Foundation

Global Safety Evidence Centre

Occupational safety and health interventions: The state of the evidence

Safe Work

Evidence Review

Briefing

1. The quick read

A review of 53 reviews of Occupational Safety and Health interventions shows that the current evidence base:

- Covers a wide range of interventions, populations, settings and countries.
- Shows that many interventions are effective, but that studies are often limited by their methodology and reporting.
- Uses many different measures of safety, both direct and indirect, with few studies showing how and why interventions lead to safety outcomes.
- Lacks clarity and consensus on what is meant by 'safety' and related concepts.

In order to provide Occupational Safety and Health practitioners with the confidence to make decisions, future researchers should work closely with them to identify and fill gaps in the evidence.

> Occupational Safety and Health interventions can broadly be defined as "actions or activities performed with the stated aim of improving the safety or health of employees in the workplace"[1]

1. Adapted from Andersen JH, Malmros P, Ebbehoej NE, Flachs EM, Bengtsen E, Bonde JP. Systematic literature review on the effects of occupational safety and health (OSH) interventions at the workplace. Scand J Work Environ Health. 2019 Mar;45(2):103–13

2. Why this is important

According to the Lloyd's Register Foundation World Risk Poll '*Engineering Safer Workplaces: Global trends in occupational safety and health*' report[2], one in five workers globally has experienced harm at work in the last two years. The International Labour Organisation[3] estimates workplace accidents and diseases to be the cause of three million deaths and 395 million non-fatal work injuries every year.

Occupational safety and health interventions have the potential to reduce harms, accidents and injuries to workers around the world, but policymakers and practitioners can't be certain that they are safe and effective without good evidence.

We wanted to understand the state of the evidence on occupational safety and health interventions, and where the gaps were that still need to be filled.

2. Lloyd's Register Foundation, "World Risk Poll 2024 Report: Engineering Safer Workplaces Global Trends in Occupational Safety and Health," Lloyd's Register Foundation, 2024. doi: 10.60743/X8MD-V972.

3. International Labour Organization, "A call for safer and healthier working environments," Internaltional Labour Organization, 2023. https://www.ilo.org/publications/call-safer-and-healthier-working-environments

3. The research

We commissioned RAND Europe to conduct a review of reviews of occupational safety and interventions. This was a challenging task as studies of occupational safety are spread across disciplines and sectors, and because they use very different ways of analysing interventions.

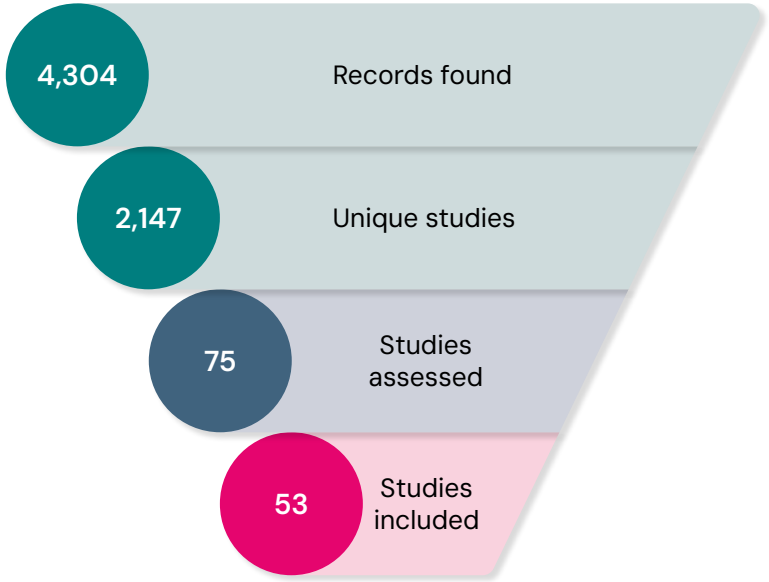
The researchers found over 4,000 records across five databases and identified 2,147 unique reviews of which 53 met the criteria for inclusion. The included studies were:

- Academic reviews which assessed the effectiveness of occupational safety and health interventions,
- Published since 2015, and
- Written in English.

The included reviews were mostly systematic reviews (28 reviews), but also included scoping reviews, general literature reviews and other types of reviews. There was substantial variation between the reviews on how many original studies they each included, with the smallest including two studies and the largest 139 studies. You can read the full technical report here: *doi.org/10.60743/5tyv-4m51*.

'Review of Reviews' Study inclusion funnel

53 studies met the predefined selection criteria



Occupational safety and health interventions: The state of the evidence. Lloyd's Register Foundation, 2025. doi.org/10.60743/sfj8-km98

What is a Review of Reviews?

