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Evidence Check

Suicide prevention in high-risk occupations

An Evidence Check rapid review brokered by the Sax Institute
for the NSW Ministry of Health—June 2020

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This report was prepared by: Rosalind Case, Jessica Alabakis, Kelly-Ann Bowles and Karen Smith of Monash University.

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High-risk occupations—Suicide

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Executive summary

Suicide is the leading cause of death for Australians aged between 15 and 45 years, creating a devastating impact on families, friends, colleagues and the wider community. Research has shown that individuals in certain occupations may have a higher risk of suicide, due to both personal and occupational factors. However, there are some inconsistencies in the literature as to which occupational groups are at greater risk of suicidal ideation and behaviour. Contextual factors relating to Australia's industries, workforce demographics and geographical landscape may contribute to suicide risk among adult workers and must be considered in determining which groups are at increased risk and require intervention. Suicide prevention is a major priority for governments, with occupational risk a particular area of focus. Understanding which occupations in Australia are most at risk of suicide is a crucial first step in determining the need for suicide prevention approaches in those fields. Furthermore, while there are a range of programs that may enhance psychological wellbeing and potentially reduce suicide risk, the effectiveness of such programs in reducing suicidal behaviours and, ultimately, mortality rates among specific occupations must be considered. It is therefore imperative to review the evidence regarding suicide risk among specific occupations and the efficacy of suicide prevention approaches provided to Australian workers.

Evidence Check questions

This Evidence Check includes four questions relating to occupational suicide risk and prevention, which were drafted by the commissioning body. The questions are:

1. Which occupations in NSW have higher rates of suicide than the background rates for all occupations in NSW, by age group and sex?
2. What suicide prevention programs or interventions have been delivered for particular occupation groups in Australia?
3. What suicide prevention programs or interventions for specific occupations have been effective in reducing suicide risk?
4. From the programs identified in Question 3, summarise the key enablers of contextual factors that contributed to their effectiveness.

Search results

The search strategy designed by the Evidence Check team found 6520 publications from four databases. After removing 1016 duplicate publications, we reviewed 5504 abstracts and titles, excluding 5280 publications that did not meet the inclusion criteria. We then reviewed the remaining 224 full-text publications, excluding a further 165 articles and leaving 59 peer-reviewed publications. Hand searching found an additional three publications, and so 62 publications were included in the Evidence Check. Fifty-one of those publications reported prevalence data for suicide deaths, ideation or attempts. A further 11 publications evaluated the efficacy and/or feasibility of workplace or occupation-focused suicide prevention approaches.

Of the 51 observational studies regarding the prevalence of suicidality among specific occupations, 10 of the articles included in the final yield were secondary reviews of international literature. Of the remaining primary articles, 21 were from Australia, 15 from the US, two from the UK, two from New Zealand and one from Australasia (mixed Australian/NZ cohort). In addition to the 10 secondary sources, 32 studies were retrospective cohort designs and nine were cross-sectional. Of the 11 intervention evaluations, six were from Australia, one from the US, one from Canada, and three were reviews of the literature. Of the eight primary sources, seven were quasi-experimental designs and one was a randomised controlled trial.

To date, the evidence suggests a significant number of workers in NSW are at increased risk of suicide due to their occupation. Rates among farmers, construction workers, ambulance and fire services, veterinarians, entertainers and artists, and the transport industry are particularly concerning, with elevated risk also evident in female doctors and male nurses. There is limited evidence regarding the effectiveness of suicide prevention programs or interventions targeting high-risk occupations, with few evaluation studies examining the impact of such approaches on suicidal ideation, behaviour or mortality rates.

This Evidence Check has collated the evidence regarding occupational suicide rates and the efficacy of suicide prevention programs and interventions among specific occupational groups. It has found there is an urgent need for high-quality evidence as to the effectiveness of suicide prevention programs, to ensure that government spending appropriately targets programs and interventions that provide the best chance of reducing suicide rates in the NSW workforce.

Background and introduction

Suicide is a leading cause of early death in Australia, with more than 3000 deaths recorded as intentional self-harm in 2018, with a mean age of occurrence of 44.4 years.[1] While employment can be a protective factor against suicide, the vast majority of suicides occur among those of working age, with many employed at the time of death.[2] A number of studies have found suicide risk is elevated among particular occupations, including health professionals, farmers, construction workers and those in the entertainment industry.[3] Various risk factors associated with specific employment types have been identified, including high job demands, low autonomy or control, shift work, physical danger and access to lethal means.[4] Personal characteristics of those drawn to particular occupations may also be associated with increased risk, with socioeconomic, personality, mental health, substance use and demographic factors identified throughout the literature.[3,5–8]

Targeting employed individuals, particularly those in high-risk occupations, with suicide prevention and intervention approaches has the potential to reduce suicidality and improve overall wellbeing and mental health. Accordingly, a variety of employment-based programs have emerged overseas and in Australia ostensibly to combat suicide risk. However, there is significant variation in the types of approaches that have been used and little is known about the effectiveness of these programs.[9] Evaluation of the efficacy of such programs is made difficult by the heterogeneity of approaches and the multi-component nature of many programs. The appropriate measurement of outcomes is particularly challenging for any intervention or prevention program designed to target suicide due to the statistical rarity of suicide as an event. Further, the use of rigorous study designs such as randomised controlled trials raises significant ethical issues, as these may require at-risk individuals to not receive assistance.

"Towards zero suicides" is one of the NSW Premier's Priorities, with a plan to reduce the rate of suicide deaths in NSW by 20 per cent by 2023. In 2017, 880 people died by suicide in NSW and it is the leading cause of death for people aged 15–44 years. The rate of suicide in Australia and NSW has been increasing over the past decade, for a complex variety of reasons.

Evidence suggests individuals working in certain occupational fields may be at increased risk of suicide. The NSW Ministry of Health is seeking evidence of what is known about suicide risk for particular occupations as part of a series of evidence reviews being commissioned by the Ministry's Mental Health Branch.

To assist the Ministry in future decision-making, this Evidence Check will address the evidence regarding occupational suicide risk, outline the programs now available for specific occupations in Australia and consider the effectiveness of such programs or interventions in the reduction of suicide rates.

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Methods

The research team conducted a scoping review of both peer-reviewed and grey literature to provide a holistic Evidence Check for all four questions. The team was commissioned in December 2019 to complete the rapid review, and the search strategy was discussed and agreed with the commissioning group later that month. This initial summary of findings was submitted for feedback in March 2020 and the final report was submitted inJune 2020.

Peer-reviewed literature

We searched the following databases to source the academic literature for this Evidence Check:

- Ovid MEDLINE (1946–current)
- CINAHL (1937–current)
- Cochrane Library (1991–current)
- PsycINFO (1806–current).

Search strategy

In accordance with the original request from the Sax Institute, the research team devised a search strategy in consultation with the commissioning group to identify relevant studies published between 2010 and the present in the English language. We generated a representative list of free-text keywords, which we entered into electronic databases for mapping to subject headings. We conducted a final database search in December 2019 and January 2020, using the following combination of keywords and subject headings:

- Suicide/ OR suicid*
- Occupation* OR work*
- Doctor* OR paramedic* OR EMT OR pharmacist* OR nurse* OR dentist* OR veterinar* OR police OR firefighter OR farmer* OR construction OR miner OR entertainer OR artist OR military personnel
- Limit to English, human and 2010–current.

We developed the search strategy to have a wide scope in order to identify both epidemiology/prevalence studies and evaluation studies of workplace suicide prevention programs, using exclusion/inclusion criteria to narrow search outcomes.

Assessment of quality

In order to assess the quality of evidence for the effectiveness of suicide prevention programs identified in this Evidence Check, all evaluation studies were subject to a quality review in line with the Grading of Recommendations, Development and Evaluation (GRADE) system of evidence assessment.[10] The GRADE system provides explicit criteria for quality rating, facilitating classification of the evidence quality (from very low to high).

Study eligibility criteria

All study eligibility criteria were devised in accordance with the research proposal provided by the Sax Institute and subsequent discussions with the commissioning group. We employed a broad scope in order to maximise the inclusion of potentially relevant information. A final list of the inclusion and exclusion criteria can be found in Table 1.

Table 1—Evidence Check inclusion and exclusion criteria

Inclusion	Exclusion
Research pertaining to prevalence rates of suicidal ideation, suicide attempts or completed suicides among specific occupational groups	Publications not in English
Research discussing workplace characteristics or working conditions associated with increased risk of suicidality among employees	Research prior to 2010
Research discussing suicide prevention programs or approaches used in occupational settings	Research focused on individuals outside the workforce (e.g. retirees, unemployed)
Research discussing technological advances aimed at reducing suicide risk among employees	Research discussing individualised psychological or medical interventions for suicidal individuals receiving psychiatric care in inpatient or outpatient mental health services
Research conducted in Australia, the UK, US, Canada, NZ	Research focused solely on military/veteran populations

Study selection, data extraction and data items

Following searches of the databases, two independent investigators screened abstracts and titles, applying the criteria listed in Table 1. In the instance of disagreement, a third independent reviewer helped determine consensus. Two independent researchers then reviewed full-text publications with conflicts again resolved by a third reviewer. A single reviewer extracted data regarding publication details (Appendix 1) with checks for accuracy by a second reviewer.

Grey literature

The review team sourced grey literature from web-based searches targeting suicide prevention programs for employees and/or specific occupation groups via similar free-text keyword terms used in the search strategy. We searched these terms via Google Scholar as an initial source. The search then developed to include direct hand-searching of government and health service websites. We completed these searches in December 2019 and January 2020.

