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Mid-term Evaluation of the National Centre for Farmer Health – Literature Review

Western District Health Service

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Deloitte Access Economics

Contents

1 Introduction and context

2.1 Purpose of the review

The purpose of this literature review is to analyse peer reviewed and grey literature about farmer health, safety and wellbeing. It forms part of the final deliverable for the mid-term evaluation of the National Centre for Farmer Health (NCFH, or the Centre). The findings have been guided by the overarching aim of the evaluation: to assess the effectiveness and efficiency of the Centre's programs to date, and to identify any opportunities for improvement and alignment. The evaluation builds on findings from a previous evaluation of the NCFH conducted by Siggins Miller in 2017[7] which identified that rural and remote residents and farmers experience higher rates of work-place injury and fatality, age-adjusted mortality, preventable injury and illness, disability and chronic disease than their metropolitan counterparts.[1]

1.1.1 Key evaluation questions

The broader evaluation seeks to answer key evaluation questions which relate to three evaluation areas: 1) justification/need, 2) effectiveness, and 3) efficiency. The data strategy for the evaluation is presented in ***Appendix 1*** of the main report. Of note, both this literature review and the document review (see ***Attachment B*** – *List of Documents Provided by the Centre*) will help to answer the following evaluation questions:

- To what extent is the NCFH addressing a demonstratable need and is responsive to the needs of rural/farming Victorians?
- Is there adequate evidence of continued need for the NCFH and therefore for government in continuing to fund this program?
- What has worked well and what can be recommended to help the NCFH become more effective and efficient?
- What is the effect of the NCFH's service on its clients/stakeholders?
- Have the programs been delivered within their scope, budget, expected timeframe, and in line with appropriate governance and risk management practices?

2 Methodology

To identify appropriate and relevant literature, our research strategy included the use of bibliographic databases that index both academic literature and networked library catalogues for print monographs and related material published since 2017. We considered Australian material of direct relevance, as well as relevant international material in comparable countries. At least the following bibliographic databases in health and the social sciences were searched inclusive of key content related to farmer health and agricultural health research, intervention and program evaluation:

- MEDLINE
- APAIS HEALTH (Australian Public Affairs Information Service)
- HEALTH MODULE – international health planning and administration.
- AMI (Australasian Medical Index)
- CINAHL – international nursing literature
- PUBLIC HEALTH ELECTRONIC LIBRARY
- AUSTRALIAN FAMILY & SOCIETY ABSTRACTS, Australian Institute of Family Studies
- COCHRANE DATABASE
- PSYCHLIT
- SOCIAL SCIENCES CITATION INDEX

In addition to searching for peer-reviewed literature, we conducted a search of grey literature on the NCFH and relevant comparison farmer and agricultural health programs and interventions within relevant websites, reports, policy and strategy documents and research papers that are published by international, national and state government departments, academic research organisations and universities, non-government organisations, health and allied health providers and relevant interest groups. This was done using web tools such as Google Scholar and Scopus. Google Scholar provides a single access point to articles, theses, books, abstracts and court opinions, from academic publishers, professional societies, online repositories, universities and other web sites. Scopus offers sophisticated tools to track citations both retrospectively and prospectively which can be used to identify reports and documents of interest.

3 Findings

3.1 Health, safety and wellbeing of farming communities

Disparities in health between farming communities and metropolitan populations arise from a combination of occupational, environmental, social and geographic factors intersecting with the accessibility, competency and familiarity of health services. Farming communities (i.e., farmers, their families and communities who reside on premises and share in the work) are frequently exposed to high risks to their health from workplace hazards (e.g., prolonged sun exposure, dust and noise pollution, agrichemicals, and quad bike injuries) and periodic intensive labour. Compounded by these health risks are a higher prevalence of comorbid mental health symptoms and conditions in rural populations compared to their metropolitan counterparts. Because of this, Australian farmers possess poorer mental and physical health outcomes compared to the general population.[2] Contributing factors to poorer outcomes include environmental and occupational stressors tied to farming livelihood including responding to changing climate conditions, intense and periodic physical activity, adapting and changing farming practices, all of which can induce prolonged psychological distress in farmers.[2]

High levels of psychological distress have been demonstrated to also be linked to alcohol consumption at high-risk levels more often than the Australian population average, which poses further health risks.[3] Farmer suicide rates, in particular within male farmers, occur consistently at higher rates compared to other occupational groups both internationally and in Australia.**Error! Bookmark not defined.** Australian qualitative research by Kunde and colleagues proposed that Queensland farmer suicides occurred as a result of two distinct pathways: (a) acute situational life stressors (e.g., divorce, separation or pending retirement) or (b) as part of a protracted process related to the experience of a chronic diagnosed mental health issue.[4] Common contributing contextual factors associated with Queensland farmer suicide include long working hours, interpersonal conflicts, physical and mental illness, pain, high levels of alcohol intake, access to firearms and climate adversity such as drought.[4] Interviews by Kunde and colleagues with bereaved relatives have also identified a complex interplay of economic and climatic challenges within the farming industry, access and familiarity with means to end life (e.g., firearms) and a cultural social pragmatic Australian farming masculine identity of "putting on a mask" through strong work ethic, self-reliance, and stoicism.[5] Both community and self-perceived mental health and health stigma, social isolation and withdrawal have been identified as both detrimental to farmer health outcomes, reduced help-seeking, and increase in maladaptive coping strategies such as alcohol misuse.[6]

The above pattern of complex health issues and cumulative impact of social, geographical and psychological factors (relating to work, living and social arrangements that affect the health and wellbeing of farming communities) indicate a need to understand the heterogeneity of health needs and behaviours among farming communities to improve health outcomes. Agricultural health condition research (inclusive of cancer, hearing difficulties, cardiovascular related illness and disease, prevention and early detection and identification) describes effective methods to decrease the burden of disease and associated costs to farming communities. Unfortunately, it is recounted both within Australia and internationally that farmers and rural populations have lower rates of, and less timely access to, health services due to reduced affordability, proximity, coordination and quality of medical and allied health services compared to metropolitan and non-farming populations. In the previous review conducted by Siggins Miller[7], access to health providers including nurses, doctors and allied health professionals was found to diminish with increasing geographic remoteness.[7] This has been further compounded by an existing workforce shortage, with high workloads leading to higher rates of burnout among staff, increased wait times for patients and reduction of timely early intervention for farmers and rural populations.[2] Additionally, the health behaviours (i.e., help-seeking)

of farmers affect how and when farmers access information and support, which can reduce ability for early intervention. However, earlier documented rural health workforce strategies approached rural medical practice in general terms and not in consideration of agricultural medicine or farmers health needs, specifically.

Many initiatives designed to address these challenges have yet to be thoroughly evaluated to determine their success in addressing shortages and antecedent factors contributing to the provision of lower quality health services and shortages in the rural and remote medical workforce. In addition, these initiatives have been increasingly recognised as adopting a "one size fits all" approach which is ineffective when attempting to align health care needs and efforts with that of diverse rural populations and communities.[8] In the previous review by Siggins Miller[7], it was found that targeted health activities must include place-based understanding and leveraging of health behaviours including what contributes to higher levels of community participation in the rural contexts and farming populations, increasing community engagement in planning, oversight and delivery of care, and farming community occupational and lifestyle needs and goals.[7] Efforts to address the limited access to health service and poorer health outcomes must address the distinctive personal values and culture of farming populations, which both health and rural practitioners in agricultural medicine must be aware of to reduce the gap between rural and urban population health outcomes.[9]

Foundational work by Brumby and colleagues in 2015, clearly outlined that health programs, interventions, workforce training and reform in agricultural communities must be interdisciplinary and designed to enable health care providers with both clinical and cultural competencies for working with Australian farmers.[10] Efforts to establish regional centres, health networks, educational and training pipeline efforts to increase rural health workforce presence and competency have been undertaken in conjunction with the NCFH, relevant government departments, universities, and farmers. For instance, from 2003-2017, the NCFH undertook 150 Sustainable Farm Families™ (SFF™) programs – 127 in rural and regional Victoria, 10 in Queensland, 3 in New South Wales, 3 in South Australia, 2 in the Northern Territory, 1 in Tasmania, and 4 in Western Australia, with an overall reach of 2,677 attendees. These programs worked with local industry facilitators and health professionals to drive farmer engagement and ensure sustained impact on health, wellbeing and safety. Commendably, the SFF™ program was viewed positively by the farming community, who reported recommending the program to other farming community members, praised program content, and valued opportunities to meet and discuss with other farmers on health, safety and wellbeing.[11]

Research by the Centre has been instrumental in providing industry partners, government and community health insights into the current health status, relevant health issues and engagement with farmers. Key evaluation outcomes include improvement of health of farmers at risk of disease, positive retention of knowledge gained through mutual co-education and project engagement, and overall improvement of farmer participant health through measurable indicators. The efforts of the Centre's programs and their evaluations speaks to the high interest of farmers to improve their health, wellbeing and safety and support this in fellow farming community members. In addition, the NCFH has a strong reputation of high-quality, theoretically sound, effective research and co-design (with health providers, farmers, other researchers and industry partners), supporting effective delivery that is personally engaging, evidence-driven and aligned to the farming community's health, wellbeing and safety needs.

Further efforts are required to understand the specific health statistics for farming communities. In particular, exploring the interaction between a farmer's specific industry, location and available resources (e.g., presence of health services) in the context of broader social, geographic, cultural and occupational factors would be a useful contribution to the sector. Efforts by the SFF™ Future Directions program aimed to fill this gap by introducing more nuanced and farming context specific research to support Australia's agricultural industries and to give a voice to farmers.[12] However, further work is required to understand the underlying contributing factors between urban and rural health, particularly regarding the understanding of local contextual factors. The previous review[7]

indicated there is a shift from a "one size fits all" approach, with emerging research now focused on the individual health needs of farmers. However, further research is required to understand the underlying factors that contribute to health, wellbeing and safety behaviours by famers.

