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Best Practices in Conveyor Safety Training: A Qualitative Study of Certified Safety Professionals in Industrial Settings

RESEARCH

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ABSTRACT

This qualitative study examined best practices for safety training and education in industrial environments, with a specific focus on conveyor systems. Five certified safety professionals (CSPs) who managed facilities with conveyors in Iowa were selected. Each CSP brought diverse educational and safety backgrounds, representing various industries and safety perspectives, with industry experience ranging from 13 to 32 years. Data were collected through semi-structured interviews with each of the five CSPs. Transcripts were thematically evaluated using NVivo (NVivo, 1994) and a Grounded Theory approach (Bernard, Wutich, & Ryan, 2016). The key themes in this study revealed the importance of integrating industry safety standards with classroom instruction, hands-on training, online learning modules, and learning management systems (LMS). Common education and training materials included PowerPoint slides, quizzes, and job safety analyses (JSAs), which covered the frequency of new hire and annual training. Validation methods for training ranged from quizzes to management observation and behavior-based safety programs. Despite structured training, several participants expressed concerns about its effectiveness and stressed the importance of instructor-led sessions and job-related site-specific materials. Recommendations to achieve best practices included developing expertise with conveyors within their organizations, conducting site-specific training to address hazards, and promoting active engagement from frontline workers through observations and employee feedback. This study found that all participants had established training practices and procedures; however, there were still opportunities to increase training customization and incorporate technology. Additionally, participants highlighted the significance of behavior-based approaches and continuous feedback in supporting effective training.

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Conveyor Safeguarding; Safety Training; Machine Guarding; Learning Management System (LMS); Job Safety Analysis (JSA); Training Effectiveness

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INTRODUCTION

Conveyors are widely used in various industries to support continuous material handling, reducing labor costs and increasing operational efficiency. Types of conveyors include belt, roller, chain, screw, pneumatic, and overhead. Despite their numerous benefits, conveyors can pose mechanical and operational hazards that should be properly safeguarded to provide a reasonably safe work environment and mitigate worker injuries, equipment damage, and costly downtime.

Hazards related to conveyors include nip points, shear points, and entanglement. These hazards are present at moving parts, such as those between belts and pulleys, rollers and frames, or chain drives and sprockets. In-running nip points are often found where a belt enters a pulley, or near rotating shafts next to a fixed surface, and create unreasonable hazards if proper safeguards, training, and education for workers are not provided. Safeguarding methods may include design features, physical guards, control devices, or methods that include being guarded by location, safe holding, and safe opening. While safeguarding methods are effective in preventing injuries, they must be supported by policies, procedures, and well-designed safety training to ensure that workers can recognize and mitigate conveyor hazards.

The Occupational Safety and Health Act was signed by President Nixon on December 29, 1970, and took effect on April 28, 1971. The Occupational Safety and Health Administration's (OSHA) mission is to ensure that American workers have safe and healthy working conditions by establishing and enforcing standards (OSHA, n.d.a).

OSHA's requirements under the General Duty Clause state that 'each employer shall furnish to each of its employees employment free from recognized hazards that are causing or are likely to cause death or serious physical harm' (OSHA, 1970). The employer is responsible for understanding hazards with machinery and for providing a reasonably safe work environment for their employees. The recognition of a hazard is discussed in chapter four of OSHA's Field Operations Manual. It states that the recognition of a hazard can be determined through employer recognition, industry recognition, or 'common sense' recognition (OSHA, n.d.b).

To assist employers in achieving a reasonably safe workplace, there are consensus standards created by the American National Standards Institute (ANSI) and the American Society of Safety Engineers (ASSE), now known as the American Society of Safety Professionals (ASSP). The *ANSI/ASSE Z490.1–2016 Criteria for Accepted Practices in Safety, Health, and Environmental Training* (ASSP, 2016) and the *ANSI/ASSP Z10.0 2019 Occupational Health & Safety Management Systems* (ASSP, 2019) detail how to structure and manage a safety program. Consensus standards are best practices developed and agreed upon by experts with diverse backgrounds, education, and experience to establish safety practices.

In addition to industry safety standards, safety programs can also help protect employees by providing a structured process to identify, assess, and mitigate hazards while ensuring compliance with industry safety standards. A well-designed safety program not only promotes the safety of workers but also provides a process that enhances productivity, reduces downtime, and minimizes financial and legal risk associated with workplace safety.

