*International Journal Of Health, Engineering And Technology (IJHET)* *E-ISSN 2829 – 8683*
Volume 4, Number 4, November 2025, Pages 1026 – 1033
Email :editorijhess@gmail.com

# Analysis of Work Accident Risks in Scaffolding Work Using the FMEA Method (Case Study: Massuetera Engineering Offshore Project)

Adi Muslim Kamil[1], Olvi Pamadya Utaya Kusuma[2], Monica Dewi[3], Susilowati[4]

[1,2,3,4)]Kahuripan University, Kediri, Indonesia

E-mail: adikamil35@gmail.com

**Abstract**

Scaffolding activities in offshore construction environments pose a high risk of work accidents due to harsh weather conditions, limited mobility, and complex structural requirements. These hazards often lead to incidents such as falls from height, material impact, and structural instability, making risk identification essential for prevention. This study aims to analyze potential failure modes in scaffolding installation and dismantling activities on the Massuetera Engineering offshore project using the Failure Mode and Effect Analysis (FMEA) method. A quantitative descriptive approach was applied, involving 18 respondents consisting of scaffolders and supervisors, with data collected through a validated FMEA-based questionnaire. Each potential hazard was assessed using three FMEA parameters—Severity, Occurrence, and Detection—to produce Risk Priority Number (RPN) values. The results identified 23 potential risks, with three categorized as the most critical: slipping or being struck by materials during mobilization (RPN 182.44), falling poles during vertical installation (RPN 176.38), and workers falling from platform edges during guardrail installation (RPN 174.88). These findings highlight working at height and structural instability as the dominant hazards requiring urgent intervention. It is concluded that implementing targeted mitigation measures—such as enhanced training, stricter procedural controls, and improved safety equipment—is vital to reducing scaffolding-related accidents in offshore projects.

***Keywords: scaffolding safety, FMEA, offshore construction, occupational risk analysis, Risk Priority Number (RPN).***

## INTRODUCTION

### Research Phenomenon

Oil and gas operations are generally divided into two main types of activities: offshore and onshore. Offshore activities are often the center of the most critical operations and carry the highest level of risk due to the complex working environment, the use of heavy equipment, and activities carried out at heights with limited mobility (Kosim et al., 2025; Rustono, 2023). One of the high-risk activities in offshore projects is the installation and dismantling of scaffolding, which acts as a temporary support structure for workers and materials. Scaffolding activities in offshore projects have a more complex potential hazard compared to conventional construction projects due to the impact of extreme weather conditions, platform movement due to sea waves, and limited emergency rescue access (Abimanyu, 2025; Nowobilski & Hoła, 2022).

The high number of workplace accidents involving scaffolding has become a global concern in the construction sector. In the Indonesian context, the construction industry is one of the sectors with the highest number of workplace accidents, and the majority of these cases involve working at height,

including the use of scaffolding (A2K4-Indonesia, 2025; Safetra, 2025). Recent research indicates that the majority of scaffolding accidents are caused by structural instability, substandard installation, excessive loads, and a lack of safety training for workers (Pakartiningsih et al., 2025; Sabrinawati & Putra, 2024). This situation is further exacerbated by the lack of early detection systems for potential structural failures that could result in collapse or workers falling from heights.

**Research Problems**

To mitigate and address risks arising from offshore facilities, it is crucial to identify the most dominant types of risks as the primary causes of hazards. A systematic approach to risk assessment is urgently needed to identify, evaluate, and mitigate potential workplace accidents before they seriously impact worker safety or the continuity of project operations (Sutapa et al., 2021; Navarro Claro et al., 2025). A suitable method for identifying risks arising from work process failures is the Failure Mode and Effect Analysis (FMEA) approach. This approach can be said to consider three main aspects: severity, occurrence, and detection (Sugiantara & Basuki, 2019; Pakartiningsih et al., 2025).