3.2 Need for targeted farmer health activity

It is well established that Australian rural residents experience poorer health than their urban counterparts.[13] Australian rural residents possess higher rates of injury, poor mental health, lifestyle disease burdens, and increased smoking and alcohol consumption.[13] Australian research by Smith and colleagues has documented that this health disparity arises from poorer service availability, socio-economic disadvantage, higher levels of personal risk, more hazardous environmental factors and occupational and transportation limitations.[14] The agricultural industry faces higher economic and physical exposure to natural disaster, higher occupational health and safety risks, operate within isolated farms, possess limited occupational health and safety information, and are located at a significant distance from health services and early intervention opportunities.[15 16 17] Safework Australia 2020 figures across workplace occupations placed farm and farm managers as possessing the highest workplace fatality rates, with an incidence rate of 15.8 deaths per 100,000 workers in a 5 year period (2016-2020).[18] This fatality rate has shown little improvement with a recorded 17% increase in farming fatalities within in the 5 year average.[18] AgHealth Australia have documented that since 2001, 1548 fatalities on farms were due to non-intentional injuries, with 58 on-farm fatalities occurring for the year of 2020.[19] It should be noted that many statistics only capture those employed in farming and do not take into account family members and children who may also undertake farming work. As 95% of farmers are self-employed, it is likely that these statistics understate the additional occupational incidents, hazards and risks for family members, children and friends who also undertake farm work.[19] Additionally research describes a complex intersection between farm and home life and reporting injuries/fatalities on the farm as occupational incidents. A 2018 study by Beattie and colleagues on farmer attitudes and behaviour following serious injuries determined that farmers are less likely to contact support agencies as they are unaware of such agencies being available, typically uninsured, and tend to rely on family or unskilled friends for farm work for support following an injury.[19] Due to the social connectivity involved with farming work, farmer occupational safety, health and wellbeing is extrinsically tied to community health and the health of the farming business. Farmers and their community collectively experience excessive work-related mortality, work-related injury, high rates of physical and mental disease, limited access to health services and lower health literacy.[20]

These findings illustrate the challenge and strong need for targeted holistic farmer health, wellbeing and safety research and intervention for farmers, farming families and communities. Despite continued higher rates of occupational injuries, earlier age-adjusted morbidity, and challenging and changing work environments, few programs focus on the health, wellbeing and safety of farmers.[21] Farmer reluctance to engage with health services and get support has been regularly documented in research as a result of a culture of self-reliance and avoidance of help-seeking. Additionally, due to the labour-intensive nature of farm work, farmers are time-poor and consider seeking health help-seeking as time-consuming and an interference to their farm work which is their primary priority. This research also found farmers can experience a great deal of financial volatility which acts as a direct stressor at the same time as reducing their ability to seek help.[22] Despite this, Australian farmers are interested in their health, health services and information when these services are relevant, engaging, and culturally competent.[21 23] Studies by Brew and colleagues who worked alongside farmers identified that the greatest barrier – over and above distance and remoteness of services, which is cited by farmers as a barrier to accessing health care – was a preference for self-managing health. This was due to a pervasive culture of stoicism, lack of confidence in health professionals and the need for health professionals to understand farmer's needs.[24] Similarly, research by Varyo and colleagues in 2021 confirmed that both farmers' mental health help-seeking behaviours and positive outcome expectancies were interrelated. This research found that farmers' beliefs about a GP's competency were dependent on the treating GP's local cultural literacy, their experience serving the local farming

workforce and community as well as their accessibility, availability and capacity to provide continuity of care. This process of building rapport between health services providers and the farming community was reported the result of farming community members word of mouth and individual past interactions with health services.[25] Further research by Adams, Beach, and colleagues emphasises that targeted health activity in the farming context must employ and train culturally competent and farmer-led professionals who understand the unique occupational, environmental and cultural hazards and barriers farmers face.[23 26]

3.2.1 Agricultural Health Workforce

Farmers and residents living within rural areas experience significant health workforce shortages, despite having a greater need for health services and practitioners with a broader scope of practice.[27] This shortage of accessible, relevant and quality healthcare is a significant contributor to health disparities observed between farmers and their metropolitan counterparts.[28 29] Additionally, health professionals in rural areas tend to be from diverse backgrounds (including urban and international) with limited experience, cultural competency, and knowledge within the workforce on issues distinct to farmers and rural workforce health needs.[30] Data from the Rural Doctors Association of Australia in 2008 estimated that only 27% of rural pathway general practice registrars were still working in rural practice, and 41% of doctors in rural and remote Australia were international medical graduates.[31] Additionally, attracting and retaining experienced and skilled health professionals to work in rural areas is a challenge not only within Australia, but internationally.[32 33 34] In the earlier review of rural health workforce literature, we observed (and it is widely known) that rural health workforce retention and turnover is influenced by professional or workplace issues, role related issues (including career or professional development opportunities), and personal issues (including family and social issues).[35 36 37] More recent literature indicates that intervention on this range of factors have had little impact on rural health workforce retention.[38] However, two recent case studies have explored the role of place-based governance in addressing the challenges of rural health workforce recruitment and retention, including the employment of a health professional recruiter to recruit for GP, nursing, allied health and medical student placement position in Marathon, Canada, and the implementation of a community health infrastructure and resilience fund to access funding sources for the recruitment of a GP as well as mentor and support new recruits in their transition in Mallacoota, Australia.[39] The various activities have proven successful in both recruiting and retaining health professionals and highlight the importance of leveraging various kinds of resources, from government funding, local industry supplementary funding and community engagement. [39]

In Australia, the federal government invested in several policies and strategies aimed at addressing rural health workforce shortages. The 2013 Mason Review recommended an integrated rural training pathway, linking investment in rural undergraduate medical training with new support for rural intern placements and continued growth in specialist training positions, which would build on existing programs and maintain access to primary and private sector training and develop a more networked approach to the delivering quality education (see *Figure 1*).[40] These strategies also included selection of medical students from rural backgrounds to complete an extended rural training year or undertake all training rurally.[40]

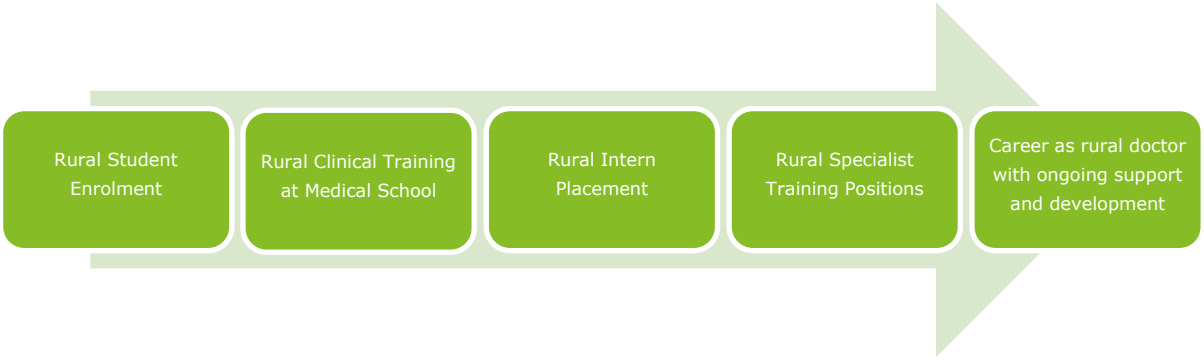

Figure 1. Mason Review rural training pathway (2013)

It was expected that positive rural training experiences would increase interest in rural medicine and also encourage a desire to pursue a career in a rural area. However, fulfilling intentions to practice rurally needed to be concurrent with significant personal and life choices.[40] In a recent 2022 review of rural health workforce research, Gillespie and colleagues suggested that three concepts were strongly relevant to rural health retention and recruitment: creating a sense of place, attachment to place of work, and belonging.[41] Medical practitioners who do not come from rural or agricultural backgrounds or have low levels of cultural competence or experience will likely encounter barriers to connecting with farmers meaningfully and low levels of engagement with the rural community as a whole. This contributes to the high turnover and low retention of the rural health workforce. Rural doctors in the 2019 Australian Medical Association Rural Health Survey identified the need for junior doctors and doctors in training to have greater exposure to rural practice, training and teaching activities.[42] As a result of identifying these health workforce needs and cultural competency gaps, there have been efforts by the NCFH to include postgraduate education and professional development to educate professionals working in agricultural communities about cultural competence and increase their understanding of specific health, wellness and safety concerns unique to farming communities.[23]

As outlined by the Australian Institute of Health and Welfare Australia's Health 2018 report, with the exception of general practitioners fulfilling broader medical roles, the full-time equivalent (FTE) rate of most health care professionals (i.e., psychologists, occupational therapists, optometrists and dentists) per 100,000 population decreases as remoteness increases (see *Figure 2*).[43] Rural and remote populations have greater reliance on primary health care providers (e.g., GPs) to provide health care services, due to less availability of local specialist services.[28] This has impacts for both patients and the broader health system. As patients have less access to specialist services, their health is placed at greater risk as early intervention could be affected by timely access to services. It also places greater pressure on the broader health system as specialist services have an important role in the efficacy and functioning of Australia's health system.

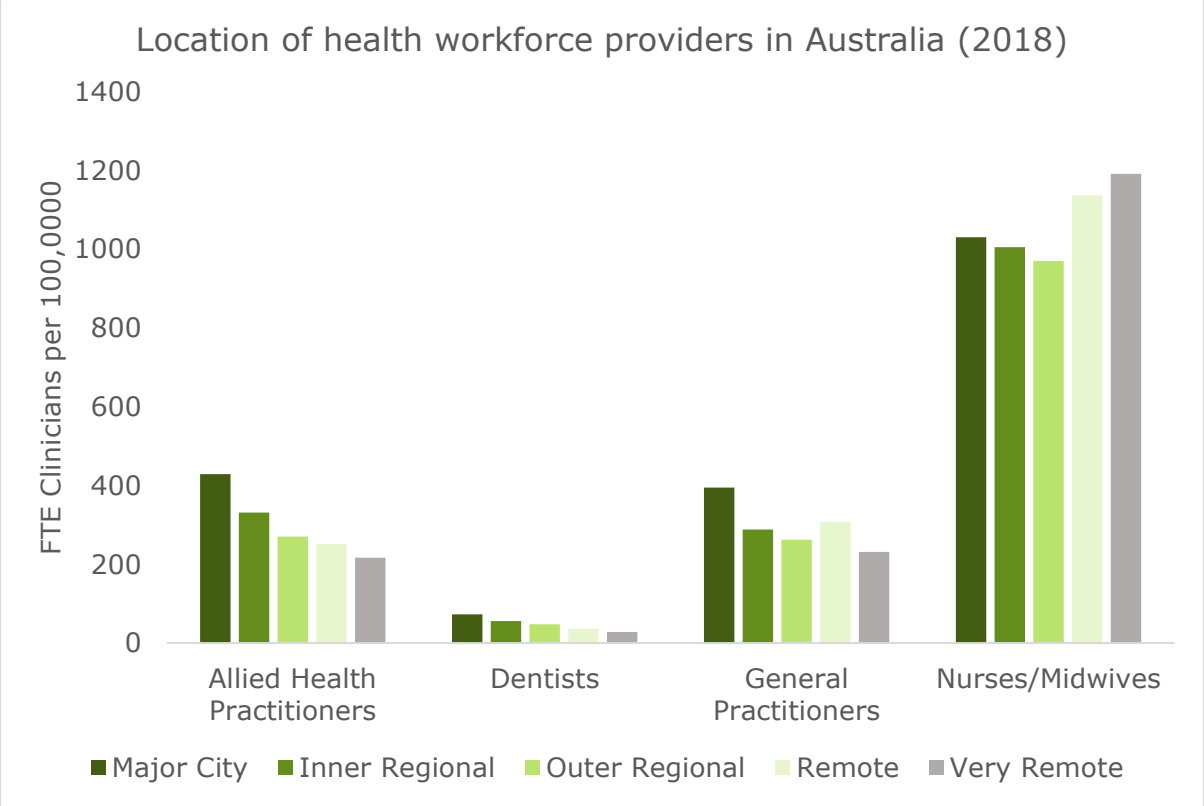

Figure 2. Health workforce data (AIHW, 2018)

