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Designing Housing to Reduce Overcrowding-Related Harms: Rheumatic Heart Disease as the Canary in the Coal Mine

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ABSTRACT

Household overcrowding is a major driver of acute rheumatic fever and rheumatic heart disease, along with other adverse social, cultural and health outcomes in remote Aboriginal communities. Overcrowding is compounded by poor thermal performance of current housing, energy insecurity and climate change. Despite strong evidence of the causes of rheumatic heart disease, upstream prevention through housing design remains underexplored. Wilya Janta, an Aboriginal-led organisation in Tennant Creek, has developed the Explain Home design: a culturally responsive, climate-adapted prototype designed to reduce overcrowding-related harms. With an unprecedented $4 billion investment in remote housing, health professionals have a critical role in advocating for evidence-informed, culturally safe housing as a form of preventive health intervention to improve equity and outcomes.

JEL Classification: Cardiovascular diseases, Indigenous health, Environment and public health

1 | Introduction

Household overcrowding is a well-established driver of adverse health and social outcomes, with severely disproportionate impacts for remote First Nations communities in Australia [1, 2]. For medical professionals who provide care to these communities, the foundational adversity that poor housing poses is obvious, but the medical profession does not have the skillset to tackle these infrastructural challenges.

To understand where solutions may lie to the rippling adversities of severely overcrowded and poorly performing housing, rheumatic heart disease (RHD) offers a platform from which to understand and measure real housing interventions.

2 | Rheumatic Heart Disease as an Indicator

There is overwhelming evidence that the primary driver of acute rheumatic fever (ARF) is poverty and overcrowded

housing, resulting in a high burden of Group A Streptococcal infections [3–6]. Poor quality housing contributes to this burden [7]. *The Australian Guideline for the Prevention, Diagnosis and Management of Acute Rheumatic Fever and Rheumatic Heart Disease* specifically recommends design and construction of housing to prevent overcrowding [8]. However, there is a distinct lack of research to demonstrate what such design and construction looks like [9].

Given that the Northern Territory has one of the highest prevalence rates of RHD in the world [10] and that there is currently an unprecedented $4 billion 10-year commitment to remote area housing construction for the Northern Territory [11], it is imperative that opportunities to design healthier, happier homes are realised with this investment.

Over the past decade, the most recently available NT remote community housing design guidelines have resulted in the construction of inappropriate houses (Figure 1) [12]. The NT has the lowest minimum building code requirements for thermal performance of any state or territory in Australia [13]. Furthermore, remote Aboriginal housing in the NT is not subject to these standards, as such communities fall outside the designated building control areas [14]. As a result, there are no legal requirements to meet the NT's already low thermal performance code. Most of these houses do not come with air conditioning, have small outdoor living spaces and have minimal attention paid to cultural requirements and subsequently are considered culturally unsafe by those who must live in them.

Increasing heat associated with climate change is already impacting population health and in remote communities, the way that prolonged periods of extreme heat exacerbate illness is integrally related to housing [15]. The poor thermal performance of houses combined with extreme poverty and pre-paid power meters results in these households being the most energy insecure in the world [16]. Families are forced to choose between electricity and food every week. When the power switches off because there are insufficient funds, which happens more frequently in hot weather, fridges and occupant-retrofitted air conditioners turn off, and families migrate to other houses not yet out of power and often already overcrowded [17]. Over recent years, the extent of very hot weather has dramatically increased, meaning that heat-related overcrowding has worsened and extended, further driving adverse health impacts [18].

For example, Figure 2 (left) shows a standard nuclear-family-type residence in Tennant Creek, NT. This house has minimal outdoor living areas for hot days. These houses have poor thermal performance and no solar power [19]. There is no readily accessible public cool space in Tennant Creek, so residents are forced to move towards and into the single bedroom with air conditioning for extended periods in very hot weather (if the power is connected).

3 | Wilya Janta and the Explain Home

Wilya Janta (https://wilyajanta.org) is an Aboriginal-controlled organisation based in Tennant Creek, designing and building a unique display village that will demonstrate to community, industry and government the broad benefits of strong investment in housing. The village will feature three dwellings (hereafter referred to as 'Explain Homes') that are informed by community knowledge of culture and climate.

At the time of publishing, design and construction of the first Explain Home (demonstration/display home showcasing design, competitive costing and scalability, Figure 2 [right] and Figure 3) is complete. The design was led by a Warumungu family around their understanding of the dynamics of how a home will be used in the context of social realities, and cultural and environmental priorities. This design process, supported by trusted architectural partners, has been mapped, is replicable and was unique in terms of being Aboriginal led with iterative input from high-calibre architectural, construction and engineering partners collaborating with the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to maximise energy efficiency.

