

The Heinrich safety triangle

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The Health and Safety Division provides SME members access to evidence-based research to guide decision making and investments. In May, the division broadcast a webinar that tackled a provocative, global debate among occupational health and safety professionals — Is Heinrich's safety triangle theory a valid way to guide investment planning for accident prevention?

Established in the 1930s, Heinrich's theory has two tenets: 1) the ratio of lower to higher severity incidents forms a triangle (300 near misses, 29 minor injuries, 1 major injury) and 2) high and low severity events have similar root causes. Unfortunately, lack of methodological specificity and inaccessibility of the database he used has made validation difficult, and many researchers have recommended abandoning the use of the safety triangle altogether.

Mining practitioners need to know if they can continue to apply the safety triangle to data from a single mine to prioritize areas for intervention. And, they need to know if they should look at the root cause of near miss or low severity events to inform intervention development.

During the webinar, researchers from the National Institute for Occupational Safety and Health (NIOSH) described a study they conducted that specifically explored the value and validity of applying the safety triangle at the mine level. They used 13 years of U.S. Mine Safety and Health Administration (MSHA) data from 27,466 mines (46.3 percent sand and gravel, 26.6 percent stone, 20.4 percent coal, 4.2 percent nonmetal and 2.4 percent metal). The researchers used longitudinal regression models that were unadjusted and adjusted for mine size (hours worked) in order to examine the range of possible effects that may be expected. The researchers also explored three different approaches for defining injury severity levels:

- Degree of injury per incident.
- Total lost and restricted days a mine experienced throughout an entire year.
- Average lost and restricted days per incident.

In the end, they were able to answer two fundamental questions with confidence. First — Is it appropriate to use near miss and lower severity events within a mine to predict future higher severity events within that same mine?

Yes, with caveats. Lower-severity events within a mine may be used to predict a future fatal event within the same mine. However, in the adjusted degree of injury model, two of the four injury variables (MSHA's Days Lost and Reportable Injuries categories) dropped from significance. Possible explanations include suppression of the statistical effects for these injuries and the causes of disabling injuries and near misses may have more in common with the causes of fatal events. From the study results, it appears that the lower-bound predictive effect for injuries categorized as Days Lost and Reportable may be zero and the upper-bound may 10-19 percent. The other delineations of severity also significantly predicted future fatalities.

Second — If it is appropriate to predict future higher severity events from near miss and lower severity events, does a systematic decline in effect occur as severity decreases (i.e., forming a triangle), and how is this impacted by the approach used to define severity levels?

Yes, the safety triangle exists, but not for all approaches used to define severity levels. The total and average lost and restricted days per incident approaches both produced a systematic decline in the effect as severity decreased. But, that was not the case when using the degree of injury data to define severity. This suggests that a specific/fixed ratio for the safety

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triangle is not practical.

What does it all mean for the practitioner?

Evidence was found to support the prevention of all near miss and lower severity events as a way to reduce future higher severity events — near miss and lower severity events were significant predictors of future fatal events, even without establishing that events shared a common cause. The benefit of investigating and preventing near miss and lower severity events may be founded in a common cause, or it may be a result of other benefits such as increasing employee knowledge, skills, abilities, awareness and motivation and improving overall safety culture. Or, still yet, it may be the result of a combination of a common cause and other benefits. Either way, the most important benefit is the reduced risk of a fatal event at your mine.

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