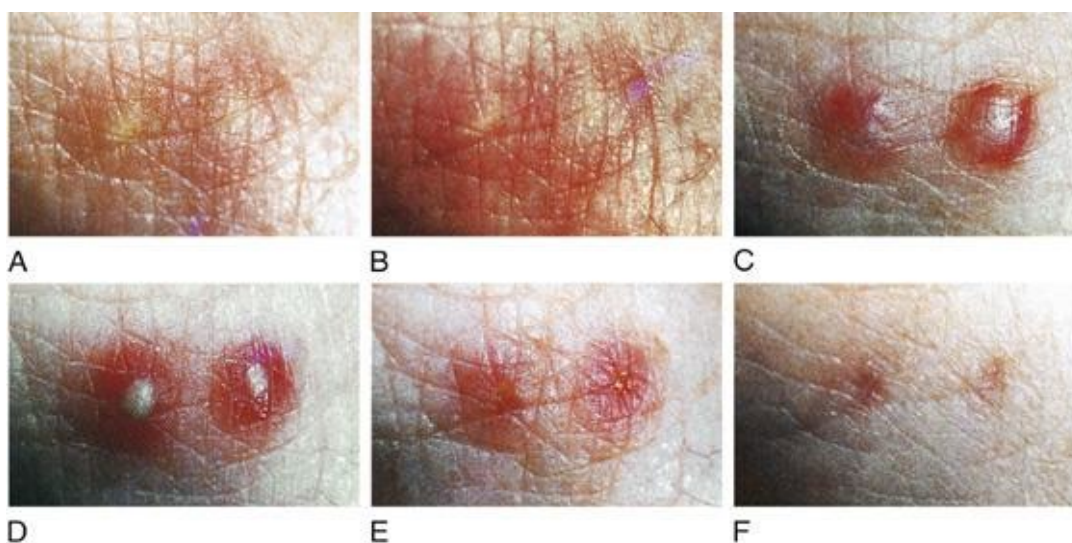
Clinical reactions to RIFA sting

Human clinical reactions to RIFA venom include: a) small, localized wheal and flare responses; b) large local reactions larger than 10 cm in diameter and associated with localized erythema (redness) and itchiness, indicating probable allergic sensitisation to venom components; and c) systemic reactions including anaphylaxis, which is a severe life-threatening allergic response that can be fatal.³

Pseudo pustule (blisters)

The most frequent reaction to an undisturbed (not scratched) RIFA sting is a sterile 1- to 2-mm blister on the skin (pseudo pustule) caused by the RIFA's venom (Figure 1).⁴ The presence of these blisters, with an appropriate history of a painful ant sting, is the hallmark of a RIFA sting.³ A severe burning sensation is the immediate response to the venom.⁴ After a few minutes, the sensation stops, and within two hours, a raised, red swelling appears.⁴ Within four hours, blisters form.⁴ This reaction is not an allergic reaction.⁴

Figure 1. Pseudo pustule clinical progression of RIFA stings (hallmark sign).⁵



A. Thirty minutes post-sting. B. One-hour post-sting, C. Twenty-four hours post-sting, D. Seventy-two hours post-sting, E. One-week post-sting, F. One-month post-sting.

RIFA and allergic sensitisation

Allergens (proteins that may cause an allergic reaction) are present in the RIFA venom.² Allergy to RIFA stings is the most common cause of Hymenoptera (bees, wasps and ants) allergic sensitisation in the areas where they are endemic.⁶ Allergic sensitisation (signified by elevated specific immunoglobulin E) to RIFA venom is detected in some individuals after being exposed to RIFA stings.⁷ However, not all individuals who are RIFA sensitised will develop an allergic reaction (local or systemic); differences in seasonality and predisposing factors, such as age and genetic factors, may affect the development and persistence of venom-specific immunoglobulin E after a RIFA sting.⁸ Cross-reactivity with venom from other Hymenoptera species (i.e. wasps) has been reported, which means that a RIFA sting may induce a systemic allergic reaction without previous RIFA venom exposure.⁹