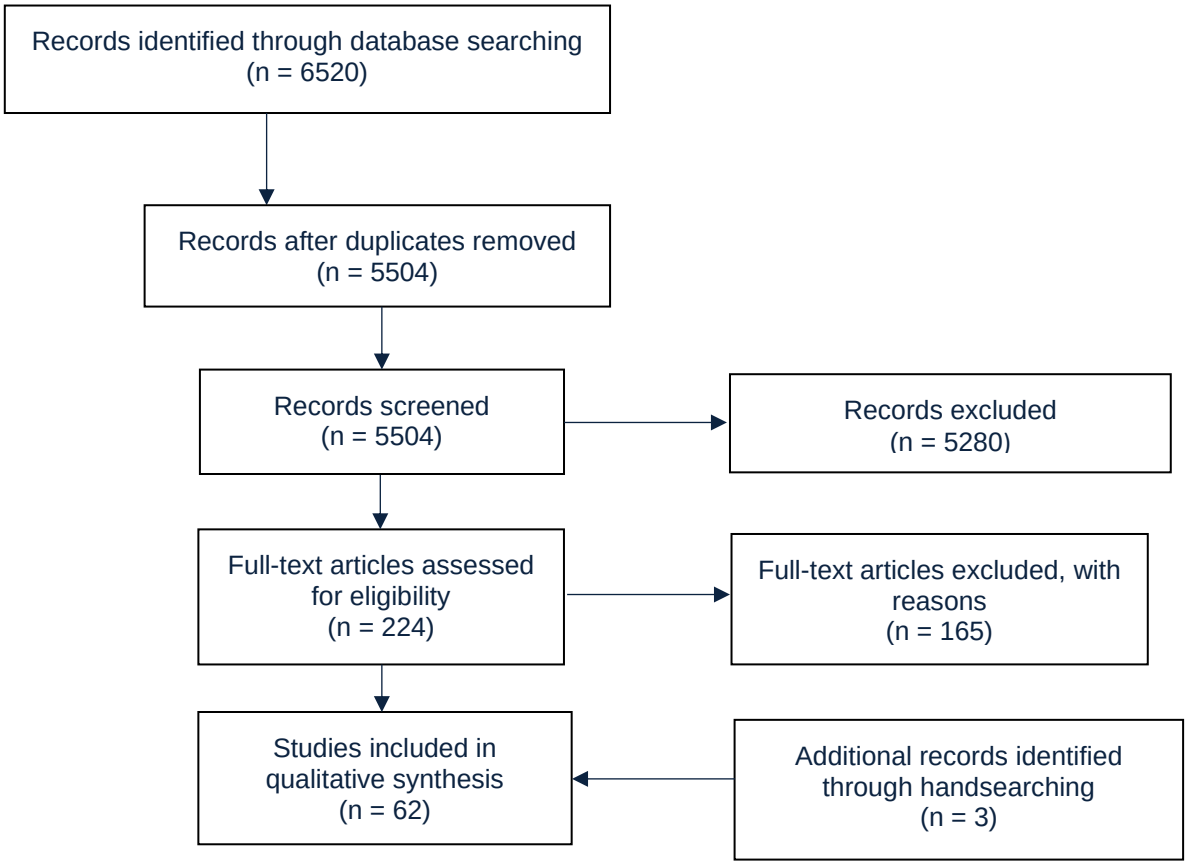
Results and discussion

The above search strategy sourced 6520 publications from four databases. After removing 1016 duplicate publications, the research team reviewed 5504 abstract and titles, excluding 5280 publications that did not meet the inclusion criteria. We reviewed the remaining 224 full-text publications, excluding a further 165 articles and leaving 59 peer-reviewed publications. Hand searching found an additional three publications, and so 62 publications were included in the Evidence Check. Fifty-one of those publications reported prevalence data for suicide deaths, ideation or attempts. A further 11 publications evaluated the efficacy and/or feasibility of workplace or occupation-focused suicide prevention approaches.

Of the 51 observational studies regarding the prevalence of suicidality among specific occupations, 10 of the articles included in the final yield were secondary reviews of international literature. Of the remaining primary articles, 21 were from Australia, 15 from the US, two from the UK, two from New Zealand and one from Australasia (mixed Australian/NZ cohort). In addition to the 10 secondary sources, 32 studies were retrospective cohort designs and nine were cross-sectional. Of the 11 intervention evaluations, six were from Australia, one from the US, one from Canada and three were reviews of the literature. Of the eight primary sources, seven were quasi-experimental designs and one was a randomised controlled trial.

The overall quality of the evidence as to the effectiveness of workplace suicide prevention and interventions was rated as **Low according to the GRADE[10] approach (see Appendix C: Table C).**

Figure 1—PRISMA flow diagram for the peer-reviewed literature in this Evidence Check.



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses:The PRISMA Statement. PLoS M ed 6(7): e1000097. doi:10.1371/journal.pmed1000097

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Findings

Question 1: Which occupations in NSW have higher rates of suicide than the background rates for all occupations in NSW, by age group and sex?

Farming and agriculture

Several studies have examined the risk of suicide among farmers and agricultural workers, with some evidence to suggest suicide rates are higher among this group than those in other occupations. Increased access to lethal means appears also to be of particular significance among those in the agriculture sector. However, there are some contradictory findings in the literature.

In the US, Stallones et al.[11] found males in the Colorado farming, fishing and forestry industries had the highest rates of suicide (475.6 per 100,000 when adjusted for age), with significantly higher use of firearms compared with other workers. In another US study of suicides among farmers and agricultural workers between 1992 and 2010, national suicide rates ranged from 0.36–0.95 per 100,000. These rates were significantly higher than those among all other occupations during the same period (0.13–0.19 per 100,000).

Research in New Zealand has yielded different results. A study by Skegg et al.[12] in New Zealand found hunters and cullers had the highest suicide mortality rates compared with other occupational groups, although farmers in that cohort did not have elevated risk. Farmers were significantly more likely to use firearms as a suicide method, however. A review of coronial records between 2007 and 2015 in New Zealand similarly found suicide rates for farmers were not elevated in comparison with the general population but noted the increased use of firearms among this group.[13]

This Evidence Check identified four studies that examined the risk of suicide among Australian farmers, with a particular focus on the state of Queensland. Andersen et al.'s[14] review of high-risk occupations for suicide in Queensland found agricultural workers had the highest risk, with a suicide rate of 24.1 per 100,000 and a significantly higher relative risk among males than females.

An examination of regional and demographic variations in the Queensland farming cohort revealed higher risk among younger farmers (aged between 18 and 34 years).[5] When geographic region was accounted for, farmer suicide rates were significantly greater than non-farmer rates in those aged up to 34 and more than 55 years, with no elevated risk in those aged 35–54 years. In another Queensland study of farming subpopulations, Arnautovska et al.[15] found farm labourers and farm managers had a similar level of risk when age was accounted for.

Suicide rates for farmers in Queensland have been found to be more than twice those in NSW, with farmers in NSW nevertheless showing elevated risk compared with the general population.[16] The study found the discrepancy between Queensland and NSW rates was most pronounced among men

aged up to 34 years; in that age bracket, the suicide rate of farmers was found to be 3.2 times higher in Queensland than in NSW. The average age of farmers who died by suicide in NSW was 53 years (± 19.1), while rates were highest among those over 55 years (similar to the general population). No differences in the underlying age distribution of farmers across the two states were identified. Interestingly, although there were no apparent differences between the two states in firearm legislation or practices, firearms were more commonly used by farmers in NSW. The authors hypothesise that this may reflect the age-related difference in methods seen in the general population, with older people more likely to use firearms as a suicide means. The study also explored the role of other demographic factors in relation to the variation between Queensland and NSW, identifying no difference in marital status between the two groups. Significant regional variation was observed in both states; however, the range of these differences was significantly broader in Queensland, where the per capita suicide rate among farmers peaked at 67.9 and 64.1 per 100,000 in the Northern and Far North populations, respectively. In contrast, the highest suicide rates among farmers in NSW was observed in the North-Western region (33.4 per 100,000), followed by the Mid-North Coast (26.7 per 100,000), South Eastern (24.3 per 100,000), Murrumbidgee (23.9 per 100,000), Northern (18.1 per 100,000), Sydney (16.1 per 100,000), Central West (13.8 per 100,000), Hunter (12.8 per 100,000), Murray (8.6 per 100,000), and Richmond-Tweed (3.3 per 100,000) regions. No farmer suicides were recorded in the Far West or Illawarra regions between 2000 and 2009. The authors concluded that a broad range of sociodemographic, economic and environmental factors were likely to contribute to the inter- and intra-state differences in farmer suicide rates.

Veterinarians

A review by Bartram & Baldwin[7] showed suicide risk among veterinarians was consistently higher than among other healthcare professionals, with suicide rates twice as high as those in other health disciplines and four times higher than the general population. In an Australian retrospective cohort study of suicide deaths among veterinarians and veterinary nurses from 2001–2012, 18 veterinary surgeons and seven veterinary nurses were found to have committed suicide during the review period.[17] The majority of cases were men (64%), with a disproportionate number coming from rural and regional areas (52%). Suicide mortality rates were significantly higher for veterinarians than for the general population; however, veterinary nurses' rates were not significantly different from those in the comparison group. Only one study yielded contrary results, showing veterinarians in New Zealand did not appear to have elevated risk when compared with the general population.[12]

Increased access to lethal means may act as a risk factor for veterinarian suicide, with 80% of cases in Australia involving self-poisoning using pentobarbitone[18], a short-acting barbiturate commonly used as a method of euthanasia for animals, and as an execution method among humans in other territories. According to a study of Australian coronial data by Pilgrim et al.[18], drug mortality rates among veterinarians in Australia were significantly higher than among other healthcare professions.

Medical practitioners

Evidence regarding the risk of suicide among medical practitioners is inconsistent, with several international studies finding suicide rates among doctors are not significantly different from those seen in the general population.[6,12] A review of suicide deaths among all occupations in the UK by Carpenter et al.[19] found there was a 63% reduction in suicides among doctors between the late 1970s and early

21st century. The review identified that lower socioeconomic status was instead associated with an increasing proportion of suicides, with access to lethal means appearing to be a less significant determinant of occupational suicide risk over time.