An evidence review brings together research and knowledge from a range of sources and studies in order to draw conclusions across a body of evidence. Rather than rely on a single evaluation or study, reviews bring together the most relevant knowledge to answer a research question.

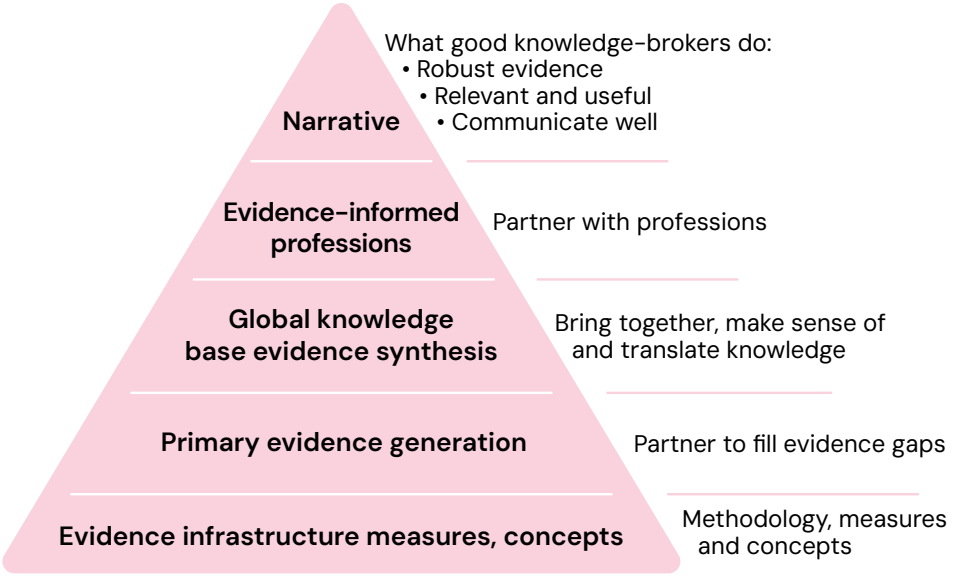
A review of reviews systematically searches and analyses existing evidence reviews of the evidence rather than primary studies or evaluations. A review of reviews brings together existing reviews on a subject.

This type of research can help assess the overall state of the evidence base, show trends, test the consistency of findings and identify gaps.

Occupational safety and health practitioners often need to make time-sensitive decisions under pressure. Evidence reviews can help ensure these decisions are based on the best available knowledge.

Evidence and innovation pathway

A 'Review of Reviews' supports the global knowledge base



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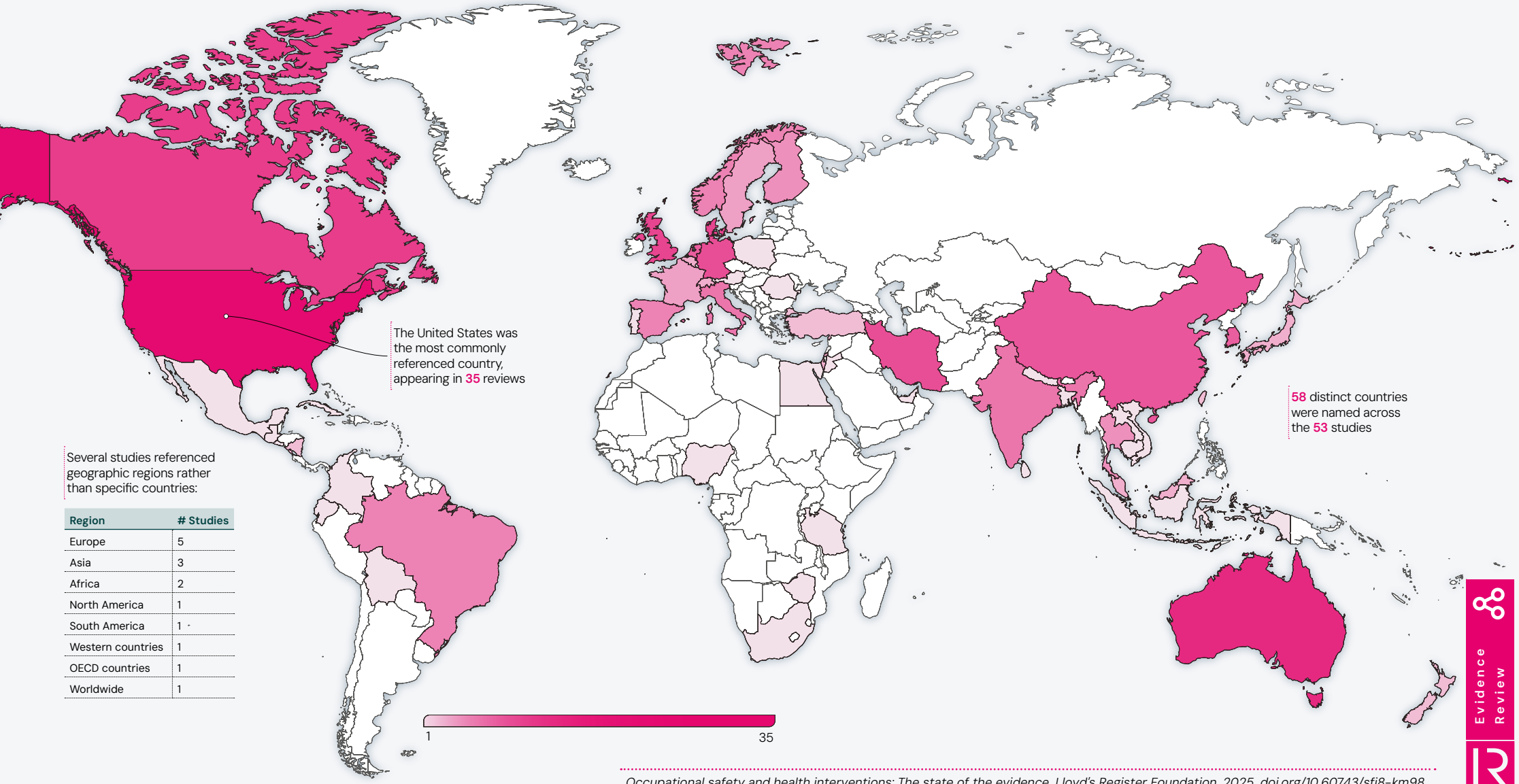
4. The findings