While there has been some improvement in the overall extent of Australia's rural health workforce, staffing shortages are still common, particularly in allied health and nursing.[40] The allied health workforce possesses an oversupply in metropolitan areas and undersupply in rural areas where experience decreases as remoteness from metropolitan areas increases.[32] Cross-disciplinary health services, in particular allied health, is essential for the integrated management of treatment and epidemiology of chronic health, mental illness and comorbidities experienced by rural populations.[44] [45] An exasperation of the nurse workforce shortage is also expected as the workforce is aging, with a large proportion of the workforce being projected to retire within the next 10-15 years.[46] This workforce shortage is predicted to impact greatly on rural health as nurses are foundational to the provision of primary healthcare in rural communities and nurses are often the only on-site health professional in remote communities.[47] Follow-up research on nursing and allied health graduates determined that the most significant contributing factor to long-term rural practice was involvement in initial rural placement in undergraduate studies.[48] Additional research on rural nurses in Canada determined two categories of nurses, those that had a rural background "going home" due to their attachment and preference for their community and lifestyle, and those for whom their rural town had "become home."[49] The latter group had either a spouse or partner from town, or had moved to the town for work and consequently decided to practice and reside within the town.[49] This workforce review demonstrates the need to provide career opportunities, exposure and specialist education to rural practice and communities, and meaningful and purposeful cultural engagement with rural communities. Additional considerations should also be explored regarding the practical assistance required for the health workforce with a non-rural backgrounds to integrate into the community including practical social, economic, health and day-to-day support requirements. A practical example of this is the "Attract, Connect, Stay" project[50], a two-year project being implemented in North-Western New South Wales designed to address rural communities long-standing health workforce shortages through the funding and management of a Health Workforce Recruiter & Connector (HWRC) position, informed by the Marathon, Canada experience.

3.3 Web-based information and services

Rural populations and farming sectors have limited access to vital health information, evidenced by a lack of relevant topics on Government Better Health Channel websites.[51] Research indicates that farmers are aware of the broader risks surrounding sun safety, hazardous noise and dust exposure and high alcohol however, they tend to underestimate the day-to-day risk that farming has on their health.[Error! Bookmark not defined.] [104] [91] [92] Additionally, smaller/medium sized farms (<500ha) typically receive safety information and policies from informal sources and employ occupational safety practices as a result of experiencing or hearing about a near-miss incident.[52] [53] [54] This is particularly important as farms of this size comprise over two thirds of all farms in Australia. Access to relevant information is a critical aspect of improving occupational health, wellbeing and safety[55] and according to research, farmers are interested in occupationally relevant health and safety information to better protect their farm, business and health.[56] [57]

Since 2010, the Centre's website has contributed to web-based information on farmer health, wellbeing, safety with the Better Health Channel to improve access to health information and make a positive difference to farmers' lives. This information has been disseminated through a variety of internet, mobile-compatible, social media platforms and cross-sectoral partnerships to ensure that even farming communities with poor digital access are able to access web-based interventions. A 2016-2017 survey of more than 2000 Australian farmers published by the Australian Bureau of Statistics (ABS) indicated that at least 95% of agricultural business had access to internet with different modes of connectivity depending on farm location, with mobile and satellite connection prevalent on more remote farms. On average, farmers reported their internet coverage was only adequate for their needs 54% of the time. Importantly, large-scale farms experience lower coverage compared to dairy and vegetable farms.[58] This variety of access among farming communities reinforces the need for user-centred web design considerations in the delivery of online farmer health and safety information.

Research from American agricultural focus groups stated that effective agricultural safety web-based information delivery requires relatable, relevant, and evidence-based safety and health materials.[59] Furthermore, a farmer's gender, age, and farming operation appear to influence communication preferences. Farmers under the age of 35 preferred internet, social media and email, while middle-aged farmers preferred local papers as a source of health and safety information. Another American study conducted with mid-western farmers determined that the most frequently cited sources for health information were local magazines, farmer newspapers, local farming-related service providers and agricultural events or shows, with the least cited source being web-based sites.[92]

Within the Australian context, Gunn and colleagues conducted interviews with 18 farmers (median age 45.5 years) on internet use and preferences regarding farmer health and wellbeing. Study findings determined that farmers utilised internet services for a variety of purposes including seeking health-related information and research, functional purposes (i.e., weather, emails, banking) and social media to reduce social isolation. Additionally, Twitter was identified as a popular social media platform. Participants reported an open and strong willingness to engage with websites specifically relevant to farmer mental health and wellbeing (including early intervention, prevention and seeking help) if several prerequisites were met. Firstly, sites must appear relevant and engaging with simple layouts and naturally occurring colours (e.g., green). Secondly, they should include authentic farming related pictures and graphics which reflect farming diversity and work. Thirdly, websites should consider copywriting that is casual and humorous in nature. Finally, sites should have accessible features which account for unreliable internet service – including compatibility with multiple devices and limited data capacity. Farmers participating in Gunn and colleagues' study also recommended partnerships with local services to increase trust, engagement and relevancy. Studies with Hungarian and UK-based farmers have reported regular use of online sources to access information regarding farming soil management, however it was not the driving mechanism for practice change.[60] Rather, farmers in these locations placed highest trust and credibility in information from other farmers

through preferred mediums (e.g., farming forums, farming press and social media – with Twitter again being identified as an important peer-peer learning tool). They also reported distrust towards traditional "experts" online, academics and government institutions who are believed to be unsympathetic towards farmer needs. The authors concluded that UK-based and Hungarian farmers increase their online presence through communities of practice, which provides an opportunity to build connections and share knowledge and resources. However, they suggested that targeted rapport building with leaders in the sector could increase the efficacy of these activites.[60] While it is important to acknowledge web-based information is not a cure-all for dissemination of health information, the impact of COVID-19 has had a dramatic increase in the daily tasks being conducted in an online digital environment (e.g., telehealth, education and training), resulting in more awareness of online engagement, and greater willingness and expertise to access information and tools online.[61]

In the 2017 Siggins Miller review[7], e-health was proposed as a cost-effective method to increase access to health services in rural and remote communities.[7] It was identified that e-health was a promising method to increase access to health services across a range of medical specialities and improve opportunities for clinical professional development without detrimental effects.[7] Since 2017, the Ripple Effect (a suicide stigma reduction and suicide prevention digital intervention developed by the Centre) demonstrated the effectiveness of combining research-based adult learning models, personalised and tailored content related to farmer experience of suicide, and empowering participants as peer agents of change through digital connection, digital storytelling, reflection, postcards and educational material.[62] Positive effects of farmer behaviours were noted including help-seeking, supporting others, initiation of challenging conversations and behavioural indicators of reduced stigma associated with death by suicide.[62] This tailor-made digital intervention delivery was the first of its kind with potential for future modelling across farming contexts and health and safety digital information promotion and intervention.

3.4 Health conditions

3.4.1 Cancer

Cancer is a leading cause of burden of disease and is a barrier to life expectancy nationally and internationally.[63] The burden of cancer incidence and mortality has continued to grow worldwide with an aging and growing population.[63] Australia possesses the leading incidence rates of non-melanoma skin cancer associated with excessive sun exposure, proportion of the population with light skin and increased detection of the disease contributing to reported high incidence rates.[64] In the previous review by Siggins Miller[7], it was established that comparative to world-wide cancer mortality rates, Australia has higher survival rates.[7] However, there remains significant inequities for populations living in rural, remote and regional Australia.[65] Australian farmers in particular possess a mortality rate from skin cancer that is 60% higher than the general Australian population.[66] Diagnostic delays and lack of early detection increases with rurality due to a shortage of specialist oncology services and medical practitioners.[67] Troublingly, despite having a lower population and incidence rate, there is higher mortality and advanced cancer diagnosis in rural locations compared to metropolitan areas.[68] Cowdery and colleagues summarise the observable differences in health outcomes including cancer incidence and survival rates in rural populations which are tied to complex factors such as rural population age, availability of screening and early detection, treatment options and access, socioeconomic status, education and income, Indigenous status, and occupation.[69] Research conducted with cancer patients in rural Australian found they were less likely to have up-to-date screening and effective clinical management – contributing to later (and therefore more severe) diagnoses.[70] [71] More recent evidence indicates that rural residents are more likely to be diagnosed as a result of emergency presentation at hospital as opposed to during the screening stage, which appears to be the opposite for metropolitan populations.[72]

In the Siggins Miller previous review[7] recommendations from Sabesan and colleagues about a tele-oncology model that addresses poorer outcomes and treatment gaps for rural residents compared to

metropolitan counterparts was summarised.[73] These included the provision of cancer oncology services and effective cancer networks closer to home, cancer research with regional centres and new models of care.[73] [74] Brumby and Smit-Kroner[75] determined that early detection is key for cancer disease burden and fatality reduction and suggest that public health campaigns (e.g., Slip! Slop! Slap! Sunsmart campaign) have had little focus on early detection or the more efficacious and occupationally relevant use of protective clothing over sunscreen. Again, we note this highlights the gaps in public health and health program initiatives in adequately understanding farmer specific occupational needs, sociocultural values and contextual factors. At present, research is still being conducted into these gaps, calling for grounded community-based research that gathers valuable qualitative information with farmers' experiences in treatment for cancer.[76] For example, a Canadian study of >70,000 farmers indicated that farmers not only have less access to treatment and screening services but also have higher incidence rates of cancer due to an associated range of occupational exposures including prolonged sun exposure, agrichemicals including pesticides, solvents, mechanical and engine emissions, dust, zoonotic viruses and bacteria.[77] These risk factors vary depending on farm category and regional location, calling for more understanding in cancer health response and initiative planning. These findings highlight the need to understand and bridge the "knowledge to practice gap" within farmer cancer prevention and treatment that does not employ a "one size fits all" approach.