OSHA also provides recommendations on the seven core elements for safety programs (OSHA, n.d.c). These seven core elements for a safety and health program include management leadership, worker participation, hazard identification and assessment, hazard prevention and control, education and training, program evaluation and improvement, and communication and coordination among employers, contractors, and staffing agencies.

Given the guidance of industry safety standards and best practices, there remains a limited amount of firsthand research on how safety training for conveyors is implemented and evaluated for effectiveness. Additionally, there is limited information regarding the best practices that safety professionals use to train, educate, and validate worker training for conveyors.

Given the context of this information, it is vital to evaluate the hazards associated with conveyors and to train and educate employees on how to mitigate those hazards to a reasonable level of safety. This qualitative study focused on best practices for structuring, delivering, and evaluating conveyor safety training within industrial facilities in Iowa.

METHODOLOGY

RESEARCH DESIGN

The purpose of this qualitative research was to identify best practices for safety training related to conveyors across five industrial facilities in Iowa. Data was collected through semi-structured interviews, guided by both open-ended and targeted questions based on the researcher's safety experience, having personally assessed thousands of conveyors for hazards. An interview guide was then created to ensure consistency during all interviews. To ensure the accuracy of the data, interviews continued until data saturation was reached. The interviews were transcribed using Otter.ai software (Otter Voice Meeting Notes, n.d.), with each interview averaging 60 to 75 minutes. A Grounded Theory approach (Bernard, Wutich, & Ryan, 2016) was used to analyze the data, allowing themes to emerge inductively from participant responses.

SUBJECTS

The target population for this study consisted of facilities in Iowa that utilized conveyor systems with a focus on those involved in manufacturing and/or distributing various products. The subjects included five certified safety professionals (CSPs) (BCSP, 2025). The participants in this study represent a diverse range of industries (i.e., seed distribution, chemical manufacturing, egg distribution, and agricultural equipment manufacturing), with safety perspectives and industry safety experience spanning 13 to 32 years. The purpose of this selection was to ensure that all participants had a standardized understanding of safety principles and expertise in managing occupational safety with a strong technical knowledge. Interviews were conducted via Zoom (One Platform to Connect, n.d.) in the spring of 2025. At the start of each interview, verbal consent was obtained from participants, and each participant was informed that all data would be kept confidential and that their identifying information and the company's identity would not be included in this research. At the beginning of each interview, the participants were informed of the study's purpose, the use of the recordings, and their right to withdraw at any time. Once the interviews were completed, all original recordings and transcripts were securely stored on a cloud-based, password-protected system. In addition, this study was reviewed by the Iowa State University Institutional Review Board (IRB) and was deemed exempt from full IRB review.

INSTRUMENTATION

Each participant chose a date and time for their one-on-one Zoom interview. These interviews focused on best practices to address hazards at their facilities and were recorded and transcribed in real-time using Otter.ai (Otter Voice Meeting Notes, n.d.). The interviews included initial, safety-focused, and ending questions, with probing questions incorporated to further explain the participants' answers. Examples of the structure of these questions include the following:

Initial Question:

- Can you describe your job title, how long you've been with the company, and your responsibilities?

Safety Focused Question:

- Does your program address training and education, and can you explain how that training applies to the employee's job?

Ending Question:

- What advice would you give to safety professionals who are new to managing safeguarding for conveyor safety systems?

DATA COLLECTION

The recordings were then transcribed for analysis. The interview questions were designed to identify hazards and the most effective conveyor safeguarding practices implemented to mitigate workplace injuries. These questions were based on the researcher's literature review, 12 years of experience, training, and education in assessing thousands of conveyors for hazards and appropriate safeguarding.

After each interview, transcripts were reviewed and organized to identify emerging themes based on their frequency, which led to key findings. All participant information remained strictly confidential. Identifiable details, such as names and company identifiers, were removed from the original transcripts.