Occupational health and safety initiatives are being implemented around the world

The United States and other Western countries featured most prominently.

The evidence shows that occupational safety and health initiatives are being implemented around the world. The primary studies included across the reviews covered interventions in Asia, Africa, North America, South America, Europe, and Australia.



Several studies referenced geographic regions rather than specific countries:

Region	# Studies
Europe	5
Asia	3
Africa	2
North America	1
South America	1
Western countries	1
OECD countries	1
Worldwide	1

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4.1. The people and settings covered by the evidence

The studies covered interventions in a range of workplace **settings**, although they were not always clearly described. Almost half of the reviews looked at unspecified occupational settings (23 reviews) , and some reviews looked at a subgroup of settings (3 reviews), with other settings including:

- Agriculture (7 reviews)
- Construction (8 reviews)
- Workplaces with specific exposures or hazards (6 reviews)
- Dairy (1 review)
- Maritime (1 review)
- Offices (1 review)
- Mining and civil engineering (1 review)
- Electrical (1 review)
- Meat processing (1 review)

The **working populations** covered by the studies were varied and not always sufficiently well described. They included:

- Workers generally (11 reviews)
- Workers exposed to specific factors, such as hot environments or chemicals (11 reviews)
- Farmers and farmworkers (2 reviews), migrant farmworkers (1 review), and agricultural workers (3 reviews), or a combination (1 review)
- Construction workers (6 review)
- Workers and employers (2 review)
- Dairy workers (1 review)

Several studies focused on the interventions themselves and did not specify the population (12 reviews).

Recommendation

Future research should fully describe the populations and settings in which interventions are carried out to understand what works, for whom and in what contexts.

4.2. The interventions studied

The **interventions** covered by the reviews were also very varied, with a large number looking at mixed or multiple interventions. Other interventions included the following examples:

Number of reviews	Intervention type	Example interventions
12	Education and training	Safety training Education to improve awareness of hazards, risks, safety and health, safety literacy
12	Exposure reduction, prevention and protective equipment	Interventions to reduce exposure (e.g. to pesticides) Cooling interventions Noise management
4	Technology and engineering	Digitalisation Virtual reality technology Engineering controls and devices
3	Health and wellbeing	Programmes integrating worker health, safety and wellbeing Health promotion
3	Safety culture and attitudes	Interventions to improve safety culture Interventions to change attitudes, behaviours, norms, or structural conditions
2	Organisational and management interventions	Interventions for supervisors to improve leadership, supervisor/worker interactions, management of injury or disability
5	Communication, social and other interventions	Safety communication Scent interventions or exposures Social marketing
12	Mixed or multiple interventions	Multiple different or similar interventions, or broad categories, including Legislation, inspection activity, technical devices Combination of regulation, training and safety campaigns Combination of exposure reduction, training and testing Mindfulness and sustainability interventions and management control systems