Allergic reactions

Large local reactions

Large local reactions may appear at the sting site in RIFA venom sensitised people (those with venom-specific immunoglobulin E) (figure 2).¹⁰ This happens at the same time as the emergence of the blister. The reaction is characterised by extreme itchiness and a large, raised, red welt at the sting site.¹⁰ The swelling and severe itching increase over the course of 6 to 12 hours and develop into a sizeable area of uncomfortable swelling. Within 24 to 48 hours, these reactions reach their peak size and become hot, itchy, and painful. Although it usually spontaneously resolves, significant swelling and damage to the underlying blood vessels can affect the extremities.¹⁰ Large local reactions do not lead to a severe allergic reaction affecting the entire body.¹⁰

Figure 2. Large local reaction due to a RIFA sting.¹¹



Systemic reactions

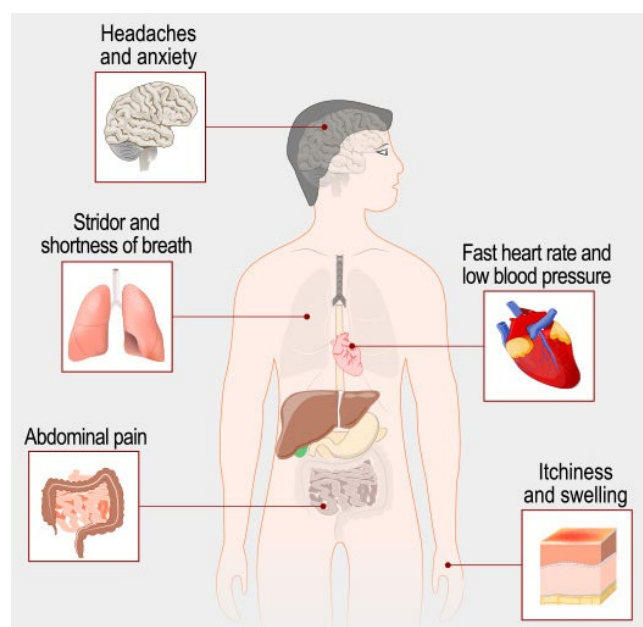
Systemic allergic reactions to a RIFA sting can range from skin manifestations (generalized urticaria or angioedema) to life-threatening anaphylaxis. The Australasian Society of Clinical Immunology and Allergy (ASCIA) defines anaphylaxis as any acute onset illness with typical skin features (urticarial rash or erythema/flushing, and/or angioedema), plus involvement of respiratory and/or cardiovascular and/or persistent severe gastrointestinal symptoms; or any acute onset of hypotension or

bronchospasm or upper airway obstruction, even if typical skin features are not present (Figure 3).¹²

One RIFA sting can be enough to cause a potentially fatal anaphylaxis reaction.⁴ This reaction usually develops within minutes of the sting but in rare cases may develop up to 2 hours after the sting.³ Adults are more prone than children to present with severe systemic allergic reactions.¹³ This is probably due to the fact that as people get older, they are more likely to have underlying health conditions, and are more likely to have developed sensitisation to RIFA venom following multiple instances of RIFA sting.¹⁴ For these reasons, older patients experience more severe reactions overall than younger ones.¹³ Moreover, men are more likely than women to experience anaphylaxis due to RIFA sting which may be due to behavioural differences and time spent outside.¹⁵ In addition, the systemic reaction to RIFA sting reaction varies with season (more systemic reactions in summer time) and the degree of sting exposure (the number of sting exposures increases the risk of a systemic reaction).^{15,16}

One RIFA sting can be enough to cause a potentially fatal anaphylaxis reaction.⁴ However, a large number of simultaneous stings, like those sustained during a RIFA mass attack, may prime an individual for a severe allergic reaction and then be followed by single-sting anaphylaxis.¹⁷ Hence, one of the major factors related to developing an allergic response to a RIFA sting appears to be the frequency of stings; a relatively brief sting interval or several stings in succession might increase the risk of a systemic allergic reaction, shifting the disease's natural course from asymptomatic sensitisation to RIFA venom allergy.⁸ The aggressive nature of RIFA and its higher frequency of stings may explain why RIFA stings induce allergic reactions more often than bees or wasps.⁸

Figure 3. Symptoms of severe systemic allergic reaction (anaphylaxis).¹⁸



Mental health impacts

Being stung by RIFA can impact on mental health.¹⁹ RIFA stings usually rate a “moderate” on the “Richter Scale of Pain” but they often make up for this through sheer numbers of stinging events.¹⁹ Concordantly, a study from China observed that 2 of 46 stung individuals may develop post-traumatic



stress syndrome after a RIFA sting.²⁰ However, the same study found no evidence that RIFA stings are associated with depression, anxiety or sleep disturbances.²⁰ Other potential RIFA-related mental health impacts may be related to the negative effect of spending less time in outdoors.²¹ RIFA infestation was reported in sports fields, parks and beaches, and their presence reduced the access to these locations.²² Further research is needed to better understand the mental health impacts of RIFA.