Several Australian studies have examined suicide risk among medical practitioners, providing some clarification as to the level of risk in that profession nationally. In a study of suicide deaths among health professionals in Queensland, Kõlves et al.[20] compared suicide rates of medical doctors and nursing professionals with those of both the general population and education professionals. This analysis revealed male medical doctors' suicide risk appeared slightly higher than that of male education professionals, with a rate ratio (RR) of 1.23, and lower than that of the general population (RR, 0.69); however, these disparities were not statistically significant. Female medical doctors demonstrated significantly higher rates than both education professionals and the general population. Self-poisoning was significantly more likely to be used among both doctors and nurses than those in the comparison groups. Higher rates of psychiatric disorders were identified among the health practitioners, with depression identified as the most common disorder reported by 48.1% of doctors and 35.6% of nurses who had died by suicide. While this rate was higher than that seen in the general population (26.2%), it was also noted that doctors and nurses were more likely to have sought medical care relating to their difficulties in the three months prior to their death. Therefore, higher rates of recorded diagnoses may reflect increased mental health help-seeking behaviour among the medical and nursing professionals. Relationship problems were the most frequently noted life events prior to suicide for all groups; however, doctors and nurses reported such difficulties less frequently (18.5% and 25.4%, respectively) than the education and 'other' groups (30.7% and 28.2%, respectively). Unspecified 'work-related problems' were reported by proxy informants in less than one-fifth of cases for both doctors and nurses; however, these were more frequently noted for doctors (18.5%) and education professionals (16.5%). Work-related problems were significantly less prevalent among nurses (6.8%) and the general population (4.8%).

Similar findings were evident in a more recent national study of suicide deaths among health professionals in Australia between 2001 and 2012.[21] Female doctors had significantly higher suicide rates than women in non-healthcare fields, with an age-standardised rate of 6.4 per 100,000 person-years compared with 2.8 per 100,000 person-years for women in other occupations. However, suicide rates for male doctors were not significantly different from those in the general population (14.8 vs 14.9 respectively). Possible explanations for this gender difference noted by the authors included systemic barriers that hinder female career advancement in the male-dominated medical field and increased stress related to domestic and childcare responsibilities more often reported by female doctors.

In a study of 404 drug-caused deaths among Australian health practitioners between 2003 and 2013 (of which half were classified as intentional self-harm), Pilgrim et al.[18] found 73 (36%) suicide cases were medical practitioners. While anaesthetists accounted for the highest number of suicide deaths among the medical practitioner group when compared with the number of registered employees in those specialties, mortality rates were highest among neurosurgery (4.55) and plastic surgery (2.41) specialties (in spite of only one documented case in each of those categories). While the mortality rate for anaesthetists was ranked third highest, at 2.32, this reflected 10 cases of suicide within the study period.

Anaesthetist-specific suicide risk was explored further in a survey of 191 fellows and trainee members of the Australian and New Zealand College of Anaesthetists that assessed psychosocial wellbeing,

substance use and suicidal ideation and/or attempts. While just one respondent reported a previous suicide attempt, 16% reported experiencing sustained suicidal ideation during their career (slightly higher than the lifetime prevalence of 13.3% seen in the general Australian population).[22] A study of suicidal ideation rates among US-based surgeons revealed somewhat lower levels, ranging from 3.8% to 7.7%, with risk highest among vascular, cardiothoracic and trauma specialties.[23] Suicide ideation rates were significantly higher among those in private clinical practice compared with those working in academic settings (7.4% vs 4.7% respectively).

Nursing and midwifery

Suicide risk has also been found to be higher for nurses and midwives than those in other occupations. Several international studies have identified higher suicide rates among nurses, with male nurses and midwives at particular risk.[12,24] In Kõlves et al.'s[20] analysis of the Queensland Suicide Register, male nurses' suicide rates were significantly above those seen in both the educational profession (RR, 2.30) and general population (RR, 1.29). While female nurses' suicide rates were significantly higher than those of females in the education sector (RR, 2.24), they were not dissimilar to those seen in the general female adult population (RR, 1.01). Work-related problems were less frequently identified as precipitants among both male and female nurses, reported in only 6.8% of cases.

Milner et al.[21] conducted the most comprehensive investigation of suicide rates among Australian health professionals, with the results of that study showing suicide rates were significantly higher among female medical practitioners than in non-healthcare occupations (RR, 2.52). Rates were also significantly higher among both male and female midwives and nurses (RR, 1.50 and RR, 2.65, respectively). Self-poisoning accounted for the highest rate of suicide methods among medical doctors (51%) and nurses and midwives (40%), compared with those in other occupations (10%).

The authors suggested the increased rate of suicidality seen among female health professionals in Australia may reflect gender role stress experienced by women in medical and nursing professions (e.g. institutionalised barriers to career advancement, additional pressure to undertake domestic labour and caregiving roles). Occupational gender norms and anxiety about perceived stigma were also highlighted as potential risk factors for male nurses and midwives, due to the traditionally feminised characterisation of such roles. Such 'sex-related stressors', in combination with the psychosocial job stressors identified in medical and nursing occupations (such as high job demands, anxiety about potential errors, long hours and shift work, and occupational trauma exposure) and increased access to lethal means, were highlighted by the authors as potential explanations for the elevated suicide risk observed in these professions.

Paramedics

There is a relative paucity of research that has investigated the suicide rates of paramedics, with only two peer-reviewed articles identified in this Evidence Check. In a review of a statewide death registry in the US state of Arizona, Vigil et al.[26] found the adjusted mortality odds ratio of suicide was significantly higher for emergency medical technicians (1.39) compared with non-EMT cases. There was no significant difference in suicide mechanisms between the two populations.

In Australia, Milner et al.[27] reviewed national coronial data and identified 29 cases of suicide among ambulance workers nationally between 2001 and 2012. Eighty-two per cent of cases were male, with the vast majority (72%) aged from 30–49 years. In comparison with other first responders and protective services (e.g. firefighters, police, military), self-poisoning was used more often by ambulance workers (17% of cases). Despite the higher absolute proportion of cases being male, the odds ratio for suicides among female staff was significantly higher. The higher rates of suicide among such services was attributed to the male-dominated nature of these fields, wherein characteristics such as stoicism and aggressiveness may contribute to a hypermasculine culture associated with poor mental health, increased stigma and reduced help-seeking. For female workers, this may be further compounded by gender role conflict and minority status in the workplace.

Firefighters

A systematic review conducted by Stanley et al.[28] found there was a relative dearth of research regarding suicidality among firefighters, despite literature emphasising the importance of this issue. In particular, the review noted there was a lack of population-based prevalence data to elucidate suicidal risk among firefighters, although several studies have examined psychosocial and demographic correlates of suicidality. The research that has been conducted in this area has yielded some conflicting results.

Studies of suicidal ideation, plans and attempts suggest increased risk among firefighters. In a US-based national study of suicidality among firefighters, 1027 firefighters (92% male) were surveyed regarding suicidal ideation, plans and attempts during their career.[29] Rates of suicidal ideation and behaviour were considerably greater than those seen in other occupations and the general population, with ideation, plans and attempts reported by 46.8%, 19.2% and 15.5% respectively. Key correlates included being of indigenous ethnicity, previous experience of cancer and being married. Firefighters working in volunteer departments and those who had responded to suicide attempts and deaths on the job also reported significantly higher ideation, with exposure to suicide deaths at work significantly correlated with previous personal attempts.

In a subsequent study, Stanley et al.[30] focused on female firefighters in comparing pre-career and career prevalence of suicidality. Career prevalence of ideation, plans and attempts were reported by 37.7%, 10.9% and 3.5% of the female cohort, respectively, compared with pre-career rates of 28.4%, 10.2% and 5.8%, respectively. These rates represent a significantly elevated risk compared with women in the general population, despite the potentially greater physical wellbeing among the firefighter cohort. Increased risk was associated with being unmarried and not having children.

Boffa et al.[31] conducted a national survey in the US of 893 firefighters and examined the relationships among suicidal ideation and behaviour, post-traumatic stress symptoms and depression. Thirty-two per cent of firefighters met diagnostic criteria for post-traumatic stress disorder (PTSD), with 15.6% reporting a previous suicide attempt during their career. Post-traumatic stress symptoms were more strongly predictive of suicidal ideation, plans or attempts than depression or sociodemographic variables.

In another US study of 3036 firefighters (with dual emergency medic roles)[8], suicidal ideation and previous attempts were reported to have occurred among 9.1% and 0.7% (respectively) of the sample during their career, compared with 9.8% and 1.8% (respectively) prior to entering the force. These rates were not significantly higher than those seen in the general population and were not associated

with years of service. However, depression and post-traumatic stress symptoms were significantly correlated with elevated suicidality.

Despite the apparently increased risk of suicidal ideation, plans and attempts among firefighters, there is little evidence suggesting they have an increased risk of completed suicide. In an examination of suicide mortality rates in the Philadelphia Fire Department between 1993 and 2014, suicide death rates among firefighters were found to be comparable to and potentially lower than the general population.[32] Only one study has examined suicide mortality among firefighters in Australia, with Milner et al.[27] reviewing mortality rates between 2001 and 2012. Results showed firefighters did not have significantly elevated rates of suicide compared either with other emergency/protective service personnel or other occupations.

Thus, it would seem that while there is considerable evidence to indicate firefighters are more likely to experience ideation, plans and attempts, this may not necessarily lead to increased suicide mortality rates among this group.

Law enforcement

While international data indicate increased risk of suicidality among police and correctional workers, Australasian studies have yielded conflicting results. In a national analysis of suicides among police and correctional officers in the US, Violanti et al.[33] found suicide rates were 69% higher among law enforcement workers than the general population, with males at considerably higher risk than females. Analysis of job type found detectives and criminal investigators had the highest suicide ratio, followed by patrolling police officers and correctional workers. Another US study of police suicide found suicide rates were higher among smaller police departments, potentially due to workload characteristics, community visibility and reduced access to mental health care.