DATA ANALYSIS

Once the interview was complete, the transcription was reviewed for accuracy. Any unclear sections or technical jargon were clarified by revisiting the original audio recordings and comparing the recordings to the transcripts. To increase data validity, the researcher conducted cross-verification by comparing the participants' responses against industry and federal safety standards and by triangulating similar themes across the interviews of other participants. The analysis followed Grounded Theory methodology (Bernard, Wutich, & Ryan, 2016), using inductive techniques to identify conveyor hazards and best practices to safeguard conveyors. A thematic analysis was conducted to identify codes and themes. A summary of the findings was prepared, excluding all identifiers of participants and facilities to protect confidentiality. Memoing and theorizing were used throughout to connect, interpret, and evaluate emerging themes, utilizing NVivo qualitative analysis software (NVivo, 1994).

RESULTS

Before conducting interviews, participants were selected based on three criteria: having a facility in Iowa, currently managing occupational safety, and being an active CSP. The participants' education level, years of experience, and job title are summarized in Table 1. This sample of participants consisted of five CSPs, all of whom had diverse educational backgrounds, job roles, and years of experience in occupational safety. Participants P1 and P3 both held Bachelor's and Master's of Science degrees in occupational safety. Participants P2 and P5 had completed bachelor's degrees. One participant (P4) held a Ph.D., which was the highest level of academic achievement among the participants. All degrees from all five participants had a focus on occupational safety and health.

PARTICIPANT	EDUCATION	EXPERIENCE (YEARS)	JOB TITLE
P1	Master	19	Occupational Health Manager
P2	Bachelor	14	Industrial Hygienist
P3	Master	29	Occupational Safety Engineer
P4	PhD	32	Director of Health and Safety
P5	Bachelor	13	Environmental Health and Safety Specialist

Table 1 Characteristics of participants based on education, years of experience, and occupation.

THEME	SUBTHEMES
Safety Training	Machine Safeguarding Program
	Training Setting
	Training Effectiveness
	Training Materials
	Content of Materials
	Frequency of Training
	Training Validation
	Complacency
	Training Technology
	Recommendations to CSPs

Table 2 Theme with subthemes regarding hazard assessments.

The participants' professional experience ranged from 13 to 32 years, with an average of approximately 21 years in the field of safety. The most experienced participant, P4, reported 32 years of experience, while P5, the least experienced, had 13 years. This range indicated that the participants in this study comprised a mix of mid-career to senior-level professionals. Their job titles, listed in Table 1, also reflect different roles and responsibilities; This diverse mix of backgrounds across various industries provided a solid foundation for evaluating best practices in training with conveyors.

Based on the data collected, the central theme was safety training, which encompassed ten sub-themes, as depicted in Table 2.

MACHINE SAFEGUARDING PROGRAM

All participants reported having a documented machine safeguarding program to help guide in mitigating risks associated with conveyor systems. P1 stated, 'We have a program specifically for machine guarding and meeting the aspects of 1910,' reflecting the participants' overarching focus on general industry standards. P2 addressed that their facility had a more general, yet structured program, stating, 'Yeah, it's pretty general, but we do have a machine guarding program,' which was similar to P3's statement, 'Yeah, we have a machine safeguarding program.' P4, on the other hand, addressed a broader organizational approach: 'We have a corporate safety program.' All participants acknowledged that, in some form, they had policies and procedures in place that reflected a structured process with oversight concerning machine safeguarding, particularly with regard to conveyors.

TRAINING SETTING

Participants used a variety of settings when conducting their training. P1 described their setting as 'classroom and on the job,' while P2 offered a more hybrid training method, combining 'online and live training.' P3 utilized a setting of 'classroom, computer-based, and hands-on training,' which reflected a comprehensive approach to their training and education for employees related to conveyors. Similarly, P4 stated, 'We have computer-based, mentoring, and showing-type processes,' whereas P5 was more focused on integrating the job and having employees learn through 'job shadowing and mentored to specific SOPs' (standard operating procedure). All participants provided diverse training tailored to their organizational needs, but the primary focus was on-the-job training. This type of training involved a hands-on approach with the conveyors.

TRAINING MATERIALS

The training materials used by the participants varied, but primarily included presentations, quizzes, facility-specific content, and on-the-job training. P1 stated, 'We use PowerPoint, quizzes, and Job Safety Analysis reviews,' while P2 stated, 'Our training consists of a site-specific video, a PowerPoint, followed by a quiz.' P3 went into further detail by not only incorporating PowerPoint and quizzes, but also the manufacturers' conveyor manuals. P3 states, 'We use PowerPoint, quizzes, a handout, and conveyor manuals incorporated into our training.' P4 stated, 'We use our learning management system for training, and we also do observations of employees for guarding.' The specifics of each participant's training materials varied, but all consisted of multiple approaches.