Climatic determinants

The prevalence of allergy to RIFA stings has been rising gradually around the world.¹⁴ RIFA range expansion is mainly constrained by low temperatures and arid conditions.²³ Climate change, through warmer temperatures and flooding, is facilitating range expansion and changing the rate of human exposure.¹⁴ Stings occur most frequently during summer.³ Off-season stings (e.g., during winter months) often do not cause as much pain and may go unnoticed until the local reaction develops.³ This may reflect seasonal differences in RIFA venom.³ Moreover, seasonal fluctuations in the RIFA venom's potency may be linked to the frequency of allergic reactions to stings. In the summer, a higher proportion of allergic reactions to RIFA venom was reported.²⁴ In the United States, it was reported that there was a higher incidence rate of anaphylactic reaction due to Hymenoptera sting (bees, wasps, and ants) from May through September (spring and summer).²⁵ Also, RIFA tend to be less active during the cool days of winter and more active during warm days of summer,²³ which may increase the probability of human encounters.

Healthcare costs in endemic areas

The cost of health services stemming from encounters with RIFA can be a financial burden for individuals, families, and the healthcare systems in endemic areas. There is scarce evidence in the literature of the economic costs of RIFA health impacts, with most of the information coming from one report from Texas.²⁶ In 1998, the average direct household cost due to RIFA per Texas household was US\$150.79, with US\$9.40 (6.23%) spent on medical care costs.²⁶ The total annual metroplex (metropolitan area) expenditures for medical care costs was 9%, or US\$47.1 million of the US\$526 million total expenditure cost due to the RIFA.²⁶ Another study determined using the estimates from the previous report, that if RIFA became endemic in the Pacific Island Countries and Territories in the period of 1997 to 2003, the projected health healthcare cost could range from the equivalent of 4% (Palau) to 86% (Vanuatu) of the total annual healthcare budget.²⁷ Other potential costs to consider are those from litigation and settlements for RIFA attacks occurring in nursing homes or public property.²⁸ Tourism industry losses due to fear of RIFA stings is another potential cost to be borne by RIFA endemic areas.²²

2. Summary of international evidence on the human health impacts of RIFA

Methods

We undertook a comprehensive literature review to assess the potential health consequences associated with RIFA. Our investigation involved a detailed search of all existing research evidence, international government reports and qualitative data. For this analysis, we followed recommendations of Green *et al.* for a narrative overview model,²⁹ a broad narrative synthesis of formerly published studies. The full text of the selected studies and other data were examined and information relevant to the review was extracted.



Results

Prevalence of RIFA stings

The rate of RIFA stings has become a significant concern in areas where RIFA has become endemic.³⁰ However, there is a significant variation in the estimates of the number of people that are stung by RIFA each year in endemic areas. Over half the population in endemic areas is exposed to a sting at least once in their first 20 years of life and virtually the whole adult population has been stung at least once.⁸ In heavily infested areas in southern United States, sting attack rates range from 13 to 58% of the population per year.³¹ Different studies conducted in China reported annual sting rates of 8.5%,³² 27.8%,³³ and 30%³⁴ of residents in RIFA infested areas to have been stung by the ant. In Taiwan, out of 10,127 residents who encountered RIFA, 3,819 were stung by RIFA (equates to a RIFA sting rate of 37.71%).³⁵ Overall, the variations may be due to methodological and environmental differences, with a yearly RIFA sting rate of around 33% being a reasonable estimate.^{36,37}