Findings from Australia and New Zealand contrast with American data. In Milner et al.'s[27] examination of suicide rates among protective services workers, police suicide rates were not significantly elevated in comparison with the general population. However, the study identified an increased risk for correctional officers. Police had the highest rates of firearm use, with 36% of the 51 deaths in the study period by means of this method (compared with 12%, 10% and 8% of the firefighter, ambulance and other occupation groups, for example). Data from New Zealand similarly found there was no significant risk elevation among police. No differences in firearms use were identified in comparison with the general population.[12] This may be attributed to the difference in access to means among New Zealand police, as guns were not routinely carried by police on general duty during the study period.

A study of suicide characteristics among NSW police officers between 1999 and 2008 found that of 247 deaths in that period, 41 were deemed to result from suicide (95% male).[34] However, this study did not generate any incidence rate ratios for comparison with other occupations or the general population and so did not elucidate whether NSW police officers were at increased risk of suicide. The data were used to develop a risk profile, however, suggesting that males aged about 35 years, residing at home and with a spouse and children were most at risk. This profile also highlighted moderate to heavy alcohol use (identified in 30% of cases), access to firearms, relationship breakdown within the previous 12 months (60%), and current performance issues (31.5%) or work-related investigations (23%) as being associated with increased suicidality. Police officers who completed suicide were more likely to have had a recent a diagnosis of a mental illness (77%, with depression noted in 31.5% of cases), be taking psychotropic medication (40%), and to have seen

their general practitioner within two months prior to their death. Previous suicide attempts or a family history of suicide were not identified as risk factors among this cohort. Internal organisational referrals for psychological, medical, welfare support or employee assistance programs (EAP) were recorded in 51.5% of cases; however, the time frame for such referrals was not described and the authors noted that 'few' of the officers appeared to have followed up these referrals and accessed internal support systems or external EAP providers.

Construction

While few studies have specifically examined suicide risk in the construction industry, several studies of general occupation risk have shown elevated rates of suicide mortality among construction workers. In a review of suicide mortality across all occupations in England between 2011 and 2015, Windsor-Shellard et al.[24] found the highest relative risk was seen in low-skilled construction workers, followed by those in skilled trades (comprising roofers, building trades, etc.). These findings are similar to those seen locally in Milner et al.'s[35] study of suicide rates among different occupational skill levels within the Australian construction industry. Those in lower-skilled roles, such as machinists and labourers, had significantly higher suicide rates than skilled trade workers in the construction industry. The risk of suicide among those in lower-skilled roles was almost double that of other occupations, while the risk among skilled trade workers was not significantly elevated by comparison. Possible explanations for the increased risk seen in lower-skilled construction workers included socioeconomic deprivation factors and work characteristics, such as reduced control and autonomy.

With respect to gender influences, there is little evidence to suggest increased risk for females in the male-dominated construction industry. Windsor-Shellard et al.[24] did not find evidence of an elevated risk among females in the construction sector. However, a US study of occupation and suicide in Colorado between 2004 and 2006 found suicide rates for women were highest among those in the construction and extraction industries (134.3 per 100,000)[11] compared with other occupations.

Mining

Australia has a larger resource sector than many other countries, with a considerable number of employees working in the mining industry. However, there is little research into the risk of suicide among workers in that sector. McPhedran et al.[36] analysed data from the Queensland Suicide Register between 1990 and 2008 and found significantly lower rates of suicide compared with those in other occupations and the general population. Other reviews of occupational suicide risk in Australia and internationally have not specifically identified workers in the mining industry as being at higher risk of suicide.[3,37–40]

Transport industry

There is some evidence that transport industry workers (e.g. road and rail drivers) have higher suicide rates than those in other occupations, with three Australian studies identified in this Evidence Check. A review of suicide deaths in Queensland found transport workers had a significantly higher risk of suicide than the general employed population, with a rate ratio of 1.80.[14] There were no recorded suicide deaths of females in that sector within the study period (1990–2006).

Milner et al.[41] examined coronial data relating to road and rail driver suicides in Australia between 2001 and 2010. There were 513 suicides among drivers within the study period, with the vast majority (63%) identified as truck drivers. As 98% of the deaths were among males, female data was not included in the analysis. Road and rail drivers had a standardised suicide rate of 22.6 per 100,000 compared with 15.9 per 100,000 among other occupations, indicating a significantly higher risk of suicide among males in the transport sector. Suicide methods were not included in the analysis; however, a study by Routley et al.[42] of work-related suicides in Australia found commercial transport-related deaths were more likely to involve individuals not working in the transport industry, suggesting access to lethal means may not be a risk factor for employees in that sector.

Creative industries

This Evidence Check did not identify any studies in the past 10 years that had specifically examined the increased risk of suicide among those in creative industries, such as artists, writers or entertainers, despite several studies in the late 20th century highlighting a potentially increased risk for those in these fields.[43–45] However, several more recent studies of general occupational risk have included artists and entertainers.

Windsor-Shellard et al.[24] found artists, musicians, actors, entertainers and media presenters of both genders had a higher risk of suicide than the general population. In a study of high-risk occupations for suicide in the UK, Roberts et al.[46] found artists and entertainers had significantly elevated suicide rates; however, while artist suicide rates increased by 54% between the early 1980s and early 2000s, suicide risk for entertainers and actors declined by 27%.

In Australia, only one study identified in this Evidence Check had examined suicide risk in the creative arts. Andersen et al.'s[14] analysis of data from the Queensland Suicide Register found artists of both genders (with occupations such as actors, dancers, authors, directors, designers, media presenters and musicians) had a slightly elevated risk of suicide, with females in that cohort at higher risk than females in all other occupational fields. There was no analysis of occupational subtypes among artists so no conclusions can be drawn as to potential variations in occupation-specific risks within the field.

Grey literature

Several government and health professional group reports published in the grey literature describe observational findings regarding suicidality rates among specific occupations in Australia. Several of these studies have made significant contributions to what is known regarding the prevalence of suicidal ideation and behaviour in the Australian workforce.

Emergency and protective services

Authors from the University of Western Australia produced a report for Beyond Blue as part of the National Survey of the Mental Health and Wellbeing of Police and Emergency Services.[47] Published online in 2018, the survey included both employees and volunteers within police, state emergency, ambulance and fire and rescue services across Australia, with 92% of agencies in those sectors participating in the study. Alongside measures of mental ill-health (including anxiety, depression and post-traumatic stress disorder), suicidal ideation and behaviours were also assessed. Overall, 5% of

police and emergency services employees reported experiencing suicidal ideation in the previous 12 months. Suicidal ideation and suicide planning rates were found to be two and three times higher than general population rates in Australia, respectively, with rates highest among fire and rescue and ambulance services. Less than 1% of employees had attempted suicide in the previous year. Ideation was associated with longer length of service, with significantly higher rates observed in those who had been in the sector for >10 years. Operational status and service location were not associated with suicidality rates. While suicidal ideation and plans were more common among police than in the general population, rates of suicide attempts among police were lower than adults not employed in the sector. Volunteers were also at elevated risk of planning or attempts; no differences were observed across the occupational subtypes, however.

The survey identified other demographic characteristics as potential risk factors, including identifying as being of minority sexual orientation or gender, and marital separation. No age, sex or geographic disparities were observed. Suicidality was highest among those with comorbid depression and post-traumatic stress disorder.

The National Coronial Information System[48] produced a fact sheet on the subject of intentional self-harm among police, fire and ambulance workers between 2000 and 2012. This data showed there were 110 suicide deaths among emergency services personnel during that period, with the majority of cases occurring in males aged between 30 and 49 years. Among fire and ambulance personnel, depression diagnoses were confirmed among 31.8% and 34.6% of the cohort, respectively, compared with 12.9% of police. Self-poisoning was the primary mechanism for ambulance personnel, indicated in 42.3% of cases, while use of firearms was the leading method for police, occurring in 40.3% of cases.

Doctors and medical students

A Beyond Blue survey[49] of doctors and medical students in Australia found that among practising clinicians, suicidal ideation in the previous 12 months was reported by 11% of females and 10% of males, with lifetime incidence of 28.5% and 22.3% for females and males, respectively. More females than males reported a previous suicide attempt (3.3% vs 1.6%). There were no disparities in terms of work settings.

Entertainment industry

The Entertainment Assist Group and Victoria University conducted a survey of workers in the Australian entertainment industry[50], finding rates of suicide ideation, planning and attempts were six, four and two times higher than those in the general population, respectively. Risk factors included anxiety and depression, poor social support and irregular work hours. The survey found no differences with respect to age or gender, and substance use was not significantly associated with elevated risk.

Question 2: What suicide prevention programs or interventions have been delivered for particular occupation groups in Australia?

This Evidence Check identified only three peer-reviewed articles regarding the delivery of suicide prevention programs or interventions for occupation groups in Australia. The majority of such programs were identified in the search of grey literature and constituted primary prevention approaches (that is, approaches designed to be available for all employees regardless of individual risk level).

Suicide prevention programs for the general workforce

Heads Up (https://www.headsup.org.au/)
Heads Up is a primarily web-based initiative developed by Beyond Blue in collaboration with the Mentally Healthy Workplace Alliance. The Heads Up website provides information for individuals and organisations about the detection and prevention of suicide among at-risk individuals in the workplace. Employers and organisations can register as members to access assessment and action planning tools to enhance workplace wellbeing, and a catalogue of resources. The website includes general tips and strategies for suicide prevention, and links to training and resources (e.g. LivingWorks).

Question, Persuade, Refer (https://www.suicidepreventioncollaborative.org.au/training/question-persuade-refer/)
Question, Persuade, Refer (QPR) is an online suicide prevention training for community members and workers to recognise and respond to warning signs of suicidality. Originally developed in the US, the 60-minute program has been adapted for Australian users by the Black Dog Institute for provision as a component of the LifeSpan Integrated Suicide Prevention program, currently under evaluation at four sites in NSW.

