Program evaluation of near miss campaign toward changes in near miss report at the upstream oil and gas company

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Abstract. As the Upstream Oil and Gas Company X reported a high risk of incidents, including Near Miss incidents, a Near Miss campaign was initiated to encourage reporting to prevent the occurrences of such incidents. In 2014, two serious accidents occurred, while 10 Near Miss incidents were reported (1:5), which is not in line with the incident pyramid (1:60). We aimed to compare levels of knowledge, behavior, and education in addition to work duration regarding reporting of Near Miss incidents before and after the campaign and associations with basic risk factors. In this cross-sectional study, primary data were collected from questionnaires related to knowledge and behavior, whereas secondary data based on education level and work duration were collected from 94 field staffs of Company X as well as in-depth interviews of 20 respondents. Most of the respondents had a high level of knowledge (61.7%), good behavior (61.7%), high education level (94.7%), and work duration ≥3 years (60.6%). The number of Near Miss reports changed by 17% (16 reports). The most common underlying causes of Near Miss incidents were mid to low knowledge level (22.2%), good behavior (20.7%), high education level (18%), and work duration ≥3 years (21.1%). However, there was no significant correlation between Near Miss reporting and knowledge, behavior, education, as well as working duration (p > 0.05).

1. Introduction

Work accidents, including near accidents, minor injuries, serious accidents resulting in the loss of work hours (Loss Time Injury), and even death (Fatality), can be initiated by unsafe acts and conditions [1]. Based on the Near Miss data from one of Canada’s largest oil companies, the frequency of accidents was reduced by more than 90% within a single year by active reporting of Near Miss incidents, whereas other large oil companies in Southeast Asia reported no accidents and reduced the direct costs incurred due to accidents by $3,000,000 in 1996 [1]. One of the obstacles in terms of Near Miss reporting in a company is the fear of workers to report because of the possibility of being blamed by a direct supervisor or management, as well as the fear of being distrusted and/or ostracized by their co-workers [2].

Changes in behavior regarding Near Miss reporting can be influenced by several factors, including predisposing factors for accidents, law enforcement factors, individual factors, and factors that allow for behavioral change [3]. In addition to behavior, reporting on Near Miss incidents is also influenced...
by knowledge. Knowledge is influenced by education level and working duration, which mainly affects the understanding of health and safety, and more specifically, knowing the difference between unsafe acts, unsafe conditions, Near Miss events, and actual accidents [4].

Company X implemented a program to prevent work accidents, which includes the reporting of Near Miss events. Two serious work accidents that caused loss of working hours (loss time injury) occurred in Company X [5], but 10 Near Miss incidents were reported to the Ministry of Health and Safety in 2014 (1:5) [5], which is not in line with the incident pyramid theory (also known as the Bird Theory [1]) where with 600 Near Miss incidents and 10 accidents resulting in Loss Time Injuries were reported (1:60).

Company X conducted a Near Miss campaign in 2015 due to the incompatibility of Near Miss incidents and serious accidents resulting in lost working hours when compared with the Bird Theory incident pyramid [1]. Nevertheless, the benefits of the Near Miss campaign program have not been evaluated against changes in Near Miss reporting before the campaign program. On the other hand, the relationship between the changes in Near Miss reporting and the levels of knowledge, behaviors, education, and work duration remains unknown.

2. Methods
This cross-sectional study was conducted using data collected by Company X, an upstream oil and gas company. The samples were active employees of Company X, who were willing to participate in this research and had received Near Miss training. The study included a total of 94 workers, which was the total population of upstream oil field workers of Company X. Data were retrieved from two sources: primary data in the form of quantitative questionnaires related to knowledge and behavior of field workers of Company X, and secondary data obtained by reporting of Near Miss incidents before the Near Miss campaign, which was conducted in 2014 and implemented in 2015. Data regarding work duration, education level before employment with Company X, and the identity of workers before (2014) and after the Near Miss (2015) campaign were collected by the Ministry of Health and Safety as well as the Human Resource Department of Company X. The descriptive data were presented in the form of percentages. Bivariate analysis was conducted using logistic regression and a multivariate method was conducted if the probability (p) value of the bivariate analysis was <0.25. In-depth interviews of field workers reporting and not reporting Near Miss incidents were conducted after the Near Miss campaign.

The study protocol was approved by Company X and the Health Research Ethics Committee, Faculty of Medicine Universitas Indonesia-Cipto Mangunkusumo Hospital.

3. Results
The characteristics of respondents from Company X are shown in Table 1. Most respondents had high knowledge (61.7%), good behavior (61.7%), high education (94.7%), and work duration of ≥3 years (60.6%).

| Variables            | Frequency (n) | Percentage (%) |
|----------------------|---------------|----------------|
| Knowledge            |               |                |
| High                 | 58            | 61.7           |
| Moderate             | 36            | 38.3           |
| Low                  | 0             | 0              |
| Behavior             |               |                |
| Good                 | 58            | 61.7           |
| Sufficient           | 32            | 34             |
| Lacking              | 4             | 4.3            |
| Educational Level    |               |                |
| High                 | 89            | 94.7           |
| Medium               | 5             | 5.3            |
| Low                  | 0             | 0              |

Table 1. Characteristics of Respondents
In total, there were 16 (17%) employees of Company X reported Near Miss incidents (Table 2). Of these employees, 87.5% were offshore placement workers, of whom 75% were at the superintendent–operator level. All reporting employees had a high level of education, whereas 22.2% had moderate knowledge, 20.7% had good behavior, and 21.1% had a work duration of ≥3 years.