CONTENT OF MATERIALS

The primary focus of the training material was on addressing hazard awareness, with a particular emphasis on industry safety standards relevant to the organization and the company's conveyor systems. P1 stated, 'Training content will cover an overview of learning conveyor safety and safeguards.' Similarly, P2 stated, 'We talk about power transmissions and conveyors.' P3's training material went even further in depth: 'We go over machine guarding and consensus standards,' to reflect industry best practices. Lastly, P4 stated that training focused on 'principles of guarding, and they learn those specifics throughout the job training.' Further discussion with each of these participants reflected that these materials were tailored to cover both best practices and site-specific factors within their training. Additionally, on-the-job training was essential when it came to educating employees about the hazards associated with conveyors and ways to mitigate them.

TRAINING EFFECTIVENESS

Each participant had different views on what made training effective, but all agreed that engaging employees was crucial. Commenting on providing the fundamentals and making training specific to the individual, P1 stated that 'You got a balance between required training, making it engaging, and not seem[ing] like you're talking down to somebody that's used this piece of equipment, that probably knows how to take it apart, put it back together, use it better than even the manufacturer.' P4 discussed the importance of 'having more of our training be instructor-led and conversational and involving…it has to be regular training done on a regular basis.' P5 focused on site-specific training and 'on-the-job training, in conjunction with a solid EHS (Environment, Health, and Safety) onboarding.' As a consensus, the participants focused on understanding your audience, ensuring the training is instructor-led, and knowing when to train employees.

FREQUENCY OF TRAINING

The frequency of training among participants was very similar, focusing on both initial and recurring sessions within each of their organizations. P1 stated that their training occurs at 'new hire orientation, on-the-job training, and on an annual basis,' while P2 listed 'new hire orientation, monthly, and annually.' P3 mentioned that training occurs during triggered events, for instance, 'near miss, or when we get a new piece of equipment, there would be operator training,' whereas P4 simply stated, 'This occurs twice a year.' Lastly, P5 said, 'Training occurs with new hires, and when they get on the floor, they would be job-shadowed and mentored to specific SOPs.' For all participants, it was important that training was scheduled regularly and frequently, with an emphasis on knowing when to train employees.

TRAINING VALIDATION

The one consistent training validation method that each participant had was verifying that the training on the conveyors was retained through observations and management oversight. P1 described a formal process which included 'an observation and a sign off from the supervisor,' whereas P2 stated, 'It is more about observations,' and P4 cited, 'The observation process for learning.' These approaches, through observations by these participants, were viewed as an effective way to confirm employees' understanding and reinforce the training they received.

COMPLACENCY

Complacency was identified as a barrier among participants, and various mitigation strategies were described. P1 stated, 'Annual refresher training…is the goal of our surveillance process,' stating that to mitigate complacency, their facility would observe employees to ensure that they were following their training. P2 mentioned 'departmental inspections' as another means of observing to mitigate complacency. P4 focused on engaging employees by 'making it personal in any aspect of EHS, trying to increase safety awareness,' and P5 focused on management. P5 stated, 'Management, leadership, and providing, you know, closing out the loop when they suggest something, and having a strong safety suggestion process, and…having those interactions.'

TRAINING TECHNOLOGY

Technology, as it relates to safety training, was a key aspect in delivering flexible and effective training amongst the participants. P4 stated, 'I have to say the single biggest technology that has impacted—and I'm going to expand this beyond just conveyor safety, but safety in general—is the ability for us to use our learning management system in a variety of different settings.' This suggested that being able to use technology in the field, in addition to hands-on training, helped increase the quality of training for employees.