Allergic sensitisation

Allergic sensitisation (signified by the presence of specific immunoglobulin E) to RIFA venom was detected in 38.3% of children, which varied according to their age: 35.7% in children 2 to 5 years old and 57.5% in children 11 to 20 years old in the southeastern United States.⁶ Similarly, a random screening of blood from adults in Georgia, USA, performed in 2003 found that RIFA-specific immunoglobulin E levels was found in 17% of the samples.³⁸ In 2021, researchers evaluated sera from 106 participants from an endemic RIFA area in Maryland, USA, and the authors reported that the RIFA allergic sensitisation rate in the area ranged from 19.1% to 24.1%.⁷ Other researchers evaluated 703 patients in a RIFA-endemic area that were referred to an allergy clinic for venom allergy, and found that RIFA venom sensitisation was present in 42% of patients.³⁹ A more conservative estimate of 25% of those who were stung by RIFA will develop allergic sensitisation seems to be a reasonable estimate.⁴⁰

Allergic reactions

In the literature there is limited information regarding the rate of large local reactions due to RIFA stings. A recent study reported that out of 3,819 residents who were stung by RIFA, 802 (21.0%) had a localised allergic reaction (wheal-and-flare reaction) to its stings in a year.³⁵

The epidemiological estimates of the burden from anaphylaxis due to RIFA stings vary in the literature. A survey completed in 1989 by 2,022 physicians who treated 20,755 patients for RIFA stings estimated 413 (2%) had been treated for life-threatening anaphylaxis.³⁶ A study by Taber suggested that approximately 0.5% individuals stung by RIFA will suffer an anaphylaxis.⁴⁰ In a study published in 1977, it was estimated that nearly four per 100,000 population in the southeastern United States developed new systemic allergic reactions to RIFA stings per year.⁴¹ A recent study from Taiwan reported that from 3,819 residents who were stung by RIFA, 106 individuals (2.78%) had an anaphylactic reaction to a RIFA sting.³⁵ According to the literature and expert opinion, a range between 0.5 to 2% of those stung by RIFA will develop an anaphylactic reaction in a given year.

Rate of health services usage due to RIFA

The use of health services due to encounters with RIFA can be significant in endemic areas, making it a public health concern within both urban and rural communities. In Georgia, USA, approximately 5% of those stung by RIFA required physician management.⁴² A survey of physicians in South Carolina, USA, estimated that more than 33,000 people (94 per 10,000 population or 0.94%) seek medical attention for RIFA stings, and of these, 660 people (1.9 per 10,000 population or 0.02%) were treated for anaphylaxis.⁴³ In the southeastern United States, it was estimated that more than 200,000 people

(around 1.5% of those stung) required medical treatment in 1995.³⁷ Of the 3,819 Taiwanese stung by RIFA, 288 (7.54%) sought medical treatment, and of those, 70 people sought medical treatment because they had an anaphylactic reaction to the sting.³⁵ The majority of those who seek medical attention do so for non-systemic reactions but up to 16% may be for generalized allergic reactions.⁴⁴ Overall, it is reasonable to expect that approximately 0.94% to 7.5% of those stung will attend health services.

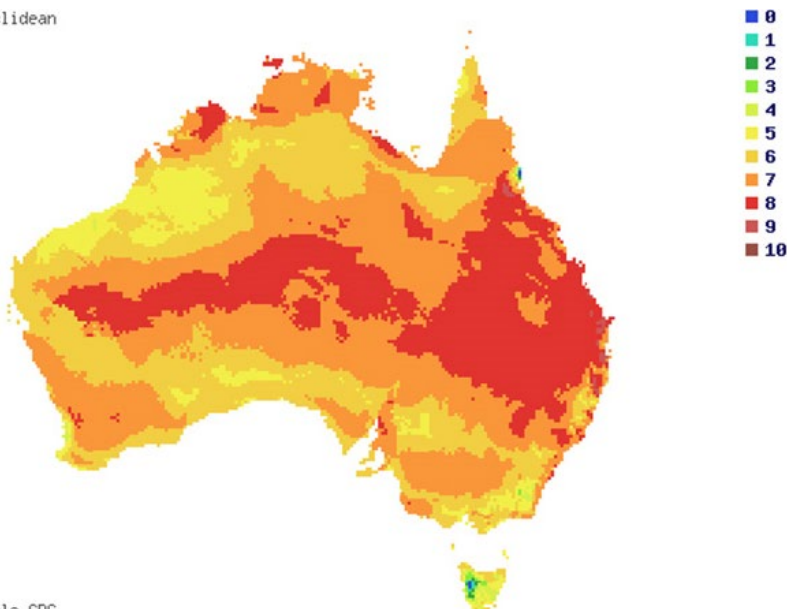
3. Projections of potential health impacts in Australia