4.3. The outcomes measured

The studies looked at a wide range of outcomes to understand the effectiveness of interventions. They didn't always measure improvements in safety and health directly, and often used indirect measures:

Direct outcome measures	Indirect outcome measures
Number and severity of industrial injuries or number of fatalities	Safety culture or safety climate, changes in organisational practice
Exposure to physical hazards (including noise and heat)	Safety knowledge and skills (in workers and supervisors)
Exposure to pesticides, hazardous chemicals or contaminants	Safety attitudes and beliefs (in workers and supervisors)
Concentrations of chemicals in workers' blood and urine	Safety practices or behaviours (such as use of PPE, seatbelts, or handwashing)
Levels of worker health (objective and subjective measures)	Healthy habits or behaviours (time spent sitting, daily step count)
Rates of sickness and injury leave, cases of worker disability	Safety compliance and participation, uptake of safety practices
Fatigue levels and perceived exertion rating	Safety motivation (undefined)
	Safety commitment (undefined)
	Prevalence of safety features (such as Rollover Protective Structures)
Other outcomes (not related to safety or health)	
Productivity gains	
Organisational costs and economic outcomes	
Emissions and fuel consumption	
Cost-effectiveness of interventions	

Relatively few studies measured objective changes in safety outcomes, such as accident, injury or fatality rates.

- The evidence shows **differences by occupational setting**: for example, none of the 16 examples of occupational safety and health interventions in dairy settings measured injuries or fatalities;
- As well as **differences by intervention**: only three of the 90 evaluations of occupational safety and health training interventions to improve safety performance measured accident or injury rates.

Mostly, the studies measured **process or intermediate outcomes**, such as changes in attitudes or safety culture, without putting those outcomes in the context of a theory of change to explain how they may lead to changes in safety or health. Without a theoretical underpinning, it's not possible to say whether these intermediate outcomes lead to improved safety or health.

Recommendation

Future research should develop and test theoretical models that clarify the causal relationships between attitudes, behaviours or organisational practices and improvements in safety and health outcomes.

Over half of the reviews included studies with **comparative designs**, meaning they looked at the effectiveness of the interventions against a control or comparison group. However, the studies varied in quality otherwise.

Some interventions which show positive effects (based on evidence which ranged from very low to moderate quality) include:

Intervention effect	Intervention details
↑	Safety culture, leadership and behavioural approaches may improve safety outcomes
↓	Educational programmes may be appropriate for reducing farmers' pesticide exposure risk
↑	Training methods may raise awareness and improve risk behaviours for farmers and agricultural workers
↑	Educational programmes may improve occupational safety and health knowledge in office workers
↓ ↑	Legislative policies may reduce injuries and fatalities and improve compliance in workers
↓	Integrating digital technologies may reduce accidents
↑	Scent intervention may improve alertness and reduce fatigue
↑	One review found greater effects with safety interventions aimed at group or organisational level, rather than the individual
↑ —	Multifaceted interventions have varying degrees of success

Although some reviews reported that these interventions were effective, the review of reviews doesn't allow us to say with certainty which interventions worked or didn't. This is because of the state of the evidence base – both the primary studies and the reviews included here.

Note that a lack of evidence that an intervention works is not the same as evidence that it doesn't work — it may simply mean that more or better-quality research is needed.

5. The state of the evidence

As the mapping of interventions, contexts and populations shows, the evidence base consists of large numbers of studies of different types, covering a wide range of interventions across different sectors and disciplines and looking at a range of outcomes.

This diversity reflects both the opportunities of evaluating occupational safety and health initiatives as well as the fragmented and siloed nature of the field.

The evidence base is patchy in other ways. Some reviewers found almost no published research on their topic (such as the effects of legislation or engineering interventions on farmers' pesticide exposure), or no studies with experimental designs (such as evaluations of technology to reduce noise levels).

Recommendation

Future research should identify evidence gaps and priorities and develop research questions with policymakers and practitioners.

Although not all the reviews assessed the risk of bias or quality of the included studies, those that did generally reported that the studies varied in quality from poor to moderate. Some common issues with the studies include:

- Studies with small sample sizes
- Evaluations which didn't account for participant drop off
- Evaluations which didn't use or properly design control groups
- Not enough detail or reporting of interventions or outcomes

This means that although some of the primary studies show the effectiveness of an intervention in specific contexts, it's not possible to look across the evidence to draw general conclusions about 'what works' across occupational safety.

Additionally, the studies included in the reviews were mostly short-term evaluations of interventions. Improvements to safety are not always immediately apparent, and long-term monitoring may be needed to fully understand the impact of legislation, culture and behaviour change.