RECOMMENDATIONS FOR CSPS

Lastly, participants shared guidance for future CSPs on managing training related to conveyors. P2 advised CSPs new to managing conveyors by saying, 'Put yourself in their shoes,' emphasizing the need to tailor training to the training site and make content that is useful and applicable to employees' everyday tasks within the organization. P3 noted the need to thoroughly understand your equipment by saying, 'Diving in and making yourself an expert on your particular conveyor is probably the best recommendation I would have for a new safety person when it comes to training.' Similarly, P5 stated the importance of 'understanding the risk of the operation in conjunction with what you do and how you do it.' Collectively, these participants wanted to emphasize to safety professionals and those new to managing conveyors that they should understand their operation, know how their equipment is used, and learn how employees interact with conveyors to adequately train workers on the hazards and how to mitigate them.

DISCUSSION

This study examined the best practices and perspectives of CSPs managing conveyors in Iowa, focusing on how they train and educate employees regarding conveyor hazards and how to create a reasonably safe work environment within a safety management system. A safety management system typically consists of programs, processes, policies, and procedures where supervisors and management oversee their development, implementation, and ongoing administration (Wachter & Yorio, 2014). The purpose of incorporating CSPs was to provide strong technical competence and managerial skills in occupational safety (Van Wassenhove et al., 2022). The findings in this study highlight the importance of safety training and education related to conveyors, emphasizing the need to evaluate the effectiveness of companies' training and to refine training and educational efforts.

Participants in this study described and discussed various training styles, including classroom, on-the-job, computer-based, and mentoring. Using a diversity of training methods helped enforce safety training and education with conveyors. Hands-on and site-specific training and observations with feedback were used to train employees, strengthen hazard awareness, and increase employee engagement.

To provide guidance and structure for safety training on conveyors, all participants in this study reported having a documented safety program that reflected an organizational commitment to reducing risks associated with conveyors. Although the structure of the machine safeguarding programs varied among participants, they each offered a framework for assessing risks and addressing hazards related to conveyors. Overall, the responses from all participants acknowledged the importance of having policies and procedures in place. This demonstrated a shared understanding that safeguarding efforts can be documented to manage hazards and deliver specific training and education to employees.

The training content for participants was based on established organization safety programs that align with industry safety standards and best practices. Materials used to support the training included PowerPoint presentations, quizzes, job safety analyses (JSAs), and, in some cases, the manufacturer's operator manuals and facility-specific videos, with a particular focus on hazard recognition and machine guarding principles among participants. An interesting aspect of this study was that only one participant used operational manuals, which typically include manufacturer requirements for safe operation, service, and maintenance. This information could improve training for those involved in operation, maintenance, and service activities.

Even with formal training in place, the participants expressed some concerns about its effectiveness. To keep employees engaged, they emphasized the importance of instructor-led sessions and hands-on, in-the-field training, as they believed these methods were more effective than traditional classroom settings or PowerPoint presentations. This key finding aligns with Burke et al. (2006), who conducted a meta-analysis showing that hands-on training results in greater knowledge retention and skill development compared to lecture-based or computer-based methods. The CSPs in this study observed that training was most impactful when the content was specific to the site and applicable to employees' daily work. Therefore, instructor-led and site-specific training were seen as key for increasing worker engagement during the training process.

These findings align with the behavior-based safety (BBS) framework, as outlined in *Behavior-based safety in industry: Realizing the large-scale potential of psychology to promote human welfare* (Geller, 2001). This article emphasized the importance of intervention through observable behaviors and positive reinforcement. Similarly, participants in this study relied on supervisor observations, job shadowing, and feedback to employees, which align with Geller's 'DO IT' process of observing, intervening, and testing (Geller, 2001), and support this approach to improve safety training. For example, several participants highlighted the value of observing employees after to ensure that they were adhering to the training and provided an opportunity for feedback. This is supported by Geller (2001), who states that 'The observation stage is not a fault-finding procedure, but is a fact-finding learning process.' Additionally, the focus on engaging employees during these feedback loops aligned with Geller's (2001) argument that these supportive interactions, such as verbal recognition or team feedback as part of training, help educate workers and contribute to creating a safer work environment.