A.L.E.R.T. (https://lifeinmindaustralia.com.au/programs/alert)
The A.L.E.R.T (Awareness & Links Enable Resilient Teams) program is delivered by the OzHelp Foundation and funded by the Australian Federal Government. This approach entails a 45-minute workshop focused on mental health and suicide awareness and detection, and support/referral information. The program is available to individuals, the public sector, industries and businesses.

Wesley Lifeforce Workplace **training** (https://www.wesleymission.org.au/find-a-service/mental-health-and-hospitals/suicide-prevention/training/)
Full or half-day workshop training available for managers and workers, as well as frontline health and social service workers, focused on teaching skills related to identifying and supporting at-risk peers, and providing information regarding appropriate actions and referral pathways.

Mental Health First Aid (https://mhfa.com.au/)
Mental Health First Aid (MHFA) is an approach that advocates for training employees to provide assistance to those with deteriorating mental health or who are at risk of suicide. Training options include:

- Standard MHFA 12-hour course. The suicide component of the course focuses on detection of suicide risk, approaching and initiating conversations about mental health and suicidality, basic risk assessment of the potential imminence of serious harm (e.g. assessment of ideation, planning and intent, access to means, elevated risk relating to substance abuse or other risky behaviour, history of planning or attempts and current support availability), safety planning and referral
- blended eLearning course of 6–8 hours, with a self-paced online learning module and half-day face-to-face session
- standard training program adaptations for culturally diverse populations
- Skilled Workplace program—recognises an organisation's commitment to MHFA. To be eligible for enrolment in the program, a workplace must have a minimum of five full-time equivalent staff, a minimum percentage of staff training in the previous three years and a minimum number of organisational 'actions' (for example, incorporating MHFA into a corporate framework or strategy, promoting MHFA officer availability and access within the workplace, providing employee refresher training on a three-yearly basis)
- provision of evidence-based guidelines for the public.

LivingWorks programs (https://www.livingworks.com.au/)
LivingWorks is a private organisation providing several suicide prevention training programs to both individuals and organisations. The programs include:

- suicideTALK: community suicide awareness training (customisable from 90 minutes to half-day duration)
- esuicideTALK: 1–2-hour online awareness training
- safeTALK: half-day 'alertness workshop'
- ASIST (Applied Suicide Intervention Skills Training): a two-day (15 hours) suicide intervention training program.

LivingWorks training programs are used in a number of other workplace suicide prevention initiatives and training courses available in Australia, including the Lifeline Comprehensive Suicide Prevention Service.

Ahead for Business (https://aheadforbusiness.org.au/)
Ahead for Business is a website and app-based information, self-assessment and resource toolkit regarding mental health and suicide risk for small business owners.

Industry-specific programs

MATES (https://lifeinmindaustralia.com.au/organisations/mates-in-construction)
MATES is a suicide prevention and intervention training program originally designed for delivery within the Australian construction industry (Mates in Construction), and more recently extended to the mining (Mates in Mining) and energy (Mates in Energy) sectors. This program was originally implemented in the Queensland construction industry in 2008 before being rolled out to multiple

Australian states. The more recent extension of the program to the mining industry is also a multi-state endeavour; however, the Mates in Energy program is reported to be Queensland-based. The general MATES program has multiple components comprising:

- General awareness training: a 45-minute session of 'universal prevention' provided onsite at the beginning of a work day. This session focuses on awareness-raising about mental health and signs of suicidality, with the aim of reducing stigma and encouraging help-seeking. Attendees are provided with a white sticker to wear on their hats
- Connector training: volunteer gatekeepers are recruited via an expression of interest invitation. Gatekeepers engage in four hours of training including LivingWorks safeTALK (see below) to assist at-risk workers to access help via more senior gatekeepers (for example,. ASIST-trained workers and managers
- Suicide First Aid: interested workers engage in the two-day ASIST program. This component is mandatory in rural and remote sites
- State field officers are ASIST-trained and employed to recruit and support construction sites, visiting enrolled sites on a fortnightly basis and providing debriefing and supervision to connectors. Field officers may provide direct support to workers who are actively suicidal, supporting referral and access to crisis support. MATES case managers provide oversight to all sites and support referral to external counselling services
- 24-hour suicide prevention hotline: trained mental health workers provide telephone support and emergency assistance
- Postvention: consultation, support and debriefing for management and workers following peer suicide.

Life Care program for construction apprentices (https://www.incolink.org.au/wellbeing-support-services/our-programs/life-care-apprentice-support/)
The Life Care program for construction apprentices (also known as 'Life Skills') stems from and extends the MATES program to encourage suicide awareness, coping and resilience and appropriate help-seeking behaviours among youth workers and apprentices entering the construction industry. The three-day program involves the following:

- Day One: Extended general awareness training; values analysis; psychoeducation regarding cognitions, feelings and behaviours; wellbeing in relation to physical and mental health, substance use, work and interpersonal functioning; financial management coaching; provision of hotline phone
- Day Two: Focus on maturity, independence, habit-forming, proactivity, goal-setting and financial coaching
- Day Three: Connector and SafeTALK programs; self care; life skills.

Farm-Link *(*https://www1.health.gov.au/internet/publications/publishing.nsf/Content/suicide-prevention-activities-evaluation~Appendices~appendixa~project12)
Farm-Link is a program that has been delivered in NSW with the primary aim of improving community responsiveness and access to mental health services for those living and working on farms. The program involves providing Mental Health First Aid training to frontline agricultural workers in regular contact with a range of farmers, linking farmers with rural service networks, including health and welfare organisations, to address emerging mental health needs early in order to reduce suicide risk.

SCARF

The SCARF[52] (Suspect, Connect, Ask, Refer, Follow-up) Well-being and Suicide Prevention workshop is a brief educational approach aimed at improving suicide literacy, reducing stigma, enhancing wellbeing and increasing confidence to provide assistance to those at risk of suicide among the rural and farming communities in Australia. Developed and trialled in NSW, the four-hour workshop focuses on the detection of potential suicidality, connecting with and listening to the at-risk individual, role-playing of enquiry skills, and information regarding appropriate referral options.

Long Lives, Healthy Workplaces (https://everymind.org.au/toolkit-for-anaesthetic-departments)

Long Lives, Healthy Workplaces is a written 'toolkit' developed by the Australian Welfare of Anaesthetists Special Interest Group and Everymind. The document highlights primary, secondary and tertiary prevention approaches to improving mental health with a focus on five key strategies and recommended actions for anaesthetic departments:

1. Improve the training and work environment to reduce risk:
   - Ensure job design, rosters and workloads reviewed to reduce mental health risk
   - Design and manage work environment to minimise harm
   - Ensure adequate, structured access to professional development and training
2. Improve the culture of medicine to increase wellbeing and reduce stigma:
   - Implement strategies to improve health and wellbeing of staff
   - Increase peer support
   - Address mental illness and suicide stigma
   - Zero tolerance for bullying, harassment and discrimination in the workplace
3. Improve capacity to recognise and respond to those needing support:
   - Improve staff capacity to recognise and respond to mental illness and suicidality
   - Improve care pathways for at-risk staff
4. Better support for anaesthetists and trainees impacted by mental ill-health and suicide:
   - Ensure effective processes to support staff to remain at or return to work
   - Ensure policies and support service available for those impacted by suicide
5. Improve leadership, coordination, data and information:
   - Improve leadership capacity
   - Improve data collection

The toolkit also contains assessment tools, tips and resource links to assist in organisational change.

Rural Adversity Mental Health Program (https://www.ramhp.com.au/)

The Rural Adversity Mental Health Program (RAMHP) is a NSW statewide initiative and a major component of the University of Newcastle Centre for Rural and Remote Mental Health (CRRMH). The purpose of the RAMPH is to provide mental health information and connect individuals with appropriate support services. It is an initiative that links rural and remote individuals with a local RAMHP coordinator who provides advice and local referral points for at-risk individuals. The RAMPH involves:

- Workplace Support Skills training: three-hour training workshop for employees and managers to support clients and colleagues at risk of stress, mental illness and suicide

- You Got This Mate: website focused on rural male mental health and suicide prevention, providing mental health awareness-raising material, self-assessment tools and links to online and telephone support services
- Heavy Industry Support Skills (HISS) training: two-hour training program in mental health and suicide risk awareness and management for employers and employees in the heavy industries (e.g. mining, manufacturing)
- Getting Through the Dry: a brief (<1 hour) training package delivered by coordinators to drought-affected communities and organisations about stress management and support options
- Podcast: audio-based information and discussions about topics such as mentally healthy workplaces, rural suicide prevention, mental health peer workers and coping with drought.

Question 3: What suicide prevention programs or interventions for specific occupations have been effective in reducing suicide risk?

While several studies have examined the efficacy of suicide prevention programs or interventions targeting specific occupations, few have included outcome measures of suicidal ideation, behaviour or mortality rates. Several studies have focused instead on outcomes such as acceptability and feasibility, suicide awareness and literacy, and enhanced mental wellbeing. Such studies are included here to provide a comprehensive list of the types and level of evidence available for relevant programs. Evaluation studies from the peer-reviewed literature were subject to quality review (see Appendix 3).

This Evidence Check identified 11 studies in the peer-reviewed literature examining the efficacy of suicide prevention programs or interventions for specific occupations. Of these, six were Australian, one was from the US and one from Canada. Three studies were reviews of the international literature.

Farming

Two studies have examined the effectiveness of suicide prevention programs targeting farming communities in Australia. In 2011, Perceval et al.[51] conducted an evaluation of the *Farm-Link* project. However, while the overarching aim of that project was suicide prevention, its focus was on the development of rural networks that could respond to mental health needs and it constituted a primary prevention approach in that regard. As such, evaluation of the project's first phase focused on its success in developing such networks among rural communities, with no data regarding the mental wellbeing or potential effect on suicidality obtained.