Recommendation

Guidance on designing, conducting and reporting evaluations of occupational safety and health interventions is needed to ensure the quality of future research.

5.1. The quality of the reviews themselves

Bringing together primary research in reviews is an essential part of understanding whether interventions are effective and transferable. This review of reviews found that the existing evidence syntheses vary in quality.

There were many reviews which used strong methods, as well as a number which summarised and described interventions without assessing their effectiveness or the quality of their evaluations. This was the case mainly for narrative or scoping reviews but also for some of the included systematic reviews. About a third of the reviews were of a high quality.

High quality reviews featured the following characteristics:

- A pre-registered protocol with clear inclusion and exclusion criteria
- A systematic and transparent approach to searching and selecting studies
- A systematic and transparent approach to analysis and interpretation
- A robust and consistent way of appraising the quality of included studies
- A clear process for assessing the confidence level of the review findings

The researchers identified 16 critical appraisal tools used across the reviews, and seven of the reviews used GRADE to assess the overall quality of their findings.

How do reviews determine the confidence we can have in the evidence?

Reviews are one or sometimes two steps removed from the primary research, so they need systematic and robust ways of assessing confidence at different stages of their analysis.

1. The quality of individual studies by using criteria and checklists to assess and record the risk of bias and methodological robustness of each study. This gives them a score or assessment for each included study.

2. The confidence in findings drawn from multiple studies by applying a framework that looks across the quality of several studies to understand how consistent, precise, biased, and so on the findings are. Two robust methods to establish confidence in reviews are GRADE (used for quantitative studies) and CERQual (used for qualitative studies)[1]. This gives them a confidence rating for different interventions or outcomes.

Practitioners and decision-makers need reviews to be robust, relevant and communicated well.

Recommendation

Guidance on designing, conducting and reporting evidence reviews in occupational safety and health is needed to ensure the quality of future research.

5.2. How 'safety' is defined

One standout feature of the evidence base is the way safety is conceptualised and defined in occupational contexts. There was considerable variation in how the studies defined or reported safety and health. Only one review provided a concrete definition of safety and pointed out the uncertain distinction between health and safety. Some reviews used definitions which were adjacent to safety or provided circular definitions. There were no clear definitions or consensus for terms used widely in occupational safety and health literature, such as 'safety climate'.

This lack of conceptual clarity, and the wide variety of outcomes measures, makes it difficult to consider the occupational safety and health evidence base as a whole or draw out comparisons and summaries.

Recommendation

Future research should provide clarity and help form consensus around definitions and measures of safety and related concepts in occupational settings.

1 https://www.cerqual.org

6. Recommendations

Future research

1. Fully describe the populations and settings in which interventions are carried out to understand what works, for whom and in what contexts.
2. Develop and test theoretical models that clarify the causal relationships between attitudes, behaviours or organisational practices and improvements in safety and health outcomes.
3. Identify the evidence gaps and priorities in collaboration with policymakers and practitioners.
4. Develop guidance on designing, conducting and reporting evaluations of occupational safety and health interventions.
5. Develop guidance on designing, conducting and reporting evidence reviews in occupational safety and health.
6. Provide clarity and help form consensus around definitions and measures of safety and related concepts in occupational settings.
7. Use established and robust methods to conduct evidence reviews, and test adaptations or methodological developments where needed to provide confidence in the safety literature.

Practitioners and policymakers

1. When commissioning occupational safety and health interventions, build evaluations into those which have low levels of prior research on their effectiveness
2. Bring together their evidence priorities and Areas of Research Interest (ARIs) to guide future research.
3. Map the interventions used by practitioners that haven't yet been evaluated.

Funders of research and practice

1. Design calls for research that use robust methods.
2. Support projects which develop theories and models to understand how and why interventions work in different contexts for different people.

About Lloyd's Register Foundation Global Safety Evidence centre

The Lloyd's Register Foundation Global Safety Evidence Centre is a hub for anyone who needs to know 'what works' to make people safer. The Centre collates, creates and communicates the best available safety evidence from the Foundation, our partners and other sources on both the nature and scale of global safety challenges, and what works to address them. It works with partners to identify and fill gaps in the evidence, and to use the evidence for action.

To find out more about the Global Safety Evidence Centre, visit *gsec.lrfoundation.org.uk*

About Lloyd's Register Foundation

Lloyd's Register Foundation is an independent global safety charity that supports research, innovation, and education to make the world a safer place. Its mission is to use the best evidence and insight to help the global community focus on tackling the world's most pressing safety and risk challenges.

To find out more about Lloyd's Register Foundation, visit *lrfoundation.org.uk*

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