Wilya Janta's process map of the Explain Home provides a cost-competitive and scalable pathway to much better housing. The benefits that will flow on from this project have already being seen, for example, through the creation of the *Right Way Housing Guidelines* published in July 2025, produced by Wilya

FIGURE 1 | House in town camp, built in 2021, according to the Northern Territory Government design guidelines.

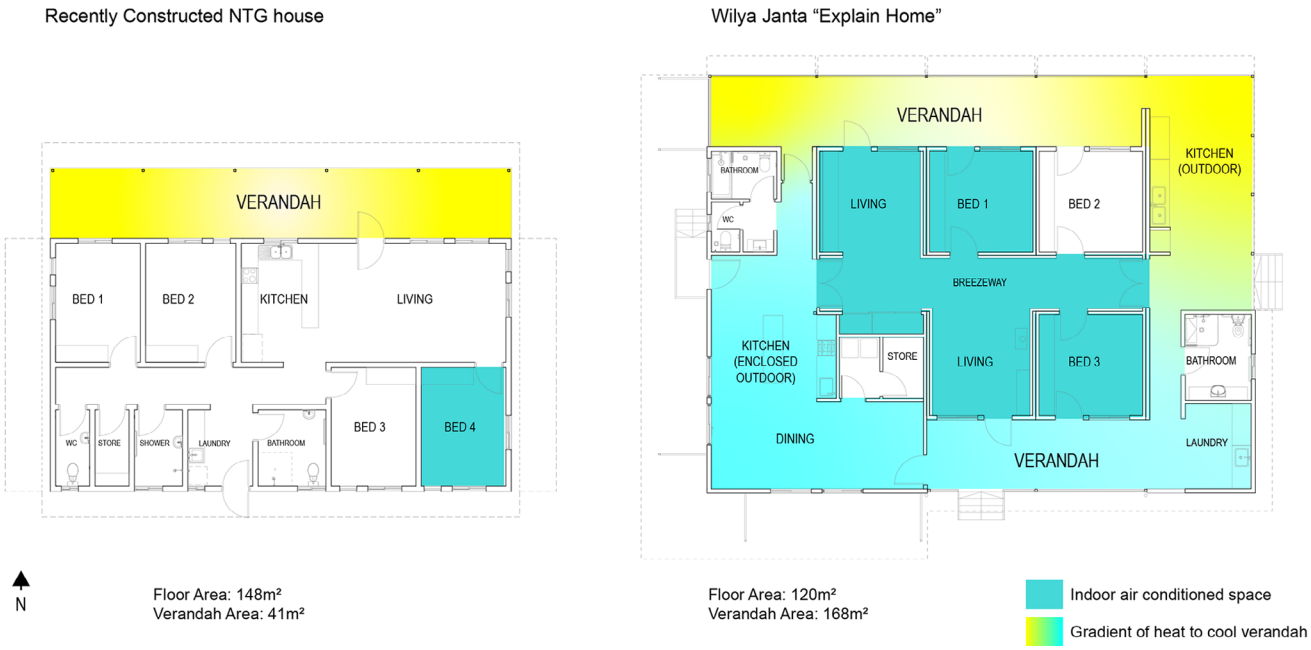

FIGURE 2 | To-scale comparison of the Northern Territory Government standard floorplans for a four-bedroom blockwork constructed house (left) to the three-bedroom Wilya Janta Explain Home (right) that is designed for fluctuating and occasional high occupancy.

Janta in collaboration with the Northern Territory and Federal housing peak bodies, Aboriginal Housing NT and National Aboriginal and Torres Strait Islander Indigenous Housing Association [20].

Figure 2 demonstrates the to-scale floorplan of the Explain Home compared with a recently completed (2024) NT Government-designed house in the same region, which is similar in floorplan and construction to most government houses currently being built. Superimposed on the figure is blue shading for air-conditioned indoor areas and a colour scale gradient from yellow to pale blue representing external living area thermal performance on a summer day, with the NT Government house having only one bedroom air-conditioned.

The Explain Home has a Nationwide House Energy Rating Scheme (NatHERS) of 7.0 out of 10 and a NatHERS Whole of Home Rating [21] of 99/100, making it among the best thermally performing Aboriginal homes constructed in remote Australia, substantially higher than the NT building code requirement of NatHERS rating of 5.0. These floorplan comparisons (Figure 2) demonstrate that there is a substantial increase in both indoor air-conditioned and outdoor cool areas in the Explain Home compared with the recently constructed NT Government home. Construction of both dwellings cost about the same. Construction methodology and industry capacity ensure that construction of the Explain Home is immediately scalable in delivery.