Fortuitously, more recent research has moved beyond general incidence rates to explore specific barriers and enablers regarding improving cancer-related protective behaviours and access with farmers. Due to the high risk of skin cancer incidence in Australia, much of the cancer related research on farmers is in this category. Research by D'Souza and colleagues[78] with Western NSW farmers found that despite overall high knowledge of sun safety and positive attitudes towards sun protective behaviours, there was an underestimation of the risk of developing skin cancer. Despite almost half of the farmers involved in the study having at least one skin cancer removed, only 60% of farmers correctly identified they were at a higher occupational risk of developing skin cancer. The most common barrier to sun safety was forgetfulness followed by inconvenience, discomfort and time constraints.[Error! Bookmark not defined.] Similar sentiments for barriers to skin cancer protection such as "forgetfulness" and "being too hot and uncomfortable" has been echoed in farmer research in Iranian, American, and Canadian farmers.[79] [80] These research findings indicate that farmers do not necessarily need global sun safety education but instead tailored practical support for actioning and implementing sun safe behaviours while conducting day-to-day duties on the farm. We also note barriers of implementation will likely vary depending on farmer location, availability of occupational health and safety services and information, farm type, cancer-related occupational risk exposures and safety measures employed by the farmer. Cancer related initiatives and health policies should first improve understanding in farmer occupational practices to leverage practical positive change. Further, much of this research in farmer cancer health focuses on skin cancer due to the high risk and incidence. We address lung cancer, zoonotic, dust and agrichemical related research efforts later in this review (see *Section 3.5*). Outside of farmer lung and skin cancer research, there remains a dearth of recent research in other types of cancer.

3.4.2 Hearing

Excessive noise exposure contributes to a significant occupational risk and incidence of hearing loss and tinnitus in farming.[81] Routine utilisation of large and loud equipment, agricultural machinery and vehicles on farms such as tractors (95-100 decibels) and headers (88-10 decibels), livestock (95-105 decibels or above), firearms (shot gun 140 decibels), process machinery (up to 95 decibels) and chainsaws (105-120 decibels) cause a prolonged and cumulative risk of hearing loss to farmers.[82] [83] The recommended maximum exposure time without any safety equipment for varying noise levels is presented in *Table 1*. For instance, WorkSafe Victoria recommends that farmers should only be exposed to chainsaw noise for a maximum of 8 seconds without any hearing protection. Research by Brumby estimated that 51% of farmers were regularly exposed to daily noise above Australian exposure standards.[84] This is particularly troubling given that farmers reside on premises with the

source of the noise and rarely limit occupational exposure within 8 hour shifts due to the ongoing nature of farm work, meaning that farmers are exposed to sustained high levels of noise across their farming career.[85] Bailey and colleagues' research with farming communities determined that small farms are even less likely to wear hearing protection, compared to larger farms, when undertaking noisy work.[86] Concerningly, compared to 22-27% of the Australian general population, 65% of Australian farmers have hearing loss.[87]

Noise Level dB(A)	Exposure Time
80	16 hours
82	12 hours
85	8 hours
88	4 hours
91	2 hours
94	1 hour
97	30 minutes
100	15 minutes
103	7.5 minutes
106	3.8 minutes
109	1.9 minutes
112	57 seconds
115	28.8 seconds
118	14.4 seconds
121	7.2 seconds
124	3.6 seconds
127	1.8 seconds
130	0.9 seconds

Table 1. Work Safe (2015) Noise Exposure Equivalence. Standard time person without hearing protective equipment can be exposed before standard safety threshold is exceeded.[88]

Excessive noise is also an occupational safety hazard for farming communities. Particularly, limited communication and delayed detection of auditory danger warnings (such as falling machinery or malfunctioning equipment) can result from hearing difficulties.[81] Research indicates that farmer uptake of safety information and policy is often a result of experiencing hearing loss, from informal sources or other farmers.[20] [53] Further, access to speech pathology or audiologist services for

assessment and support decreases as rurality increases with only 1 FTE specialist per 10,000 people in remote areas.[89]

In 2016, the Centre identified the risk of hearing damage for farmers and conducted The Shhh Hearing Project to extend successful health outcomes from the SFF™ program into early intervention hearing services. The Shhh Hearing workshops included a hearing screening, health assessment, and educational and experiential discussion sessions on farmer hearing loss. Research indicates that these activities were successful in increasing awareness and contributed to positive behaviour to manage and prevent hearing loss. Personal farm noise audits and reports were positively received due to farmers perceptions that findings were relevant to their own farm and business. In addition, farmers reported post-intervention they were more likely to wear Personal Protective Equipment (PPE) at 6-8 months follow-up.[84] These results differed from prior efforts in hearing loss awareness by Williams and colleagues in 2015, where individual hearing tests were not successful in improving awareness of noise, risk and utilisation of hearing protection.[90] Rather, findings from The Shhh Hearing Project indicate that personalisation and tailoring health intervention to the farmers environment were key to successful protective behaviour change and general awareness.

More recently, 2018 research by Mead-Hunter and colleagues in Western Australian confirms that despite numerous studies and government publications, farmers remain exposed to extended shifts, sometimes up to 16 hours, where dangerous noise levels are above 85 decibels.[91] In addition, hearing protection is typically not worn for the length of this duration and only for a small subset of particular tasks considered to be “noisy”. Surveys with farmers highlighted that hearing protection was worn when using chainsaws 86% of the time. However, this was less prevalent when using moving vehicles/equipment (43% of the time), shearing equipment (26% of the time), and handling livestock (17% of the time).[91] Farmers employed other methods of noise reduction including turning off equipment when not in use, buying quieter equipment or silencers, or separating noisy tasks from quieter tasks. The study results indicated that farmers do recognize noise is a potential issue, and therefore apply hearing and preventative steps. However, this is not adequately managed due to lack of knowledge of specific farm risks and information.

Internationally, research with 280 Midwestern American farmers (56.4% with mild to severe hearing loss) on hearing attitudes and practices determined that, while farmers agreed that PPE was important to health, only half wore hearing protection.[92] Further, while generally aware of the occupational risks of dust and noise, there were gaps in correctly identifying hazardous noise exposures, associated long-term health consequences and correct fitting and selection of PPE for the appropriate noise or dust hazard.[92] Consistent with findings in the Australian context,[27] American farmers had limited access to and relied very little on web, TV or radio information sources and preferred obtaining health information from agricultural shows, farming newspapers or publications, farming peers or by “practical common sense”.[20 92] Given noise induced hearing loss is the leading cause of hearing loss for farmers and is entirely preventable, personalised and farmer specific educational program efforts such as those employed by The Shhh Hearing Project by the Centre should be considered for farmers.

3.4.3 Cardiovascular disease

Cardiovascular disease (CVD) is a leading source of burden of disease and death in Australia, causing one in four deaths.[93] Interestingly, research indicates that when age-related differences in the population are accounted for, the prevalence of CVD and stroke does not vary by remoteness in area.[94] However, in 2017-19 the CVD death rate in rural and remote populations was 1.4 times higher than their metropolitan counterparts.[94] Additionally, in 2018-19, CVD hospitalisation rate was also 30% higher for rural and remote residents than those in major cities. This was attributed to the higher proportion of Aboriginal and/or Torres Strait Islander people residing within remote and rural areas, and delays in diagnosis and access to health services contributing to increased severity in hospital presentation.[94] Additionally, rural populations possess higher risk factors such as smoking,

hypertension, high cholesterol, obesity and physical inactivity.[100] CVD burden modelling by Alston and colleagues determined that one third of CVD deaths in rural residents were due to presence of higher risk factors and if these risk factors were brought to urban levels, 1,461 rural CVD deaths per annum could be delayed.[95]

Brumby and colleagues confirmed that Australian farmers possess a higher prevalence of CVD risk factors including obesity and overweightness (as determined by waist circumference), hypertension, diabetes and psychological distress than their metropolitan counterparts.[96] More recently, research by Pinidiyapathirage and colleagues reported farmers having higher BMI, blood pressure, and risky levels of alcohol consumption when compared to the metropolitan population.[97] With increasing mechanisation, farmers are also not as physically active as they once may have been. This highlights the unique combination of health and lifestyle characteristics (e.g., physical activity, diet, alcohol use) of farmers within rural populations, and with the heterogeneity of farming practices between different types of farms (i.e., grain compared to dairy) and the local availability of health services and resources, the health risk characteristics of farmers may differ between locations. This further emphasises the need to understand the socio-cultural and local risk factors across farming communities.

In terms of farmer behaviours when experiencing CVD-related symptoms, we established from research by Baker and colleagues that farmer decision-making of how and when to seek medical help was inconsistent with community guidelines.[98] Additionally, when asked to name the nearest Emergency Department (ED), 10% of farmers incorrectly named towns without an ED and 66% incorrectly reported it was safe to commute by car when experiencing a myocardial infarction.[99] This research identified a strong need to increase critical decision-making and broad health care literacy among farmers. A recent review confirmed that low symptom awareness and recognition – in combination with other frequently occurring comorbidities – contributes to CVD-related hospital and early detection delays. Other reasons for delays in early detection include farmer dismissal of symptoms in the face of other demands, cultural and communication misalignment with healthcare services, and avoidance over implications of symptoms.[100]

When addressing matters of CVD which are intrinsically tied to lifestyle and global environmental factors such as health access and availability, the National Rural Health Alliance recommends the best path involves leveraging underlying risk factors which contribute to poor heart health.[101] As farmers have health issues which differ to the urban population – and even to rural residents within the same community – it is critical when providing health interventions to understand the unique factors contributing to CVD epidemiology rather than taking a broad "rural Australian health" approach.[97] To date, further work is needed to understand the combination of socio-economic, health literacy, working conditions, and lifestyle risk factors that contribute to CVD and cardiovascular health and in turn the design of interventions. The NRHA identifies that this requires sincere and genuine partnership across health sectors, true community engagement and tailoring of programs to the specific needs of rural communities, inclusive of farmers.[101] Interviews with rural practitioners on CVD health yield further recommendations for undergraduate education to prepare for contextual lifestyle problems and better connection with patients, much like the courses run by the NCFH. Clinicians also recommend that the broader health system could improve coordination, communication and continuity of care between services to improve patient coordination efforts and navigation throughout the health system. This would provide better access to preventative services, targeted health screening, and tailored lifestyle programs that are often offered by specialist healthcare providers.[102]