In a subsequent study, Perceval et al.[52] evaluated the efficacy of the SCARF Well-being and Suicide Prevention program in improving mental wellbeing, suicide literacy and reducing stigma. A total 255 participants engaged in the workshop and initial follow-up assessment, with 127 also completing a follow-up assessment three months later. Suicide literacy increased significantly at initial and three-month follow-up, particularly among males. Confidence to assist peers also increased significantly, and stigma reduced. Mental wellbeing was significantly higher at three-month follow-up. While the findings suggest some benefits for participants in regards to both their personal mental health and the

enhancement of suicide awareness, it is not clear from this evaluation whether such benefits would translate to reductions in suicidal ideation or behaviour.

Construction

Within the construction industry, four Australian studies have evaluated the effectiveness of suicide prevention and wellbeing programs. According to Gullestrup et al.[53], *MATES in Construction* (MiC) was found to have good acceptability and was perceived as a valid and useful approach by employers and workers in the industry, with significant growth in industry participation between 2007 and 2010. The general awareness training (GAT) component increased suicide awareness and support for the industry's role in reducing suicide rates, with strong endorsement for the importance and perceived effectiveness of the program. However, the majority of case management referrals were for emotional or personal issues rather than suicidality, and there was no data obtained regarding the impact of the MiC program on suicidal ideation, behaviour or mortality rates. In another study, King et al.[54] similarly found engagement in the GAT component of MiC was associated with small but significant changes in suicide literacy.

In a five-year review of the MiC program, Martin et al.[55] accessed coronial data to compare suicide rates within the Queensland construction industry before the delivery of the program (2003–2007) and afterwards (2008–2012). The results showed suicide rates in Queensland among working-age males increased from 21.7 to 24.5 per 100,000 across the two study periods, as opposed to national rates, which remained stable at 21.1 and 20.9 per 100,000 across the two periods, respectively. However, suicide rates within the construction industry decreased from 28.9 per 100,000 in 2003–2007 to 26.7 per 100,000 between 2008 and 2012. Closer analysis showed this decrease occurred among machine operators and labourers, with a slight increase observed in suicides among skilled tradespeople. While the suicide rate within the Queensland construction industry remained higher than among those in other occupations, there was a significant decrease in mortality rates that could potentially be attributed to the impact of the MiC program.

Broadbent & Papadopoulos[56] examined whether engagement in the *Incolink Life Skills* program led to long-term increases in service knowledge and use. They employed a mixed-methods design, with 18 participants engaging in interviews and 119 completing surveys regarding resilience, self-help and referral, risk reduction and peer support. Seventy per cent of participants indicated the workshop raised their awareness of lifestyle risk, but as no empirical measure of behavioural change was used it remains unclear as to whether this led to an actual reduction in risk. The study did not assess wellbeing or suicidal ideation or behaviour.

Emergency and protective services

The Evidence Check retrieved two papers that examined suicide prevention programs for emergency and protective services. An evaluation of the impact of the *Together for Life* suicide prevention training program revealed suicide rates among police in Montreal, Canada, decreased by 79% over the 12-year period following the program's implementation.[57] And a systematic review and meta-analysis of suicide prevention programs for emergency and protective service workers[4] found most programs focused on secondary and tertiary approaches and were associated with significant suicide

risk reductions. While several studies assessed mortality rates, none included measures of suicidal ideation.

Doctors

A systematic review and meta-analysis of interventions to reduce mental illness and suicidal ideation in physicians identified only one study that included a focus on suicidality.[58] That study, by Guille et al.[23], was a randomised controlled trial of a web-based cognitive behavioural intervention for the prevention of suicidal ideation in medical interns in the US. Results showed that at follow-up, 12% of interns in the intervention group reported suicidal ideation in comparison with 21.2% of those in the control group, indicating the intervention was effective in reducing suicide risk.

Question 4: From the programs identified in Question 3, summarise the key enablers or contextual factors that contributed to their effectiveness

Few of the evaluations of the above-described programs included measures of suicidal ideation, planning, attempts or mortality. Of those that did, however, there were several characteristics and contextual factors identified that may have contributed to their effectiveness.

1. Delivery of individual psychological interventions to at-risk individuals[23,58]

   Targeting individuals at the primary level, using cognitive-behavioural interventions (including web-based cognitive behavioural therapy (CBT) modules such as MoodGym). Such approaches would require accurate screening and assessment processes to enable detection of individuals who may benefit from such interventions.

2. Training to identify and support at-risk peers[9,57]

   Comprehensive, multi-component training and awareness-raising activities across organisational levels, with identified leadership and supervision roles and opportunities. Increasing employee confidence to detect signs of mental distress or suicide risk, approach and support peers and access referral links appears to be a common component of successful workplace-based prevention programs.

3. High acceptability and support for the program among key stakeholders[9,57]

   Interventions that are perceived as useful and feasible by employers and employees have greater likelihood of effectiveness. Collaborative industry-specific approaches that seek and respond to participant feedback may increase cross-organisation ‘buy-in’, which may be a critical prerequisite for intervention effectiveness.

However, there does not appear to be adequate evidence to establish exactly which program components have been most successful at reducing suicidality. A systematic review by Witt et al.[4] found that as most programs were multi-component, it was difficult to establish which variables contributed to effectiveness. In a review of both published and unpublished evaluations of workplace suicide prevention programs, Milner et al.[9] observed that the majority of programs evaluated failed to

address modifiable risk factors in the workplace. This review stated that it was ‘impossible’ to draw any conclusions regarding the effectiveness of workplace suicide prevention programs given the lack of controlled trials assessing suicidality as an outcome.

Implications of the findings

The results of the observational studies of prevalence included in this Evidence Check indicate that there are several occupations at increased risk of suicide. In particular, there is clear evidence to show that in Australia, suicide risk is significantly elevated among farmers and farm workers, construction workers, veterinarians, ambulance personnel, firefighters, artists and entertainers, and the transport industry. The evidence is less clear among other occupations. While considerable attention has been focused on risk among health professionals, the evidence for increased risk among this cohort is scant, with some indication that rates among male medical doctors and female nurses may in fact be lower than those seen in the general population. Suicide rates among female doctors and male nurses in Australia do appear to be higher than those seen in the general population, however, and thus warrant further attention. Suicide risk among police officers and those in the mining industry does not appear to be higher than in other occupations or the general population. Rates among men, and among those in male-dominated industries, appear to be consistently higher. Access to lethal means emerges as a significant trend, potentially associated with increased mortality rates.

There is limited evidence as to the effectiveness of suicide prevention programs targeting specific occupations and it is not possible to draw firm conclusions regarding the efficacy of such approaches based on the current literature.

Gap analysis

Review of the available evidence regarding the effectiveness of workplace suicide prevention approaches is hindered by the use of proximal measures of suicidality (e.g. wellbeing, suicide literacy) rather than suicidal behaviour or deaths. Therefore, it is difficult to draw conclusions as to whether such programs, while potentially effective in enhancing wellbeing among some employees, would lead to actual reductions in suicide rates. Inclusion of direct measures of suicidal ideation, planning or attempts, and longitudinal analysis of mortality rates is necessary to establish the efficacy of such programs. The use of randomised controlled trial designs is necessary to obtain accurate data as to the effectiveness of specific program components; currently, it is unclear which, if any, of the multiple components included in many of the described approaches are in fact indicated for delivery.

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Appendix

Table A—Summary of observational studies used in this Evidence Check.

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
1	Andersen 2010[14]	Retrospective	Australia	3010	Deceased employees within 15–64 year age group identified in Queensland, Australia, 1990–2006	Completed suicide rates classified by occupational subtype, stratified by age and relationship status	Higher than average suicide risk among those employed in Queensland agricultural, artist, cleaner, construction and transport industries than in other industries Lower relative suicide rate among employees in education sector Suicide risk among employees lower than in unemployed population

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
2	Arnautovska 2014[5]	Retrospective	Australia	147	Deceased farmers in Queensland, Australia, 2000–2009	Completed suicides stratified by demographic variables	Suicide rate among farmers 28.9/100,000, approximately twice that of non-farmers Significant regional variation in rates not related to non-farmer suicide disparities indicate differential influences
3	Arnautovska 2014[15]	Retrospective	Australia	147	Deceased farmers in Queensland, Australia, 2000–2009	Completed suicides stratified by demographic/health variables and farming occupation subtype (farm managers vs farm labourers)	Suicide rates similar regardless of job type. Elevated risk potentially associated with younger age, alcohol use and precarious employment
4	Arnautovska 2016[16]	Retrospective	Australia	239	Deceased farmers in Queensland (n=147) and NSW (n=92) Australia, 2000–2009	Suicide deaths	Suicide rate of farmers in Qld 28.9 per 100,000, 2.1x higher than NSW rate of 13.5 per 100,000, with disparity most significant in those aged <34 years

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
5	Bailey 2018[6]	Narrative review	International	N/A	Suicidality among medical practitioners	Suicide risk	Evidence inconclusive as to whether suicide rate higher than among general population. Female risk higher than males. Medical specialty may be a risk factor; psychiatrists and anaesthetists have higher rates
6	Balch 2011[59]	Cross-sectional	US	123	Surgeons	Suicidal ideation	Suicidal ideation rates range from 3.8%–7.7% among surgical specialty subtypes. Highest rates of ideation among vascular (7.7%), cardiothoracic (7.3%) and trauma (7.0%) surgeons, and those in private practice vs academic settings (7.4% vs 4.7%)
7	Barron 2010[34]	Narrative view	Australia	N/A	Police	Suicide deaths	Greater attention to risk factors necessary