The NatHERS rating system contains assumptions of metropolitan, suburban occupancy, does not cater for outdoor living practices and penalises design elements such as outdoor kitchens, which reduce energy consumption and can improve overall efficiency. Therefore, NatHERS is not always well-suited to remote Aboriginal housing [22]. Managing the design to balance passive temperature control, minimal air conditioner energy demand and the real expected occupancy profile will require careful balancing beyond a simple star rating such as NatHERS. Electricity in the Explain Home will be provided by a solar/battery system with extensive capacity. As per the strong preference of community members, the design features extensive outdoor space, and incorporates many beautiful and nuanced elements of culture (Figure 3).

Drinking water will be rooftop-harvested, noting that with appropriate design, installation and maintenance, residential rainwater harvesting in arid zones is both affordable, feasible and safe [23]. This will make tap water palatable and even enjoyable, with the tank stored in the cool underneath the house. By using rainwater, the Explain Home will not have contamination or calcification issues that are commonplace and problematic from health and infrastructural perspectives [24].

4 | Next Steps

It is vital that such design and construction processes aiming to address overcrowding and associated diseases, including RHD, are supported by an evidence base. This requires substantial infrastructural/research investment to allow data collection, which for Wilya Janta will be co-led by the Tennant Creek Aboriginal Community and university partners, and supported by CSIRO [25]. This evaluation will focus on four domains, comparing as case studies, the Explain Homes to recently constructed remote public housing. The first domain is the technical performance, including inside environmental conditions such as temperature and per-room occupancy levels (identifying internal spaces that regularly experience overcrowding), energy and water usage and durability. The second domain is health and wellbeing, using this small-scale display village to