3.4.4 Alcohol and other drugs (AOD)

It has been established both nationally and internationally that alcohol consumption is higher within rural and remote populations.[3] Farmers in these communities consume alcohol at more hazardous levels than their fellow rural/remote community members or the Australian general population.[97] **Error!**

Bookmark not defined. Pinidiyapathirage and colleagues[103] found that 53% of farmers reported high-risk alcohol consumption. International studies have found that alcohol abuse prevalence of farmers is between 33% and 35% (specifically in Brazil, India and Vietnam). Research with fishing and farming workers, industry partners and community leaders on AOD use reported that many workers were still under the influence of alcohol (i.e., drunk or "hungover"), which presents a safety risk due to reduced reaction times. Illicit drug use was reported as infrequent, with 13.7% of participants reporting cannabis use and 9% reporting amphetamine use.[104] Farmers and fishers also voiced low concern about alcohol use and the impact it may have on health or work.[104] On comorbid factors associated with alcohol use, Brumby and colleagues identified a link between risky alcohol consumption, hypertension, age, obesity and psychological distress for younger farmers (under the age of 50 years).[3] At the time of the previous review, much remained unknown on the culture around patterns of consumption and consequences on both farmer health and mental health. Specifically, researchers identified a need to conduct further qualitative and representative research in these areas.**Error! Bookmark not defined.**

In a 2021 comprehensive scoping review by Watanabe-Galloway and colleagues (across 42 articles on farmers and farmworker substance use literature), it was confirmed that, globally, farmers have a higher prevalence of hazardous alcohol consumption than non-farmers. Most of the studies focused on alcohol use, with only 12 of the 42 studies researching farmer drug use. None of these studies were conducted in Australia, which highlights a research gap due to the known incidence of alcohol misuse. Commonly reported themes contributing to alcohol misuse included easy access to alcohol, lack of access to other recreational or leisure activities (to cope with anxiety or stress) and peer pressure. While many studies acknowledged the unique culture of farm work, the international recommendations ranged from investment in early detection and intervention, alcohol excise taxes, limiting alcohol outlet densities and hours of operations, educational interventions, to studying psychosocial variables that contribute to substance abuse. In line with recommendations from previous studies, Watanabe-Galloway and colleagues recommended further research beyond the sociodemographic factors associated with drug and alcohol misuse, and instead focus on lifestyle and life perspectives of farmers. Further research and gaps remain in understanding the embedded attitudinal, cultural, coping methods surrounding alcohol use, and best practice AOD and clinical intervention and guidelines for farming communities.[105] [106]

3.4.5 Farming across the lifespan

Despite a predominantly senior and aging workforce, farmers report retirement and ceasing farm work as not feasible due to financial and succession uncertainties.[107] Older farmers also face reduced quality of life, higher incidence rates of work-related injury, experience high social isolation and have little agency over their choice to work in agriculture.[108] Research by Walker and colleagues in NSW found that between 2012 and 2016, older famers (>50 years of age) were significantly more likely to be severely injured on farms and require longer hospitalisation than younger farmers. This places economic and productivity pressures on older farmers to return to work quickly following severe injury as they form a high proportion of the farming workforce.[20] Older farmers are also at a significantly elevated risk of accidental farm-related fatalities, occurring at a rate 2.5 times higher (36 per 100,000 older farmers) than the agricultural norm (14.4 per 100,000 farmers).[109] This rate has remained stable for the past 15 years despite the known higher incidence rates and risk.[109] These risk rates arise from an aging workforce exposed to regular occupational risks (e.g., high work demands, isolation, and hazardous work) with low access to health services and information, combined with age-related factors (e.g., reduced reaction time, reduced mobility, increased severity and recovery time, and fatality following injury for older farmers).

Initiatives and policy directives concerned with improving retirement rates with older and low producing farm workers have had little success. Work completed by Peel and colleagues[110] examined the relationship between farmers' exit intentions and their wellbeing and found that increased exit likelihood was associated with poorer wellbeing, and this association was more pronounced among

those with less profitable farms, those with larger farms and farmers earning low-to-moderate percentage of their household income off-farm. Latest figures from the ABS in 2020, indicates the farming workforce have the highest mean retirement age across all Australian industries at 63.2 years.[111] Additionally, the average farmer age has also increased with data from 2018-2019 (financial year), indicating the average farmer age is now 58-59 years, approximately 20 years older than the Australian industry average of 39 years.[112] For farming work, the long hours and hard workdays have no specified retirement age.[15] The higher figures in workforce age and retirement are related to complex agrarian lifestyle traditions and values, succession and rural population composition, and unique business structures. As noted in the previous Siggins Miller review[7], vital information gaps relating to policy and intervention success were prevalent, and it was suggested that these gaps should be addressed to adequately understand the compounding factors and comprehensive data on the relationship between aging and injury and disease across rural farm workforces in Australia.

The previous review[7] also recounted a promising study as the first of its kind to compile data patterns of disease and injury burden in Western Victoria.[113] To date, this study found that hip fracture hospitalisation rates are highest when health care is least accessible. This typically occurs in lower socio-economic stats Local Government Areas (LGAs), where increased age is associated with higher hip fracture rates.[114] Notable key areas were sparsely populated LGAs used for agricultural cropping, grazing or sheep farming, as well as meat and meat product manufacturing.[114] Possible reasons for higher hip rate fracture incidence rates considered complex factors such as older populations migrating to metropolitan locations for better access to health care versus older populations moving to rural areas for retirement. However, farmers continue to work well past retirement age and remain on farms.[113] [114] Additional studies have been conducted, mapping fall rates in people under the age of 40, joint revision surgeries and cancer incidence rates.[115] However, the application of these findings to farm specific locations remains to be conducted to understand aging, injury and disease burden for farmers in Western Victoria.

A 2019 review was conducted by O'Meara to synthesise findings on delay in retirement, sustainability of the agricultural community and health of aging farmers.[116] Findings from 16 articles identified that farmers face economic and climatic pressures to continue farm work but also demonstrate vulnerability at a personal level – exhibiting concerns about farm succession and who would look after them in their retirement. Interviews with Australian farmers by O'Callaghan and colleagues gave farmer voice to challenges associated with losses to their sense of agrarian self-identity, retiring from farm work, loneliness and isolation.[117] The Royal Commission into Aged Care Quality and Safety affirmed that at the heart of aging is compassionate care, respect and dignity for the individual, indicating the importance of enhancing and preserving a person's sense of identity and worth.[118] O'Callaghan and colleagues emphasise society's role in ensuring that all farmers are able to age with dignity and agency. They posit that farmers should be supported to remain connected to health services, free from financial or social pressures, and be assured independence, fulfilment, security and safety.[117] Threats to this dignity arise from a lack of appropriate health and social support processes.[117] O'Meara recognised that these vulnerabilities called for integrated age-friendly initiatives for rural communities through government leadership and funding that fosters engagement between farmers and their associated community to build employment and economic sustainability, and reconcile the competing social and economic needs of aging farmers and family.[116]

3.4.6 Mental health

Global studies have identified common psychosocial risk factors unique to farmers including long hours, social isolation, climatic variability and natural disasters (e.g., drought, flood or bushfires), economic and market variability, workforce capability, role conflict and time pressures.[119] Unsurprisingly, this means that farmers experience significantly higher psychological distress than their urban counterparts.[Error! Bookmark not defined.] The previous 2017 review[7] summarised research efforts in farmer mental health with articles spanning 2008-2015.[7] Many of the studies aimed to assess and

describe determinants and outcomes of mental health in farms. For instance, a 2008 Aghealth study by Fragar and colleagues[120] profiled the most difficult pressures reported by farmers, including:

1. Business-related pressures (e.g., financial, drought/weather impacts, government compliance regulations, family needs, time, employee retention and skill).
2. Family-related pressures (e.g., financial, work-life balance, conflict and succession).
3. Individual-level pressures (e.g., relaxation, fatigue, socialisation, lack of marketing and IT skills).

While AIHW data reports that rural Australians outside of urban locations experience similar rates of mental illness compared to the national average (1 in 5 people), these populations have higher prevalence of self-harm and death by suicide, increasing with remoteness.[121] [122] [123] Between 2010-2017, 52.7% of all non-accidental deaths by suicide or self-harm were outside of metropolitan areas.[124] Within these communities, farmers, young men, older people and Aboriginal and/or Torres Strait Islander people possess an even greater risk of dying by suicide.[125] To date, information on farmer and region specific mental illness (i.e., depression or anxiety) and comorbidity with known chronic health conditions remains sparse due to limitations in data collection. National estimates from the ABS National Health Survey data indicate that 20% of individuals with chronic physical illness also have a diagnosed mental health condition. Additionally, 80% of individuals living with mental illness also have co-existing physical conditions.[126] [127] Research by Kennedy and colleagues has also determined that rural residents with physical health conditions experience elevated suicide risk from both practical and cultural challenges managing their condition, the cause and experience of pain, and loss of independent and contributing life.[128] These figures reiterate the importance of addressing mental health for all populations groups, but especially for farming communities.

The National Rural Health Alliance comments that while rates of diagnosed mental illness occur at similar rates between rural and urban Australians, rates of self-harm and death by suicide increase with remoteness.[129] Brumby and colleagues have suggested that differences in these mental health experiences are related to lack of early diagnosis, health service, distance-decay effects, poor concurrent physical health and access to firearms.[2] Additionally, for many people living with chronic mental health conditions they do not have a single, dominant condition. Rather, they experience the presence of multiple mental, behavioural (i.e., mood disorders, alcohol and drug-related problems) and physical health conditions (i.e., cardiovascular diseases, arthritis, cancer, diabetes, or back pain) in their lifetime, have complex health needs and require holistic and specialised care.[130] A 2021 review by Yazd and colleagues determined that poorer mental health was found amongst farmers who also have poor physical health, past injury or work disability.[119] Unfortunately, despite this strong need for research and intervention many farmers continue to live with undiagnosed co-morbid conditions with little opportunity for integrated, culturally informed and specialist mental health care.