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
							to further development of interventions
8	Bartram 2010[7]	Review	International	N/A	Veterinarians	Suicide risk	Suicide rates of veterinarians 4x higher than general population and 2x higher than other healthcare professionals. Deliberate self-poisoning used in 76%–89% of cases
9	Beautrais 2018[13]	Retrospective	NZ	185	Farmers and agricultural workers	Completed suicides stratified by demographic variables	Two times higher suicide rate among farm labourers vs owners/managers. Major risk factors: existing mental illness (28.6%), relationship separation (20%), similar to non-farming population Hanging most common method (45.9%); firearm use five times higher than in normal population

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
							Prevention implications emphasise restriction of access to lethal means, primary health provider involvement and mental illness treatment
10	Boffa 2017[31]	Cross-sectional	US	893	Firefighters	Suicidal ideation and history of attempts	Ideation and attempts associated with post-traumatic stress, depression and Native American ethnicity
11	Kõlves 2013[20]	Retrospective	Australia	151	Medical doctors, nurses and education professionals	Completed studies	Suicide rates significantly higher among male nurses vs educational professionals and general population. Female doctors and nurses have higher rate than female education professionals but similar to general population. Depression and

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
							relationship problems significant risk factors
12	Koopmans 2017[60]	Review	International	40 studies	Law enforcement and emergency services	Suicidal ideation, attempts and deaths Demographic and psychosocial correlates	Inconsistent findings regarding suicide rates, particularly among police
13	Martin 2017[8]	Cross-sectional	US	3306	Firefighters	Suicidal ideation	Rates higher than general population
14	McDonnell 2013[61]	Cross-sectional	Australia/NZ	191	Anaesthesiology fellows and trainees	Suicidal ideation and attempts	16% reported suicidal ideation and <1% (n=1) attempt
15	MacFarlane 2011[62]	Retrospective (nested case-control)	Australia	90 cases vs 270 controls	Pesticide-exposed workers from various industries	Suicide deaths	No significant differences in suicide risk between those with or without self-reported pesticide exposure
16	McPhedran 2015[36]	Cross-sectional	Australia	42	Mining	Suicide deaths	Lower suicide rates among men employed in Queensland mining industry between

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
							1990-2008 compared to males employed in other occupations and overall male working-age population
17	Milner 2013[3]	Meta-analysis	International	34 studies	All occupations	Suicide deaths	Highest rates among 'elementary workers' (e.g. labourers, cleaners). Significantly elevated risk also among farming/agricultural workers, emergency services, and skilled trades. Lowest rates in managers and clerical workers
18	Milner 2014[35]	Retrospective	Australia	1947	Employees in construction industry	Suicide deaths in Australia, 2001–2010	Suicide rates for labourers/ machine operators greater than for those in skilled trades in construction industry. Skilled trades risk lower than general male population

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
19	Milner 2015a[41]	Retrospective	Australia	513	Road and rail drivers	Suicide deaths in Australia, 2001–2010	Overall suicide rate for road and rail drivers significantly higher at 22.6 per 100,000 vs 15.9 per 100,000 for all other occupations
20	Milner 2015b[17]	Retrospective	Australia	25 (72% veterinarian)	Veterinarian and veterinary nurses	Suicide deaths in Australia, 2001–2012	Suicide rate among veterinarians significantly higher than general population. No significant difference between suicide rate of veterinary nurses and general population. 80% of suicides used pentobarbitone as method
21	Milner 2015c[39]	Retrospective	Australia	–	All occupations	Suicide deaths in Australia between 2007 and 2009 (Global Financial Crisis period) vs 2001–2006	During the economic downturn, suicide rates among unskilled workers increased three to six-fold and in technical/trade work were four-fold greater

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
							than the highest occupation class
22	Milner 2016a[63]	Meta-analysis	International	8 studies	All occupations	Relationship between gender and occupational suicide risk	Largely similar risk between genders. Males in professional occupations have lower rates than females
23	Milner 2016b[21]	Retrospective	Australia	8865	Medical practitioners and nurses	Suicide deaths in Australia, 2001–2012	Suicide rates for female health professionals higher than for women in other occupations. Elevated risk for male nurses and midwives but not for male medical practitioners (doctors). Higher suicide rate among those with easier access to medication, with most frequent method self-poisoning
24	Milner et al. 2017a[27]	Retrospective	Australia	10,422	Emergency and protective service workers	Suicide deaths in Australia, 2001–2012	Most suicides among emergency and protective service

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
							workers among men <40 years. Overall age-adjusted suicide rate 22.4 per 100,000 in males and 7.8 per 100,000 in females (vs 15.5 per 100,000 for males and 3.4 per 100,000 for females among all other occupations). Firearms most common method among police; self-poisoning more often used by ambulance personnel than other occupations. Firefighters' rate of suicide not significantly higher than other occupations
25	Milner 2017b[64]	Retrospective	Australia	10,150	Employees in occupations with increased access to lethal means	Suicide deaths in Australia, 2001–2012	Occupational access to means increased risk, particularly among women

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
26	Milner 2017c[65]	Retrospective cohort (nested case-control)	Australia	9010 cases vs 14,007 matched controls	Employees in various occupations	Suicide deaths in Australia, 2001–2012	Suicide risk higher for men in jobs characterised by low control and high demands. Higher job demands did not increase risk for women
27	Milner 2018a[38]	Review	International	22 studies included	All occupations	Relationship between job stress and suicidal ideation, self-harm, attempts or deaths	Limited evidence that job stressors related to suicidal outcomes. Most studies cross-sectional and observational designs, limited robust / longitudinal research
28	Milner 2018b[66]	Retrospective cohort	Australia	8379	Male employees in various occupations	Suicidal ideation	Job insecurity, low job control, and casual / fixed-term employment associated with increased suicidal ideation
29	Milner 2019[67]	Retrospective cohort	Australia	12,053	Employed males and females 15–74 yrs	Suicide deaths in Australia, 2001–2015	Suicide rates for women highest in female-dominated

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
							occupations. Suicide rates for males highest in male-dominated occupations when SES and mental illness controlled for. Relative risk of suicide in heavily male-dominated occupations 3.83 times higher than in female-dominated occupations
30	Milner 2020[40]	Cross-sectional	Australia	16,021	Male employees in all occupations	Suicidal ideation	Ideation reported by 4.6% of men, with 0.62% reporting suicide attempt in past 12 months. Risk of ideation and attempts lower in employed groups vs non-employed
31	Mintz 2018[68]	Retrospective	US	8753	Healthcare practitioners and technicians in Colorado, US	Suicide deaths	Healthcare professionals showed higher rate of death by poisoning than other occupations

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
32	Pilgrim 2016[18]	Retrospective	Australia	404	Medical practitioners and healthcare professionals	Drug-caused deaths	Relative risk of suicide highest among veterinarians
33	Platt 2010[69]	Systematic review	International	19 studies	Veterinary surgeons	Suicide deaths	Higher quality studies suggest veterinarian suicide risk three times that of general population
34	Ringgenberg 2018[70]	Retrospective	US	230	Farmers and agriculture workers in US	Work-related suicide deaths	Suicide rates among farm operators / workers significantly higher (0.36–0.95 per 100,000) than in other occupations (0.13–0.19 per 100,000)
35	Roberts 2013[46]	Retrospective	UK	–	Male and female employees in various occupations	Suicide deaths	Suicide rates of health practitioners and farmers were highest in 1970s and early 1980s but declined in the 21st century, with a significant increase in rates within manual occupations. Risk factors included

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
							access to lethal means, social isolation at work, and 'natural selection of high-risk' individuals to particular work types (e.g. entertainers, merchant seafarers)
36	Rothenberger 2017[71]	Narrative review	International	–	Physicians and medical students	Burnout, wellbeing, suicidal ideation, attempts and deaths	Physician suicide mortality rates in the US higher than general population, particularly among females
37	Routley 2012[42]	Retrospective	Australia	642	Male and female employees in Victoria, Australia	Suicide deaths 2000–2007	17% of suicides in study period 'work-related': 55% related to work stressors, 32% commercial vehicle / driver work-related, 7% work location and 6% work access to lethal means
38	Sancho 2010[72]	Narrative review	International	N/A	Dentists	Suicide risk	Dentists at increased risk

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
39	Shanafelt 2012[73]	Narrative review	International	N/A	Oncologists	Burnout and suicidality	While physicians may be at higher risk of suicide, there is little evidence pertaining specifically to oncologists
40	Skegg 2010[12]	Retrospective	NZ		High-risk occupations (dentists, doctors, farmers, hunters, military, nurses, pharmacists, police, veterinarians)	Suicide deaths 1973–2004	Standardised mortality ratios higher for male and female nurses, male hunters and female pharmacists than other occupations. Risk was not elevated for doctors, farmers or veterinarians, and was significantly lower in police and military than in the standard population. Access to means (e.g. medication, firearms) relevant
41	Stallones 2013[11]	Retrospective	US	2352	Male and female employees in Colorado, US	Suicide deaths 2004–2006	Male rates significantly higher in majority of occupation categories. Suicide rates highest

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
							among men in farming, fishing and forestry, and women in construction and extraction. Access to lethal means relevant
42	Stanley 2015[29]	Cross-sectional	US	1027	Current and retired firefighters	Suicidal thoughts and behaviour	Career prevalence of ideation, plans and attempts 46.8%, 19.2% and 15.5% respectively, significantly higher than the general population. Increased suicidality associated with lower rank, early career, volunteer department, previous exposure and military background
43	Stanley 2016a[32]	Retrospective	US	11	Firefighters in Philadelphia, US	Suicide deaths 1993–2014	Suicide rates comparable and possibly lower than general population. All male cases

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
44	Stanley 2016b[28]	Systematic review	International	63 studies	Police, firefighters, paramedics and emergency medical technicians (EMTs)	Suicidal thoughts and behaviour	Emergency and protective services personnel may be at increased risk of suicidality
45	Stanley 2017[30]	Cross-sectional	US	313	Female firefighters	Suicidal ideation, plans and attempt	Pre-career suicidality predictive of career suicidality. Other job characteristics (e.g. career length, hours, department size) not associated with suicidal ideation plans or attempts
46	Tiesman 2015[74]	Retrospective	US	1719	Male and female employees	Suicide deaths in US workplaces	Farming, protective service occupations and minority ethnicity associated with increased workplace suicide risk. Access to lethal means relevant
47	Vigil 2018[26]	Retrospective	US	63	Emergency medical	Suicide deaths	Adjusted mortality odds ratio for EMT suicides significantly