Participants also reported that observing their employees performing tasks in a real work setting was crucial for validating comprehension and adherence to safety policies and procedures they had been trained on. These findings align with those of Wachter and Yorio (2014), who demonstrated that workers' lack of engagement can significantly reduce the impact and success of a safety management system, and emphasized that even the most well-designed safety management practices, such as training programs, require active worker involvement to be effective. This perspective supports the views shared by participants in this study, who noted that training efforts are most effective when they are hands-on, led by an instructor, and when employees are observed for validation after training and given feedback. Wachter and Yorio (2014) emphasize worker engagement, further validating the participants' focus on observational validation, discussions, and feedback with employees. This suggests that increasing employee engagement is not just a component but a vital part of a safety system that helps evolve safety training into safe behaviors. In return, this leads to additional strategies for designing training, improving results, and ultimately boosting safety performance within a safety management system.

The frequency of training in this study was consistent, with a focus on both initial and ongoing sessions with employees. Most participants discussed training during new hire orientation, followed by routine and scheduled refresher sessions or training for specific events (i.e., receiving a new conveyor). Overall, these approaches reflected a shared understanding that, to be effective, practical training must be both timely and continuous, with schedules responding to employees' roles, their exposure, and organizational needs.

In this rapidly evolving technological world, using technology among participants was proven to be an effective training strategy in terms of delivery methods. Participants discussed learning management systems and third-party platforms as tools to enhance the flexibility of training in the field, which further improved retention through hybrid training that combined these technological tools with hands-on training. Having a diverse approach to training employees on hazards and methods to mitigate hazards associated with conveyors through technology and hands-on field training was found to be a strong foundational technique.

Finally, CSPs were asked to offer recommendations for current or future CSPs and CSPs responsible for managing conveyors. Their suggestions emphasized the importance of site-specific training programs that actively involve employees throughout the training process. One major recommendation from this study was to develop organizational expertise related to the types of conveyors at specific facilities and to understand the hazards they pose. The goal of building this expertise was to ensure that safety professionals understand the mechanical and operational features unique to their conveyors and to establish processes and procedures that employees can be trained in. This knowledge helped create training content that includes technical details and directly relates to employees' daily tasks for managing hazards with conveyors. Additionally, participants consistently recommended involving frontline workers in training through safety observations, hands-on demonstrations, and feedback loops. Overall, these practices reflect a proactive approach to conveyor safety training that combines technical knowledge with ongoing worker engagement.

This study had several limitations. The data were self-reported during semi-structured interviews conducted virtually via Zoom, which may have limited the depth of discussions compared to in-person, one-on-one interviews. Despite these potential limitations, this study offers valuable insights into best practices for training and educating employees about conveyors. Future research could broaden the scope and methods to include assessing the effectiveness of alternative measures and exploring how training and supervision vary between organizations that may rely more heavily on different training methods.

CONCLUSION

This qualitative study assessed best practices in conveyor safety training from the perspectives of five CSPs managing facilities in Iowa, drawing on their technical expertise and industry safety experience. Using a qualitative approach based on thematic analysis, the findings show how practical training can differ by incorporating hands-on instructions and technological tools like learning management systems (LMS). While all participants had structured safety programs, this study highlighted several key areas to improve training: site-specific content, greater worker engagement, and ongoing validation of knowledge through observation and feedback.

A key takeaway from this study was the importance of instructor-led, site-specific, and hands-on training that employees can use for their daily tasks. This type of training was seen as more effective than just providing generic machine safety training, especially in reducing complacency and building a proactive safety management system. The use of behavior-based strategies aligning with Geller's (2001) safety framework, along with supervisory oversight, also helped employees focus on and apply safety principles in their daily work.

Additionally, this study highlighted the importance of ongoing improvement through feedback and adopting training for emerging technologies in the work environment. By applying technical knowledge, engaging in training practices, and maintaining consistent follow-up with employees, safety professionals can create a safety management system that establishes ownership and not only meets industry safety standards but also helps ensure a reasonably safe workplace for employees.

Although this study had some limitations, it offered practical insights for CSPs and industrial companies seeking to enhance their conveyor safety training. Future research should involve a larger and more diverse sample of industries, regions, and organizations of various sizes. These comparative studies could assess how training effectiveness varies across sectors with different types of technologies and operational hazards related to conveyors. Additionally, longitudinal research could help determine the long-term effects of these instructor-led, site-specific, and hands-on training methods on reducing conveyor incidents, thereby revealing innovative approaches to increase engagement, retention, and hazard awareness in conveyor operations.

COMPETING INTERESTS

The authors have no competing interests to declare.

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