A 2019 farmer mental health outcome and intervention scoping review by Hagen and colleagues determined that across 341 farmer mental health intervention and outcomes studies published between 1998-2016, few studies included formal evaluations of their mental health interventions. All 12 published evaluations originated from Australia.[131] This was inclusive of SFF™ Train the Trainer workshops (2015-2017), SFF™ Health workshops (2003-2007), the Australian Rural Mental Health Study (2007-2009), Mental Health First Aid training for farming advisory and extension agents (2010) and Farm-Link NSW (2006-2011). Hagen determined that consistent across these interventions was a requirement for services that tailor to farmer needs and are delivered by professionals that have sound cultural competency of occupational demands of farming and associated impacts on mental and physical health. Within farmer mental health research, the most commonly reported negative health outcomes were related to stress (42% of studies), followed by death by suicide (33%), depression (32%), anxiety (15%), and resilience (6%), with little to no reporting of positive outcomes.[132] The findings from this review confirm that building farming community resilience and wellbeing is most successful when delivered in a tailored and meaningful way. A rapid review of 178 farming resiliency studies and stakeholder interviews by the National Centre for Farmers Health

identified community wellbeing and resiliency building can be achieved through a focus on viable and sustainable peer-led and place-based prevention, engagement, and development. The review also noted challenges including engaging "hard to reach" populations and vulnerable groups, fundings models of initiatives being not fit for purpose, workforce limitations, ineffective resourcing and coordination and poor internet connectivity.[133] Addressing these research gaps and practical challenges are key to developing an integrated understanding and response to farming challenges or adversity impacting farmer mental health.

Another review completed in 2022 on 50 years of farmer mental health interventions by Younker & Radovich found that, while single intervention programs such as mental health literacy or mental health first aid workshops can be helpful, there is an overall reliance on outcome measures of farmer self-reporting attitude change, knowledge and engagement.[134] Younker and Radovich reported that future farmer mental health focused interventions and research could help to measure direct indicators of farmer behavioural change and wellbeing, as well as provide an appraisal of long-term impacts.[134] Younker and Radovich synthesised feedback across researchers and farmers, noting an overall lack of integrated and multi-component service delivery from mental health interventions. Authors state that this is due to clear evidence that farmers require a variety of resources to combat psychological distress, inclusive of counselling, psychoeducation, technical, financial and legal advice, social support, emergency needs and vocational counselling.[134] Given the combination of lifestyle factors, occupational risk, individual and cultural preferences unique to farmers, integrated and practical health care to support these concerns is critical. Further engagement with farmers in developing co-designed mental health interventions that address social, environmental, cultural and occupational relevant factors is key to effective implementation. A recent example is the co-design of the Primary Producer Knowledge Network (PPKN) designed to prevent poor mental health for primary producers, which was translated from face-to-face co-design to an online environment in response to COVID-19 restrictions.[61] Findings from the PPKN determined that successfully co-designing and delivering interventions with farmers online was enabled through adequate preparation, training and resourcing. Authors also noted that provided there is focused relationship building in the community and relevant stakeholder groups in early pre-workshop phases, these online interventions can also engage "hard to reach" populations. Finally, the online translation of a co-designed intervention did not translate to a compromise of quality. Cost saving from using online co-design methods, rather than face-to-face, allowed for the realigning of efforts towards engagement, overcoming barriers to participation (e.g., distance) and achieving greater diversity in representation. Challenges in facilitating online co-design included zoom fatigue, online etiquette, internet connection and resource demand of facilitators monitoring online meeting rooms.[61] Overall, the PPKN indicates online translation of co-design has clear benefits and is a viable option in generating farmer accessibility, engagement and representation where geographic barriers and hard to reach populations exist.

Additionally, although famers reported gaining emotional support from peer and paraprofessionals, support interventions for these groups are under-supported and understudied.[134] [135] A recent study by Murray and colleagues with Victorian farmers confirmed that following life-changing traumatic injury, farmers rely on each other, their family, known people and institutions in their community.[136] Researchers identified that family is an extremely crucial support resource in the psychological response and recovery of injury.[137] However, this places additional stress on the spouse, friend or family member and wider community who assist in extra farm tasks, who may have witnessed the traumatic incident and who continue to care for the injured individual. Authors affirm earlier recommendations that the provision of psychological and financial support should be provided to the affected family as well as additional appropriate brief support to manage the farm.

2017 research by Hull and colleagues examined the barriers to mental health support-seeking among farmers and non-farmers in rural South Australia. Researchers determined that farmers tended to normalise and ignore physical and mental health issues until there is no other alternative than to seek treatment.[138] Hull and colleagues discuss that for farmers the condition is commonly decided as

requiring treatment only once the capacity to complete work is hindered. Additionally, Australian farmers are on average half as likely (compared to non-farmers) to visit a general practitioner or psychologist within the past 12 months.[24] Australian farmers have also reported individual barriers to help-seeking include a preference for self-management of physical and mental health needs, commute, time, cost, stigma and concerns of health professionals efficacy, knowledge and cultural competency.[24]

3.4.7 Death by suicide

Higher rates of farmer death by suicide are consistently reported in national and international research. Within farmer suicide, these rates are proportionally higher for males (compared to other genders) – a pattern evidenced in both western and developing countries. There is a large amount of research on understanding occupational-level key contributing factors to farmer suicide rates. From the previous Siggins Miller review[7] and as established by the research to date, farmer suicide has been understood to occur from the cumulative and multiplicative presence of climatic variability or natural disasters, economic decline, and changes in government, legislation or technology.[15] [24] Other documented occupational associations elevating suicide risk include the changing pressures of managing a farm inclusive of frequent exposure death and suffering of animals, lethality and high access to a "means to end life" (e.g., firearms or ropes).[5] [139] For most farmers the process of suicide commonly begins from acute salient stressors such as romantic breakdowns or financial difficulties, with no previous suicide exposure or intent to communicate suicidal ideation.[4] Explanatory research by Bryant and colleagues have identified when faced by crisis beyond their control, farmers experience a sense of failure to uphold traditional agrarian values of maintaining self-reliance, strength, stoic pragmatism, and providing for their families. This loss of agrarian identity increases farmer social isolation, reluctance to seek help, normalisation and dismissal of struggles, among other stoic behaviours which elevate suicide risk.[140] For those living with ongoing ill health, an analysis of the Victorian Suicide Register from 2009-2015 by Kennedy and colleagues determined 4 key themes associated with farmer pathways to suicide: living with ill health in rural settings, the experience of ill health, loss of capacity to lead an independent and meaningful life and the elevation of suicide risk from ill health to other factors such as poor mental health or alcohol misuse as self-management.[128] Kunde and colleagues report that for farmers living with long term psychiatric disorder who have died by suicide reported a protracted pathway to suicide from experiences of burdensomeness, loss of belonging as well as illness and pain. These farmers with long term psychiatric illness, typically received mental health support in the two weeks prior to their passing, have had prior exposure to suicide and had commented their intent to suicide.[5]

Health access research by Kavalidou and colleagues determined that male farmers had similar levels of GP contact as other rural men in the area.[141] However, research completed by Kennedy and colleagues in 2020 determined that farmers (compared to non-farmers) were less likely to engage with GP mental health treatment services prior to death by suicide. Additionally, farming related deaths were less likely to have been diagnosed with a mood disorder than non-farmers prior to such an event.[146] This data suggests that GPs continue to be the main pathway for rural health, however differences are being observed in the uptake of mental health and support between farmers and non-farmers. It is therefore critical to ensure that GPs provide culturally competent critical health support and information for farmers both for physical and mental health.

The Ripple Effect project was conducted between 2015-2017 by the NCFH in response to self- and perceived- suicide stigma experienced by farmers with lived experience of suicide.[142] The program involved tailored digital storytelling workshops, personal stories and psychoeducation tailored to the faming context and to participants' experience.[142] The Ripple Effect findings published by Kennedy and colleagues suggest that farmers demonstrated significantly high levels of suicide literacy compared to the general population.[62] Additionally, overall self- and perceived-stigma – as measured by the Stigma of Suicide Scale (SOSS) – did not decrease following participation in the digital intervention. However, the Ripple Effect intervention demonstrated behavioural indicators of stigma

reduction including supporting others, initiating challenging conversations, increasing social connection and seeking support. Farmers reported benefits to self-empowerment and sense of relief through personal and anonymous story sharing with others when otherwise unable to share these stories due to close-knit communities, low anonymity and fear of stigma. Key conclusions from this intervention were that previously identified associations from broader population research between increased mental health literacy and decreased mental health stigma does not necessarily translate to the farmer context. Kennedy and colleagues discuss that while farmers may be highly informed about suicide, there remain gaps in knowledge about risk factors for suicide, for example hazardous alcohol use and suicide.**Error! Bookmark not defined.** Additionally, links between stigma and suicide prevention must be further researched within the farming context to better inform intervention design. Opportunities to connect peers in a safe and non-judgemental space was demonstrated to be of great benefit and value to farmers and warrants further replication and understanding.

Additional 2021 research on the contextual experience of farming families bereaved by suicide by Kennedy and colleagues described a sense of "farming fatalism" surrounding death. While suicide has often been perceived as a violent or traumatic losses, farming families – through their frequent exposure to life and death and acclimatisation to risk in the farming context – often demonstrated a level of normalisation, expectedness and a sense of "preparedness" for death.[199] Additionally, for faming families who remain living and/or working on the farm, the farm itself had an ongoing profound connection to the deceased person. While a sudden or accidental death can impact familial or social bonds, farming families reported that their loved one's connection and legacy often strengthened their bond to the farm and continuing farm work. These interviews provide individualised and valuable insights into the experience of farming families bereaved by suicide.

A suicide prevention and targeted training program in the Sundarban region (India) built from participatory community co-design with farmers, community leaders, educators and representatives, health care providers and pesticide owners was successful in lowering hospital admissions for deliberate self-harm and suicide.[143] Critical to the success of this intervention were co-designed, focused educational materials delivered across the farming community on health, mental health literacy, suicide and self-harm psychoeducation and prevention, violence against women and targeted safe pesticide use.[143] However, this research was completed within the agricultural context of Sundarban, so may not be fully generalisable to the Australian context. The success of this program's efforts was evident from utilising participatory research to address specific community member identified associations between pesticide-related suicide and deliberate self-harm to deliver this targeted intervention with and through identified groups.[143]

A mental health and well-being initiative conducted from 2016-2018, Our Healthy Clarence (OHC) in the Clarence Valley (NSW), modelled a successful community-driven and community-controlled initiative to target suicide prevention and build local capacity to recognise and response to declining mental health and stigma.[144] Factors contributing to successful community engagement and development included collective and community-led commitment to mental health, clarity, leadership from local partners, independent professional contractor expertise for mental health literacy and training, and inclusive and transparent governance. The OHC approach combined principles from public health and community development to allow for community buy-in, capacity building and agency to create social and structural change.[144] A 2018 evaluation conducted by the Centre for Rural and Remote Mental Health, found that whilst the OHC at the time of evaluation was still in its infancy at completion, there were positive achievements to increasing community mental health and wellbeing support, access and attitudes in the Clarence Valley.[145] The evaluation outcomes determined that the initiative increased collaboration between health services, improved access to services, increased suicide prevention training, increased suicide response management and anniversary planning in schools, and improved sense of positivity towards mental health and suicide in media response and the community. Participants report successes of the initiative were due to community commitment focus, leadership and the OHC coordinator's dedicated community

engagement efforts.[145] The OHC community-controlled model for suicide prevention serves as a promising model for replication across rural Australia and farming communities.