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
					technicians (EMTs)		higher than in non-EMTs. No significant difference in methods
48	Violanti 2012[75]	Retrospective	US	189	Police officers	Suicide deaths	Annual suicide rate 15.3 per 100,000, above general population (11 per 100,000). Higher reported suicide rates in smaller police departments than larger departments
49	Violanti 2013[33]	Retrospective	US	264	Police officers	Suicide deaths: 1999, 2003–2004, 2007	Proportionate mortality higher among all law enforcement types than other occupations for males only. Higher suicide ratio for detectives / criminal investigators vs police / patrol officers
50	Windsor-Shellard 2019[24]	Retrospective	UK	13,232	Male and female employees	Suicide deaths in England 2011–2015	Suicide risk highest for males in construction and manual workers. Elevated risk for females associated

	First author and year	Study design	Country	*N*	Cohort	Measurement outcomes	Study findings
							with artist, hospitality, caregiving, education and nursing occupations. Elevated risk also noted in male call centre workers (novel finding)
51	Wu 2016[76]	Cross-sectional	US	1837	Airline pilots	Suicidal ideation	4.1% reported suicidal ideation in past two weeks

Table B—Intervention evaluation studies included in this Evidence Check.

First author and year	Country/topic	Study design and outcome variable/s	Description of intervention/program	Study findings	Implications drawn from results by author/s
Broadbent 2014[56]	Australia / mental health in building and construction industry	Design: Quasi-experimental Outcome: Impact of resources and support	Incolink Life Skills program 1 x 1.5 life skills workshop Delivered to first-year construction and metal trades apprentices	Successful in creating awareness of suicide and suicide prevention Promoted key messages regarding help-seeking behaviour	Reduces apprenticeship attrition Life Care Skills Program has been successful in raising awareness of suicide risk factors, getting help if needed and

First author and year	Country/topic	Study design and outcome variable/s	Description of intervention/program	Study findings	Implications drawn from results by author/s
			Also provides information, assessment and referral; face-to-face counselling; and outreach	Raised awareness of risk factors associated with suicide Education on how to seek help Increase in knowledge of how to seek help	supporting friends who may be facing problems
Guille 2015[23]	US / suicidal ideation in medical interns	Randomised controlled trial	Web-based cognitive behavioural program (4-week intervention). Control group received psychoeducation regarding depression and suicidal ideation via weekly emails	US / suicidal ideation in medical interns	Reduced suicidal ideation among interns randomised to web CBT intervention compared to those assigned to attention control
Gullestrup 2011[53]	Australia / Mates in Construction program efficacy	Design: Quasi-experimental Outcomes: Usefulness of connector training, suicide awareness/ knowledge, acceptability	General Awareness Training (45 minutes) Connector training Suicide First Aid training Field officers and case management involvement Suicide prevention hotline	Small effect sizes for improved knowledge after General Awareness Training Majority of referrals to MiC for issues other than suicidality Usefulness and acceptability of training	Evidence to support the social validity of the program, with positive responses from employers and staff. Increased suicide prevention awareness. Greatest benefit may be enhanced legitimisation of building industry attention to issue of suicide prevention

First author and year	Country/topic	Study design and outcome variable/s	Description of intervention/program	Study findings	Implications drawn from results by author/s
			Specialised intervention for at-risk workers Postvention	endorsed by majority of participants	
King 2018[54]	Australia / Mates in Construction program efficacy	Design: Quasi-experimental Outcomes: Suicide and prevention awareness and beliefs	General Awareness Training (one hour)	Small but significant positive shifts in three out of four beliefs about suicide immediately after training completion	General Awareness Training effective in challenging and shifting stigmatising beliefs and attitudes about suicide
Petrie 2019[58]	International / effectiveness of suicide interventions	Design: Review Outcomes: Differences in symptoms of common mental health disorders following intervention	Systematic review and meta-analysis of randomised controlled studies and controlled before–after studies of interventions for depression, anxiety and suicidality in physicians 8 articles: systematic review 7 articles :meta-analysis 1023 physicians	Physician-directed intervention reduced symptoms of common mental health disorders Physician-directed intervention reduced symptoms of depression, anxiety and suicidality	Physician-directed interventions are associated with small reductions in symptoms of common mental health disorders Urgent need for more comprehensive rigorous research regarding individual and organisational interventions aimed at improving the mental health of physicians

First author and year	Country/topic	Study design and outcome variable/s	Description of intervention/program	Study findings	Implications drawn from results by author/s
Martin 2016[55]	Australia / Mates in Construction	Design: Retrospective Outcomes: Suicide mortality rates	Retrospective analysis of suicide rates in Queensland construction industry pre- and post-implementation of MiC program	Age-adjusted male suicide rate in Queensland construction industry decreased 7.9% across two time periods. Reduction not statistically significant	Low rates contributed to low statistical power. Promising results suggesting MiC associated with reduction in suicide rates
Milner 2015[9]	International / workplace suicide prevention	Design: Review Outcome: Effectiveness of programs	Review of 13 interventions Several prevention strategies for at-risk occupations and several general awareness programs	Suicide prevention has the potential to be integrated into existing workplace mental health activities Prevention initiatives had beneficial effects	Due to a lack of available information, it is impossible to make any conclusions about the effectiveness of workplace suicide prevention
Mishara 2012[57]	Canada / police suicide prevention	Design: Quasi-experimental Outcome: Frequency of suicide rates	Together for Life Suicide training for all members Helpline available 12-year study	Reduction in suicide rates Increase in supervisors engaged in interventions	Programs that are tailored to the work environment are successful at reducing the rate of suicide

First author and year	Country/topic	Study design and outcome variable/s	Description of intervention/program	Study findings	Implications drawn from results by author/s
			Four components: Training for all units; police resources; training for supervisors and union representatives; and a publicity campaign		
Perceval 2011[51]	Australia / mental health of NSW farmers	Design: Observational, mixed-methods Outcome: Service network growth, staff perceptions	220 participants 2007–2009 133 participants 2009–2010 Farm-Link	Successfully identified and established mental health service development interventions in target communities	Ongoing continuity of services in rural communities has positive impact on mental health and knowledge
Perceval 2019[52]	Australia / suicide prevention in rural communities	Design: Quasi-experimental Outcome: Reduction of suicide rates	SCARF (Suspect, Connect, Ask, Refer, Follow-Up): Workshop and action plan 14 groups including frontline agricultural workers and farmers from NSW Literacy of Suicide Scale, Stigma of Suicide Scale and items assessing confidence to assist others were	Increase in suicide literacy and confidence to assist others immediately after the workshop Mental wellbeing improved significantly	Programs that assist rural people in better understanding how to respond to suicide risk may contribute to suicide prevention

First author and year	Country/topic	Study design and outcome variable/s	Description of intervention/program	Study findings	Implications drawn from results by author/s
			administered immediately before and after the workshop and at 3-month follow-up. Warwick Edinburgh Mental Wellbeing Scale was given immediately before and at 3-month follow-up		
Witt 2017[4]	International / effectiveness of suicide prevention for emergency and protective services	Design: Review Outcome: Effectiveness of programs Reduction of suicidal ideation	7 studies included Most aimed at military personnel, followed by police and firefighters Mainly focused on secondary level suicide prevention: awareness training and how to link people with mental health professionals Most programs also provided tertiary level prevention activities: 24-hr crisis hotlines	Programs halved suicide rate	Few programs are focused on primary intervention levels and so a greater focus is needed on workplace primary prevention

Table C—Assessment of overall quality (GRADE).

	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Large effect	Plausible confounding	Dose-response gradient	Overall quantity
Item description:	Evaluates the limitations in study design or execution that may affect evidence quality	Evaluates the consistency of results across included studies and whether inconsistency may have affected evidence quality	Evaluates the directness of the included evidence to directly answer healthcare question	Evaluates the precision of results of included studies and whether imprecision may have affected evidence quality	Evaluates the probability of publication and reporting bias affecting evidence quality	Evaluates whether any studies with large or very large effects should upgrade evidence quality	Evaluates, in studies with no 'downgrading' due to other factors, whether plausible confounders may have affected evidence quality	Evaluates, in studies with no 'downgrading' due to other factors, influence of dose-response gradient	High / moderate / low / very low
Judgment:	**Serious**	**Serious**	**Serious**	**Serious**	**Unable to be formally assessed**	**No**	**Yes**	**N/A**	**LOW**
Comments to substantiate judgments	Significant methodological weaknesses and risk of bias in the majority of	Lack of consistent outcome measures or results across studies	Little direct evidence to answer question of intervention efficacy	Results likely affected by study design, affecting	Methodological disparities preclude formal evaluation of	No large effects reported	Study designs may have led to results being influenced by multiple	Not applicable	

	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Large effect	Plausible confounding	Dose-response gradient	Overall quantity
	studies due to study designs			evidence quality	publication bias		confounding variables		

The Grades of Recommendation, Assessment, Development and Evaluation (GRADE) approach (The GRADE* working group. Grading quality of evidence and strength of recommendations. BMJ 2004; 328:1490-1494 printed, abridged version) involves rating the quality of evidence for included outcomes and determination of an overall quality of evidence across outcomes. The quality of evidence reflects the extent to which we are confident that an estimate of the effect is correct. Judgments regarding overall evidence quality are made relative to the specific context the evidence is to be used in. For transparency and simplicity, overall evidence quality is rated as one of four grades: High (further research is very unlikely to change our confidence in the estimate of effect); Moderate (further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate); Low (further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate); Very Low (any estimate of effect is very uncertain).