We have attempted to predict the health impacts and health service if RIFA becomes endemic in Australia. To do so, we used the international health impacts estimates described in the literature and governmental reports, and we also followed a similar approach employed by Wylie and Janssen-May.²² Importantly, we made certain assumptions which may not be valid, namely: 1) RIFA becomes endemic in almost all Australia; 2) all Australians in RIFA suitable areas are exposed; 3) state and federal governments of Australia have adopted a 'management' approach to the pest; that is, there is no central, coordinated attempt at eradication or containment but quarantine zones may be employed to slow the spread as in the US; and 4) RIFA immunotherapy is not used widely (currently not available in Australia).

A Climatch (Australian Bureau of Agricultural and Resource Economics and Sciences 2008) analysis was undertaken to determine areas within Australia that would be suitable for RIFA by comparing climatic matches, with 644 source stations for climatic analysis, in Australia to that of RIFA distribution worldwide (Figure 4).⁴⁵ This analysis determined that almost all Australians (98.5%) live in areas suitable for RIFA.⁴⁵

Figure 4. Map of potential distribution of RIFA in Australia.⁴⁵

Algorithm: Euclidean



Climatch v1.0
Invasive Animals CRC
ABARES 2008

Scores 0–4 (below threshold, or not suitable RIFA habitat) and scores 5–10 (above threshold, or suitable RIFA habitat)



The population of Australia was 26,473,055 in March 2023.⁴⁶ The RIFA exposed population in Australia in 2023 would be 26,067,542 (98.5%)⁴⁵ using the above assumptions. It is expected that one third of the exposed population is stung per year, which is equivalent to 8,688,312 people annually. Of those 2,172,077 people (a quarter of those stung) would develop allergic sensitisation, and around 43,441 to 173,766 (0.5% to 2% of those stung) may develop systemic allergic reactions which will require medical attention. Furthermore, we determined through direct extrapolation from the most up to date health service usage estimates from Taiwan,³⁵ if RIFA were to become endemic in Australia there would be around 78,194 to 651,623 people (0.94% to 7.5%) people that will seek medical consultation due to RIFA stings each year, and most of the consultations would be due to local reactions.⁴⁴

Summary

Our review of the existing international literature indicates that:

- approximately one-third of the population residing in RIFA-endemic areas experiences ant stings each year;
- around 25% of those stung will develop allergic sensitisation to RIFA venom;
- of those stung, around 20% will experience large local reactions;
- approximately 0.5 to 2% of those stung will experience systemic reactions, including potentially life-threatening anaphylaxis;
- fatalities caused by RIFA are, fortunately, relatively rare;⁴⁷
- estimates of health service utilisation vary, but the rate of healthcare-seeking behaviour among those stung falls within the range of 0.94% to 7.54%;
- The mental health impacts of the loss of environmental amenity, and fear of potentially lethal stings, are likely significant but are poorly documented.

Consequently, the potential for RIFA to establish itself as an endemic species in Australia presents a substantial and costly health issue. The findings presented in this report emphasize the pressing need for collective action, with communities, health authorities, government, and researchers joining forces to raise awareness and address this issue effectively. All the RIFA-related human health impacts are preventable.

Recommendations

The knowledge gathered in this report underscores the urgency of addressing the threat, and that communities, health authorities, and researchers should work collaboratively to address this challenge. We recommend:

- A successful eradication program that would avoid substantial health impacts, and costs, for the Australian population.
- The eradication funds should be made available immediately to increase the effectiveness of the program to avoid future increases in eradication costs.
- Ongoing funding to support permanent biosecurity surveillance for RIFA to ensure rapid identification and eradication of future RIFA incursions.
- In the event of continued spread of RIFA, public health awareness must be raised, and health systems must be supported to manage the increased health care utilisation.
- Despite the clear impacts of RIFA on human health, there remains relatively limited evidence available from international jurisdictions where RIFA are endemic. We encourage further



research on the human health impacts of RIFA from such areas to help inform projections for what endemic RIFA may mean to Australia.

- A cost-benefit analysis of the RIFA eradication program versus the averted health and economic costs caused by endemic RIFA for the Australian context is required.

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