It is well noted that firearm access and usage is a strong indicator of death by suicide, often leading to a reduction in the timeframe between suicide ideation and attempt[146] – decreasing the window of opportunity for intervention. Powell and colleagues' 2019 research within the OHC caution that due to the multi-dimensional nature of suicide, simple metrics such as suicide rate or hospital admission for self-harm may not reflect broader multi-dimensional objectives of suicide prevention and wellbeing initiatives. Long-term and shorter subjective and objective measures within evaluation are of strong benefit to capture the voices and values held by the farming community and continue the community driven aspects of initiatives. Additionally, suicide rates vary across rural farming communities and can fluctuate greatly depending on the occurrence and frequency of recent suicides – particularly noting the small absolute number of deaths (even if the rate per 100,000 population remains higher than the general population).[144] Research by Arnautovska and colleagues using the Queensland Farm Suicide register confirmed the incidence and rates of suicide in farmers varied substantially across regions in Queensland.[147] However, an isolated location effect to explain these varying regional suicide rates was not detected as incidence and suicide rates were dissimilar between farmer and non-farmer populations within location. This indicates that farmer suicide occurs in relation to compositional factors of both part of farming as an occupation and location differences between farmers.[147] As discussed, this heterogeneity in farmer suicide rate speaks to region-specific unique contextual relations between the farmer experience of demographic, social, economic, and environmental stressors, supports and coping strategies contributing to farmer suicide.

3.4.8 Comorbidity

The previous Siggins Miller review[7] summarised findings from Brumby and colleagues, which demonstrated that rural and regional Australians experience higher rates of lifestyle associated comorbidities, including obesity, diabetes, cardiovascular disease and alcohol related harms.[7] [148] **Error! Bookmark not defined.** Treatment of ongoing and comorbid conditions and health behaviours require integrated and consistent professional health care assessment, intervention, advice and tailored information for an individual to choose beneficial lifestyle and health behaviours at home and work.[149] Comorbid health conditions will differ from one farmer to the next and require a multidisciplinary health care team, however the availability of multidisciplinary teams decreases as remoteness increases, which is another barrier for people living in remote and rural areas accessing the care they need.[43]

A 2021 review by Rasmussen and colleagues on regional and rural communities living with diabetes and comorbid conditions identified that barriers to self-management included lack of transport, limited access to health services, delays in diagnosis and treatment and financial costs.[150] Telehealth has been demonstrated to be effective in assisting rural participants with uncontrolled diabetes and depression to overcome some barriers including distance and availability of health services.[151] Authors suggest an expansion of demonstrated positive effects of telehealth from single disease management and modelling to comorbid disease management and self-management as a promising pathway to overcome distance barriers and improve health behaviours in rural and remote populations.[150] Due to the limited targeted peer-reviewed research and complexity of comorbid health conditions, further research is recommended to investigate health behaviour, barriers to access and information, and health care service pathways that contribute to comorbid health presentation. On theme with the review, it is also crucial that interventions for comorbid disease and complex health are co-designed with their respective farming communities to ensure health care solutions are tailored and actionable.

3.5 Safety

3.5.1 Tractor

The Siggins Miller review[7] identified the farm tractor as the most common vehicle involved in farm work-related injuries and fatalities in Australia, with rollovers and run overs accounting for 57% and 17% of adult fatalities.[7] Additionally, males were more frequently fatally injured (compared to other genders), and passengers accounted for four of the five child fatalities.[152] 2018 Research by Lower and colleagues confirmed tractors were involved in the largest number of unintentional farm injury fatalities in the period 2001-2016, with 23 of the rollover and 13 of the run over fatalities potentially preventable through rollover protective structures (i.e., ROPS) and safer access (i.e., steps), respectively.[153] ROPS, which include a frame or roll-bar fitted on the back of the operator seat, were developed for tractors without an enclosed cabin to prevent tractor operators from fatal injuries in case of an overturn incident by providing a protection zone for the operator compartment.[154] Access steps are designed so that the operator steps on and off the tractor outboard of the wheel track to minimise the risk of the operator's foot slipping. Most recent Australian data indicates that the proportion of fatalities caused by tractors, agricultural or otherwise, was much lower in 2020 than the 5-year average (2016-2020). However, tractors remain a major source of farm work-related fatalities in Australia.[18] Unfortunately, this data does not provide a breakdown of the causative factors (rollover or run over), and there remains a gap in recent Australian research to identify high-risk groups and the circumstances leading up to these events. Key to further progress and the prevention of these incidents is a thorough understanding of the circumstances and causal mechanisms, as well as individual and environmental factors, to determine the need for potential reinvestment and modification of existing design solutions, work practice modification, or training and prevention programs.[152] [153] [155]

More recently, a review was conducted by Fargnoli in 2020 synthesised trends and challenges for tractor safety literature for the period of 2009 to 2019.[156] Synthesis of 79 articles identified most of the literature to date focused on retrofitting ROPS on older tractors as the most relevant safety issue worldwide. Studies carried out in Australia and America focused more on their respective national programs aimed at increasing farmer uptake of retrofitting ROPS, while the focus of European studies was building knowledge about the technical performance of these aftermarket structures. Further, authors identified the need for a more user-centred approach to manage tractor safety. A user-centred approach is a process that aims to make equipment more usable as well as eliminating workplace hazards by explicitly focusing on the end-user, their tasks, and their work environment, by involving the end-user throughout the design process.[157] Authors also noted the emerging trend of studies that investigated novel solutions in line with Industry 4.0, a growing trend towards automation of production in workplaces by adopting automatically controlled, sensor-equipped machinery or equipment to improve processes through autonomous decision-making.[158] Studies included in this review explored the potential to enhance tractor safety by means of automated solutions, for example, devices monitoring and detecting tractor stability and emergency notification systems in the case of an overturn incident. The authors noted this provides the basis for further research to examine whether automated solutions change an operator's risk perception.[156]

3.5.2 Quad bikes

The safety of quad bike use in a farm context has been widely accepted as a major workplace health and safety issue.[159] [160] Although quad bikes (sometimes referred to as All-Terrain Vehicles or ATVs) are central to both recreational use and everyday farm tasks such as mustering, transport, and spraying weeds, they are the leading cause of unintentional death and serious injuries on farms in Australia[161] [162] and internationally.[163] [164] A review of a trauma register at one Australian regional hospital found common quad bike injury circumstances included falling off and quad bike rollovers.[161] Recent figures from Safe Work Australia indicate there were 22 quad-related farm deaths from workers employed in farming during the 2016-2020 period[18], noting that this figure may not include

quad-related deaths from bikes used recreationally on farms or by children. A descriptive 2021 review conducted by Lower and colleagues confirmed the fatality burden of quad-related farm deaths by reviewing coronial case files for the 2011-2020 period. They found that of fatalities prevalent, 75% of incidents occurred on farms, and observed little to no change in the pattern of incidents from previous Australian studies. Those aged over 45 years accounted for 60% and children under the age of 15 accounted for 13% of farming related fatalities. In terms of the injury mechanisms, quad bike rollovers accounted for a greater proportion of cases.[162] These findings are consistent with studies conducted in the United States [164] and previous Australian studies.[165] [166] Further, head injury and asphyxiation were the primary causes of death.[162] Despite this prevalent safety issue trending in injury and fatality data, a 2021 Agriculture Injury and Fatality Trend Report found the risks and hazards associated with quad bikes was not mentioned very often by farmers during safety conversations.[167]

Children on farms are particularly vulnerable to injury. Children's representation in farming related injury data is limited due to inconsistencies in reporting and recognition in data collection of the blurring of farm and homelife on shared premises.[168] Research by Peachey and colleagues has identified from ABS data that between 2001-2019, 15% of fatalities involving Australian children under 15 were attributed to recreational quadbike use incidents and that 80% of incidents involved a rollover. Many (50%) of these fatalities were drivers of 10-14 years of age.[169] Despite manufacturer safety guidelines, a New Zealand farm study found at least half of rural children hospitalised for a quadbike related injury were drivers of adult-sized bikes. 70% of these quadbike injuries occurred on farms.[163] International research confirms that farming parents' are broadly aware of risks however they overestimate children's physical, social and cognitive capabilities to safely undertake farm related work or tasks.[170] [171] Research by Summers and colleagues also suggest that while children exhibit a level of age expected risk-taking, play and curiosity – they also model unsafe behaviours on the behaviour of parents and adult relatives on farms.[172]

In the Siggins Miller review[7], a range of preventive approaches was noted, comprising of behavioural compliance (e.g., helmet use, passengers, and speed) and design controls to enhance quad bike safety.[7] [173] [174] A consistent recommendation by authors of the included studies was the mandatory fitting of crush prevention devices to protect riders in the event of a rollover. At the time of the Siggins Miller review[7], the Australian Competition and Consumer Commission (ACCC) investigated whether a safety standard for all new quad bikes entering Australia was required to reduce the risk of rollovers.[160] Following a systematic consultation process, the Consumer Goods (Quad Bike) Safety Standard 2019 was introduced, and its stage two requirement – that all new quad bikes be fitted with an approved operator protection device (OPD) – was enforced from October 2021.[175] It should be noted the Standard does not apply to second-hand quad bikes, other than those imported into Australia. While exploratory testing on the effectiveness of OPDs has recently been conducted on behalf of the United States Consumer Product Safety Commission,[176] Australian research monitoring and evaluating the effectiveness of OPDs minimising the risk of suffocation and crush injuries has yet to be done.[162] Further, since 2016, the Victorian Government has funded a rebate scheme for farmers to recover costs associated with fitting an OPD on quad bikes, or the purchase of an approved side-by-side vehicle with rollover protection and fitted seat belts. A recent evaluation of the rebate process was conducted by the Institute for Safety, Compensation and Recovery Research.[177] The study found Victorian farmer quad bike users had a strong understanding of the dangers and risks involved in quad bike use, however, their perception of how these risks applied to their own setting was a major decision-making factor in their willingness to take part in the rebate scheme. These findings are critical to understand the relevant barriers and enablers likely to influence farmers' perceptions of the rebate scheme benefits and ultimately the uptake of such schemes. It is noted that side-by-side vehicles are increasing in their use in Australian farms as a safer and stabler vehicle option due to reduced roll over risk, heavier carry capacity, and fitting of both Rollover Protective Structure (ROPS) and seat belts.[178] [179] However, safe vehicle utilisation is dependent on the appropriate selection of the safest vehicle for farming task and adherence to safety requirements and training (e.g., wearing seat belts

provided).[180] At present there is no research on farmer side-by-side vehicle utilisation and safety outcomes in peer-reviewed literature.