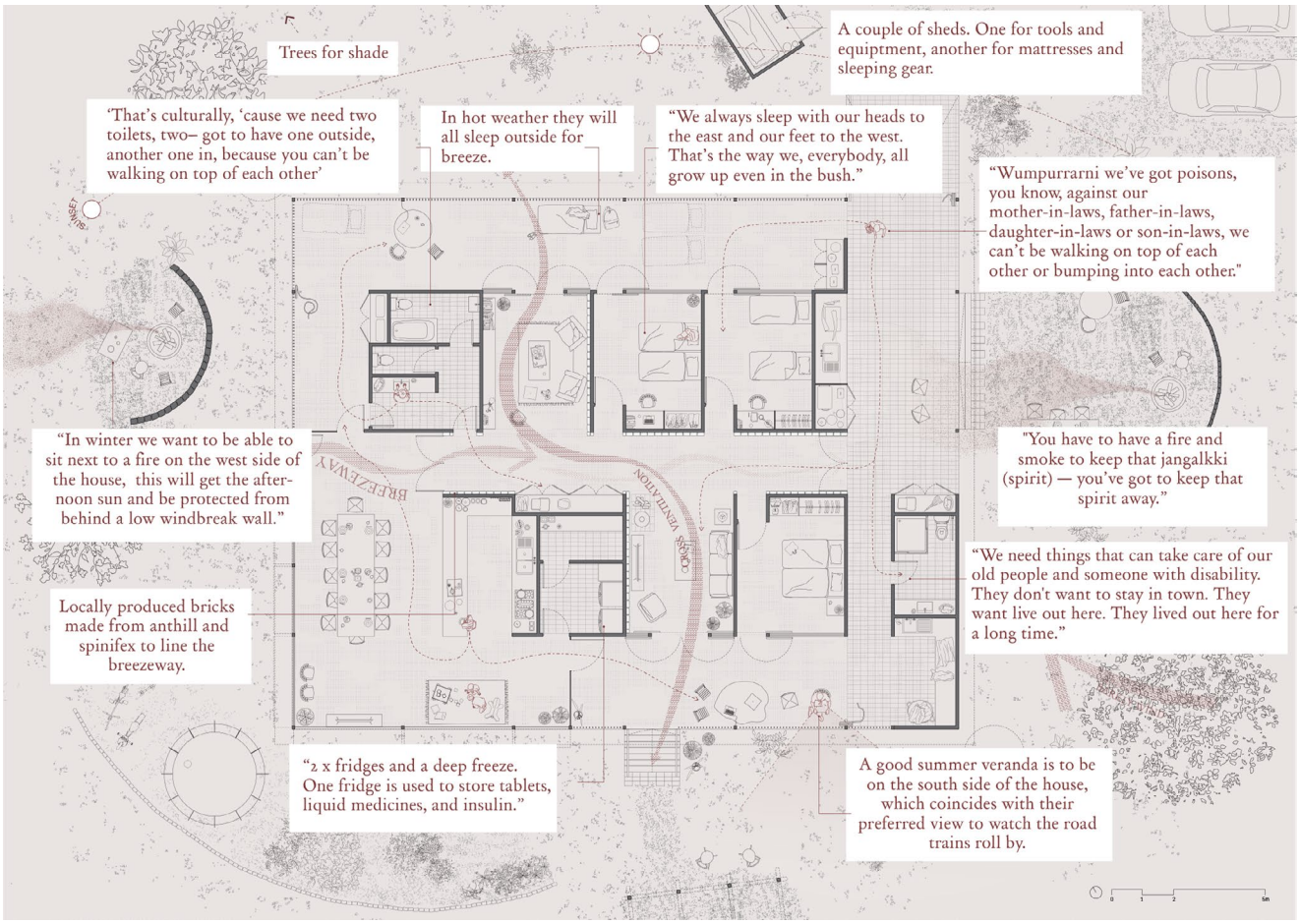

FIGURE 3 | Cultural nuances of the Explain Home with explanations of essential elements. The foundational cultural element is to provide space that facilitates avoidance relationships so that wrong-skin people (there are complex skin-name kinship avoidance relationships that dictate that certain people within a family must avoid contact) can readily avoid close contact while residing in the house. This design aspect includes inherent understanding from Serena Morton Nabanunga and Norman Frank Jupurrurla of a combination of cultural knowledge and lived experience of how the occupancy will fluctuate, to enable up to 20 people to comfortably reside in the home without breaking cultural obligations. This includes the need for two bathrooms and two kitchens, which is very reasonable when the house will regularly exceed 10 occupants. Utilising outdoor space, optimising prevailing weather conditions such as wind direction to enable smoke to flow through the house and other deeper cultural considerations have also been included in the design.

develop a community-centric housing and health evaluation platform. The third domain is socio-cultural evaluation by community of how the home performs for each family. And the fourth domain is a macro-economic analysis of the broad impacts of well-designed climate-ready remote housing.

However, some features already have a substantial evidence base. For example, there is no need to collect further evidence that rooftop solar reduces energy poverty. And likewise with design and construction—in very hot climates, architectural, construction and thermal science is already very clear in what needs to be done to make a house function well to be a safe place for families and children to thrive.

Although the Explain Home model demonstrates feasibility and strong cultural and climatic performance, challenges remain around high construction costs in remote settings, ongoing maintenance and long-term material durability in extreme environments. However, the most challenging aspect of progressing improvements in remote housing design is in navigating regulatory and procurement frameworks that were not designed for Aboriginal-led housing innovation.

The way that remote housing is currently being delivered in the NT is failing to seize opportunities to address serious population health challenges and is poorly aligned with the realities of climate change. For decades, there has been little innovation in this sector, leaving the construction industry stagnant and disconnected from community needs. The $4 billion housing commitment represents a rare chance to transform housing into a form of preventive health intervention. Medical professionals can play a critical role by advocating for culturally safe, disease-reducing and climate-adapted housing—grounded in existing evidence and informed by remote communities and forthcoming evaluations such as the Explain Home project. This advocacy can be advanced through clinical leadership, partnership with Aboriginal organisations, research into housing-health impacts and active engagement in policy debates. By doing so, doctors can help ensure that this investment delivers genuine health equity and climate resilience for remote communities.

Author Contributions

Simon Quilty and Veronica Matthews: draft. Angus Baumann, James Marangou, Bo Remenyi and Gavin Wheaton: editorials relating to rheumatic heart disease. Joshua Francis: development and review of revision. Paul Memmott, Steve Mintern, Simon Robinson, Cary Duffield: contributed to edits and co-designed the house. Serena Morton Nabanunga and Norman Frank Jupurrurla: designed the house.

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Conflicts of Interest

Simon Quilty is employed as the Chief Operating Officer of Wilya Anyul Janta Aboriginal Corporation and receives a salary of $30,000 per year. Steve Mintern and Simon Robinson are architectural consultants who have been paid approximately $40,000 in the development of the design of Explain Home 1 in their role as directors of https://OFFICE.org.au, Australia's first-ever not-for-profit charitable architectural firm. Cary Duffield consults with Wilya Janta. There is Indigenous cultural and intellectual property in the design of this house, not protected by patent.

Data Availability Statement

The authors have nothing to report.

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