Accident precursors, near misses and warning signs

How Saleh et al. (2013) define the core terms

Term	Definition	Page
Accident sequence (or accident trajectory)	The base concept. **A chain of events that starts with an initiating event** (which moves the system past a barrier from normal into off-normal operation) and ends with the accident event. Events before the initiating event are not part of the sequence.	151–152
Accident precursor	A **truncated accident sequence**: a chain of adverse events following an initiating off-normal event, which can lead to an accident when compounded with additional adverse conditions. Formally, the accident sequence with its last *m* events removed.	150, 152
Near miss	A **special type of precursor where the truncation is minimal**. It sits close to the accident end-state, and the accident is close to being released: only a few events are missing.	152
Early precursor	The contrast to a near miss: a precursor where **the truncation is extensive**, much further back from the accident end-state.	152
Accident pathway (new term)	An **intermediate string of events within an accident sequence**, truncated at both the start and the end. Because one pathway can appear in several sequences, it can show where an extra barrier would block multiple sequences.	153
Warning sign	A **signal associated with the occurrence of any event** in an accident sequence, or an indication that the system has assumed a hazardous state. A signal near the end of the sequence warns of imminent danger; near the start, it is an early warning.	153
Accident pathogen	An **adverse latent or pre-existing condition**. Combined with other factors or adverse events, it can further advance an accident sequence, precipitate the accident, or aggravate its consequences.	153

Source: Saleh, J.H., Saltmarsh, E.A., Favarò, F.M. & Brevault, L. (2013). Accident precursors, near misses, and warning signs: Critical review and formal definitions within the framework of Discrete Event Systems. Reliability Engineering and System Safety, 114, 148–154.

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Key distinctions & proposed measures

Distinction / measure	What the article says	Example from the article	Pag
Events vs conditions	Precursors are events. Some definitions (NAE, NASA, NRC) also include conditions; the authors exclude them. Static or lurking adverse conditions are better called latent errors, contributing factors or accident pathogens.	*Rusted pipe in a chemical plant; cold weather before a shuttle launch; Texas City trailer siting (a pathogen, not a precursor or warning sign)*	150, 153
Ex-ante vs ex-post	A precursor still qualifies if it is only identified after the accident, so any accident has precursors. The challenge is recognising them beforehand.	—	149
Causality not required	Based on the Oxford English Dictionary definition, a precursor need not be part of the causal chain. It can announce the accident or be correlated with it.	—	149
Previously postulated sequence not required	The NRC definition ties precursors to postulated accident sequences. The authors call this restriction uncalled for: off-normal events can reveal sequences no one had considered.	*NRC Accident Sequence Precursor program*	149–150
Transferability	Precursors apply beyond the plant or system where they occurred: across similar systems, within a company, or across an industry.	*Foam strike on Endeavour, a precursor for all shuttles; Davis-Besse relief valve failure, a precursor for Three Mile Island*	150
Warning sign ≠ precursor	A warning sign is a signal attached to an event in the sequence. A precursor is the truncated sequence of events itself.	*Signal near the end = imminent danger; near the start = early warning*	153
Precursor closeness (I_pr)	The conditional probability that the complete accident sequence unfolds, given the precursor has occurred. Can be extended to all sequences by taking the maximum. Used with consequences, it helps prioritise precursors.	—	152–153
Pathway importance (I_j(u))	The number of accident sequences leading to an accident that a pathway takes part in. Used with consequences, it shows where extra barriers would block several sequences at once.	—	153

Source: Saleh et al. 2013. Reliability Engineering and System Safety, 114, 148–154.