Research conducted since the Siggins Miller review[7] suggests reported helmet use is consistently low in retrospective quad bike injury and fatality studies.[161] [162] Despite evidence that helmet minimises risk of head injury while operating a quad bike (in studies from the USA),[181] little research or intervention to increase self-directed helmet use among Australian farmers has been conducted to date. Internationally, recent research with 211 UK and Irish farmers exploring attitudes towards ATV helmet use determined helmet properties, risk perception, farming culture and environment key barriers, while enhancing awareness of the consequences of ATV accidents were found to be a key enabler.[182] A study by Beattie and colleagues exploring Victorian farmer attitudes and behaviour following serious injuries determined that farmers who had sustained a quad-bike related injury reported mandating helmet use on their own farm and that they noticed an uptake of helmet use in their local farming community post-injury. The farmers also indicated a willingness to be safety advocates if presented with an opportunity.[19] Authors suggest farmers who have experienced a serious injury may be an important resource to assist in the development or enhancement of safety programs.

3.5.3 Pesticides

Exposure to pesticides continues to be a considerable occupational health risk for farmers and their workers.[183] Additional research suggests exposure to pesticides may also be placing other farm household members at risk.[184] Organophosphates are one of the most used class of pesticide in Australian agricultural settings, in livestock production (naphthalophos for sheep dipping, jetting and drenching), fruit and vegetable production (disulforon), crop production (dimethoate), and public health (malathion for head lice).[185] [186] A key feature of organophosphates is the inhibition of the enzyme acetylcholinesterase (AChE), which is essential for the regulation of the nervous system.[183] [187] Symptoms of acute organophosphates toxicity include blurry vision, headache, nausea, diarrhoea, muscle weakness, confusion, loss of consciousness and respiratory distress. The severity of the symptoms depends on the amount ingested, the route of absorption, and the rate of metabolic breakdown of the insecticide.[187] At the time of the Siggins Miller review[7], much remained unknown about the health effects for farmers who have had chronic exposure to organophosphates.[185] Two recent reviews have provided some insight into the effect of chronic pesticide exposure on the mental and physical health of farmers.[188] [189]

A 2019 scoping review by Khan and colleagues on the effects of pesticide exposure on the mental health of farmers identified an association between poor mental health and the previously underreported area of chronic low-dose exposure to pesticides. However, authors noted the need for future research to delineate descriptors for exposure types (long-term and acute) and for mental health conditions and neurobehavioral symptoms to facilitate appropriate analysis, discussion and context.[188] Another 2020 review by Perry and colleagues across 70 articles examined neurological and non-neurological effects of chronic organophosphates exposure in farmers globally (although none of these articles were from Australia). Findings suggested that chronic exposure was associated with deficits in attention and short-term memory, increased incidents of neurodegenerative diseases such as Alzheimer's and Parkinson's disease and effects on peripheral nerves and neurodevelopment.[189] In contrast, research to support non-neurological health concerns were limited, highlighting the need for further work to determine if there is a significant effect associated with chronic exposure. Authors also noted the need for further research to focus on early identification of farmers' risk of organophosphate exposure and early detection of symptoms.

The Siggins Miller review[7] presented recommendations by Cotton and colleagues[190] for the integration of regular AChE monitoring into routine point of care health clinics.[7] Authors noted regular monitoring would establish baseline AChE levels and provide farming and non-farming people with an understandable link between their AChE levels and pesticide use, empowering them to identify

potential exposure and act to reduce exposure through improved health and safety practices. Building on their previous work, a prospective 2018 cohort study by Cotton and colleagues determined the integration of routine AChE monitoring into rural health clinics was well accepted by farming and non-farming participants from South-West Victoria and generated considerable interest amongst participants, with many recognising fluctuations in their AChE levels may indicate exposure.[191] Authors noted the competency of health professionals crucial to the retention of farmers who require follow up monitoring. Further, incorporating point of care testing into health clinics is highly dependent on health professionals' attitude, skills and knowledge and availability of testing equipment. A key focus of the NCFH is its conduct of Agrisafe™ clinics, where anyone in the agricultural sector can meet a trained agricultural clinician for a free comprehensive health, safety, and occupational exposure check, including pesticide (organophosphate specific) testing.[192] However, further research could be conducted to examine the AChE surveillance provided at the Agrisafe™ clinics within the context of the factors identified by the authors.

Health and safety education has the potential to increase the level of health and safety literacy for farmers and agricultural workers concerning pesticide exposure. A recent systematic review by Coman and colleagues[193] of different educational interventions for agricultural workers suggest the strongest results in terms of behaviour change towards pesticide safety were reported for studies that used community participatory methods and considered not only self-reported knowledge, attitude, and practice indicators but also biomarkers as outcome indicators. The review also recommended continuous safety education from an early age that is culturally appropriate.[193] More recently, a limited follow-up study by Russell-Green and colleagues[194] of farming and agricultural workers established that research and education may be able to influence practice change, with results establishing changed organophosphates and other agrichemical handling practices and an increase in the use of personal protective equipment (PPE) following their involvement in the In-Field Personalised Cholinesterase Assessment Project (PCAP). Although an increase in PPE usage was identified across all categories, authors noted the largest increase (66%) occurred in the frequency of respirator use post-PCAP. Qualitative data collection from farmers focused on one key theme – participation in PCAP – and highlighted participant sentiment that the study enabled greater awareness of their current behaviours and attitudes towards agrichemical use and allowed them to re-evaluate their safety practices. Authors identified the need for future research to include a control group and longitudinal research to determine the longevity of changed practices.

3.6 Community participation

Community participation is critical to align health care efforts to local rural and farming population needs.[8] The health and sustainability of a community is threatened if provided health services and programs are unavailable or inappropriately designed and delivered.[195] As stated within the Australian National Strategic Framework for Rural and Remote Health, working with local contextual knowledge provides both an accurate picture of health issues and requirements of the community, and identifies missed opportunities and needed resources. Additionally, stronger relations between health services and communities build a stronger understanding between the community population's health and influencing socioeconomic and physical environment factors.[28] These sentiments are echoed by Bourke and colleagues who advocate for rural and remote communities as active change agents to participate and inform on healthcare service planning and delivery within their rural community.[196] An online co-design approach was more recently used with farmers to design a program to prevent poor mental health for primary producers in response to COVID-19 restrictions and illustrates how this additional research method for use when operating with limited resources or geographic constraints, and recognise,[61] that programs which are developed through place-based and co-designed approaches capitalise on established and trusted community networks.[197] Rural and farming communities are interested and have a high willingness to support their local community. In the Rural Engaging Communities in Oral Health study, rural participant motivations included aims of achieving a self-perceived positive outcome for their community or organisation, perceptions they could

provide useful personal information, or a relevant role where they could benefit service delivery.[198] Study findings from The Ripple Effect and research by Kennedy determined that farmers have a high willingness and readiness to support others while avoiding help for themselves.[199] In all literature to date, we documented the extensive positive engagement effects of including community presence within co-design in farmer health promotion programs and research, community engagement in health workforce retention and delivery, and social support protective factors of health and recovery following severe injury.[20 41 49]

Exploratory research by Currie and colleagues in 2015 found absence of community participation in rural health service delivery resulted in lack of positive impact and sustained change. Community members reported this was due to low participation and misalignment of methods to community contexts.[200] Additionally, farmers in particular report a strong willingness to help others while avoiding seeking help for themselves. Currie and colleagues also found in the absence of formal community governance mechanisms and involvement for health issues, rural health practitioners acted as knowledge and practice translators between rural population and government health authorities.[200] We understand from our profiling of the diminishing rural health workforce that there is a general low cultural competence and understanding of farming context which contributes to health gap disparities between farming communities and the general population. It is crucial that healthcare promotion, health care education and government health directives embed a whole community centred and engagement approach.

In the prior Siggins Miller review[7], community participation and community member led decision-making to healthcare was discussed by Kenny and colleagues as a locally responsive, cost-effective and capacity-building approach to improving rural health outcomes.[7 8] Kenny and colleagues discussed that despite strong assertions from policymakers on the benefits of community participation, there was a significant gap in understanding the challenges and mitigating strategies associated with higher community participation.[8] This included evidence to inform good community participation and health care service improvements, sustainability of participation, shared understanding, governance and practical application.[8] Since this paper, the OHC program conducted in NSW has changed the local community narrative about mental health, suicide and quality of life through community driven decision-making, early and continued community involvement and control, building on local assets as designated by the local community as relevant and sustainable, and the ability to leverage expertise when required. The OHC noted similar sustainability issues noted by Kenny and colleagues' theoretical community participation paper, which suggested that community engagement (while strong at inception lay-person membership) fluctuated over time, effectiveness of working groups as membership declined, and steering committee memberships appear to alter as needs change. Preston and colleagues' review of the literature have suggested that health improvements with community participation are not gained without an extended timeframe, strong design methodology, adequate and sustained resources and strong relationships.[201] While considerable improvements can be made to health through community engagement to identify and justify increased resources, the question of how to sustain and maintain goal clarity within community driven health promotion remains unknown.

To date, government and public health policy priority within rural populations key focal strategy asserts community participation and involvement with health care delivery, however, there is a dearth of research within peer-reviewed empirical literature on sound and rigorous Australian co-participatory health care delivery with published evaluations. A 2021 scoping review by De Cotta and colleagues on characteristics of co-produced initiatives in rural Australian mental health found sparse results within peer-reviewed evidence published 2009-2019. The authors discuss that it is possible these findings do not appear in peer-reviewed journals and occupy the grey-literature space.[202] However, the benefits of partnerships with academics can promote the cross-disciplinary knowledge divide, improve the rigour and design of evaluation of community co-designed health programs and other health initiatives. This speaks to a continued need for the NCFH to bridge partnerships,

academics and farmers and farming families for positive impacts and sustainable efforts to farmer health, safety and wellbeing.

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