Table 2. Near Miss Reporting

| Variable | Frequency (n) | Percentage (%) |
|----------|--------------|----------------|
| Change in Reporting | | |
| No | 78 | 83.0 |
| Yes | 16 | 17.0 |

As shown in Table 3, 22.2% of workers that reported Near Miss incidents had moderate to low knowledge, 18% had good behavior, and 21.1% had a working duration of ≥3 years.

Table 3. Correlations between Knowledge, Behavior, Education, and Working Duration and Changes in Near Miss Reports

| Variable | Near Miss Report Change | OR | 95% CI | p |
|----------|-------------------------|----|--------|---|
| Knowledge | Yes | No | | |
| High | 8 | 50 | 0.560 | 0.189–1.655 | 0.294\textsuperscript{rl} |
| Moderate - Low | 8 | 28 | 1.00 | Ref |
| Education Level | Yes | No | | |
| High | 16 | 73 | 354076679.5 | 0.000–0.999 | Ref |
| Moderate - Low | 0 | 5 | 1.00 | Ref |
| Working Duration | Yes | No | | |
| ≥3 years | 12 | 5 | 2.20 | 0.651–7.433 | 0.204\textsuperscript{rl} |
| <3 years | 4 | 33 | 1.00 | Ref |

\textsuperscript{rl} Logistic Regression Analysis

Of 26 Near Miss events reported before and after the campaign, there were 39 categories of Basic Risk Factors (BRFs) for Near Miss incidents, as depicted in the bar chart presented in Fig. 1.

Figure 1. BRFs of Near Miss incidents reported from 2014 to 2016
As shown in the bar chart in Fig. 1, the 10 most frequent BRFs of Near Miss events before and after the campaign were procedures (10 incidents), followed by hardware (6 incidents), design engineering, maintenance management, and error-enforcing (5 incidents each), housekeeping (2 incident), and organization (1 incident), whereas no Near Miss incidents were due to incompetent goals, training, and defenses.

In-depth interviews were conducted with only 10 of 16 respondents who reported Near Miss incidents. Thus, as a control, in-depth interviews were conducted with the same number of respondents who did not report a Near Miss incident.

Of the 10 respondents who reported Near Miss incidents, some were Safety Health Officers and Operation Super Intendents with an average age of >30 years, and the majority worked offshore. Most of the respondents stated that their motivation of reporting Near Miss incidents was as a lesson learned for other workers to prevent the occurrence of such future incidents. Meanwhile, the 10 respondents who were field workers of Company X did not encounter Near Miss incidents until the study was completed but would have reported any Near Miss incident that occurred.

4. Discussion
The Near Miss campaign resulted in a 17% change in the number of reported Near Miss incidents (16 of 94 field workers). A similar study conducted by Garbutt et al. [6] in 2008 found that 60% of 642 doctors in the United States had reported Near Miss incidents.

There was a change in Near Miss reporting after the campaign program related to a behavioral change strategy [7] through the use of force (enforcement) by company policy encouraging workers to actively report Near Miss incidents and with the provision of education (i.e., training and socialization) of field workers.

In accordance with the operational definition in this research, the Near Miss campaign program conducted by Company X resulted in a change in Near Miss reporting. From Near Miss event data of Company X based on BRFs, the category of procedures was the most common cause of Near Miss events before and after the campaign, which is in line with the previous incident data reported by Ness [8] in 2015 who specifically noted two incidents, a fire at the Partridge Raleigh Oilfield in 2006 due to the failure to implement a safe work permitting procedure and a fire at Formosa Plastics Vinyl Chloride in 2004 due to the unavailability of operating procedures and protocols.

Field workers with high knowledge about the Near Miss campaign program reported fewer Near Miss incidents, as compared to those with moderate to low knowledge (n = 8, 22.2%). The findings of the present study are in line with those reported in a 2016 study by Bagenal et al. [9] where nurses with lower knowledge were more likely to report incidents than new doctors with higher knowledge. However, based on secondary data in the form of position and location of work, and primary data in the form of in-depth interviews of 10 respondents, 9 of 10 field workers who reported Near Miss incidents had a moderate to low position (superintendent–operator), where field workers at that level served in the production process area every day and were at a greater risk of incidents in the workplace.

All field workers reporting Near Miss incidents had a high level of education, which is in line with a 2012 report by Almutary and Lewis [10] stating that the reporting of incidents and/or errors was positively correlated with a high level of education, as the higher the education level, the greater the desire to report incidents and/or errors [10].

Further analysis showed that work duration was not statistically correlated to a change in the reporting of Near Miss incidents. However, there was a difference of 10.3% in the reporting rate between the field workers with a working duration < 3 years vs. ≥3 years (4, 10.8% vs. 12, 21.1%, respectively). This is in line with a 2013 study by Hikmawan et al. [11] who reported that longer employment was associated with a lower risk of accidents and greater ability to identify potential hazards.

The majority of the 10 respondents who reported Near Miss incidents stated that the motivation to report was as a lesson learned for other workers to prevent future work accidents.
If associated with the opinions and expectations of the management of Company X against the Near Miss campaign program, in the form of creating a generative safety culture of every worker who prioritize safety and health in every activity, so that work accidents can be avoided, then some of the expectations of the management have been achieved based on the results of the interviews of the majority of respondents who reported a Near Miss incident as a lesson learned for other workers to prevent similar incidents.

All 10 respondents who did not report Near Miss incident after the campaign due to missing/no Near Miss incident at work until the study was conducted said that they would report a Near Miss incident in the future.

5. Conclusion
There was a change in Near Miss reports after the campaign, and the category of procedures was the most common cause of Near Miss events based on BRFs at Company X. There was no statistically significant correlation between the variables of knowledge, education, work duration, and behavior with the changes in Near Miss reporting in Company X.

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