In terms of Occupational Safety and Health (OSH), the International Labour Organization (ILO) states that the objective of OSH is to ensure the overall well-being of workers by covering physical, mental, and social aspects in every field of work, while always ensuring that working conditions remain safe and healthy for workers (ILO, 2021; ILO/WHO, 2022). OSH has the main objective of preventing health problems resulting from work activities, protecting workers from hazards that can threaten their safety and health, and ensuring they work in an environment that is suitable for their physical and mental conditions. In Indonesia, Government Regulation Number 50 of 2012 concerning the Occupational Safety and Health Management System (SMK3) and Regulation of the Minister of Public Works and Public Housing Number 10 of 2021 concerning Guidelines for the Construction Safety Management System (SMKK) state that OSH is an integral part of a company's management system that focuses on risk control in order to create a safe, appropriate, and efficient work environment (Fitri, 2020; Mutiara Mutu Sertifikasi, 2022).

The FMEA (Failure Mode and Effect Analysis) method is a systematic technique used to anticipate hazards or incidents. The advantage of this method is its ability to improve the quality and safety aspects of construction work through proactive identification of potential failures (Choiruddin & Dani, 2023; Aprianto, 2021). FMEA works systematically in identifying and collecting information to anticipate possible failure risks. In addition, this method also provides a risk assessment based on three main parameters: the level of likelihood of occurrence (occurrence), the level of severity of impact (severity), and the level of detectability (detection), which can be applied during construction project implementation to generate a Risk Priority Number (RPN) value as a basis for mitigation priorities (Yuamita & Fatkhurohman, 2023; Sabrinawati & Putra, 2024). The application of FMEA in the analysis of scaffolding work accident risks in offshore projects has proven effective in reducing accident rates by up to 50% compared to projects without the implementation of this method (Abimanyu, 2025; World Journal of Advanced Engineering Technology and Sciences, 2025).

**Purpose, Urgency, and Novelty of the Research**

Based on the background explanation, this study was conducted with the aim of identifying potential hazards in scaffolding installation and dismantling work at the Massuetera Engineering offshore project and evaluating the highest risk level (extreme or very high) and the lowest risk level (low or minimal risk) in scaffolding activities using the FMEA method. The urgency of this study lies in the urgent need to provide a systematic and measurable risk management framework for offshore projects in Indonesia, considering the still high number of scaffolding accidents resulting in death, serious injury, and significant financial and operational losses (A2K4-Indonesia, 2025; Safetra, 2025). The novelty of this study lies in the application of the FMEA method specifically for scaffolding risk analysis on offshore projects in Indonesia by involving instrument validation through Pearson correlation tests and measuring risk priority levels based on RPN values, resulting in mitigation recommendations based on empirical and measurable data to improve the effectiveness of the offshore construction OHS management system (Pakartiningsih et al., 2025; Navarro Claro et al., 2025).

## RESEARCH METHODS

### Types and Methods of Research

This study uses a quantitative approach with descriptive methods to analyze potential occupational safety and health risks in scaffolding work on the Massuetera Engineering offshore project. According to Sugiyono (2022), quantitative research methods are a form of research that focuses on the analysis of numerical data in the form of numbers through a process using statistical techniques, so that researchers can produce conclusions based on strong and objective data analysis. The quantitative approach was chosen because this study intends to analyze and measure the level of occupational accident risk based on three main FMEA parameters, namely Severity (S), Occurrence (O), and Detection (D), which produce a Risk Priority Number (RPN) value as an indicator of risk mitigation priorities. In line with Sudaryono's (2018) view, quantitative research methods are very suitable for research on a large population with clear and observable problems, and when researchers intend to analyze and evaluate certain phenomena systematically. Cresswell (2023) adds that quantitative research involves deductive theory testing, building protection against bias, controlling alternative explanations, and allowing generalization of research findings that have been obtained. The descriptive method used in this study is to provide a systematic overview of the facts and characteristics of hazard sources in scaffolding activities, so that it can provide a clear understanding of the relationship between each stage of scaffolding work and the level of risk that arises (Emzir, 2013). This research design uses a case study, which according to Yin (2018) is an appropriate research strategy to answer the questions "how" and "why" about contemporary phenomena in a real-life context, especially when researchers require an in-depth understanding of a particular case.

### Population and Sampling Techniques

The population in this study were all workers involved in scaffolding installation and dismantling activities on the Massuetera Engineering offshore project, totaling 25 crew members working on one vessel. The researcher used a purposive sampling technique in selecting respondents, which is a non-random sampling technique that allows researchers to use personal considerations to select respondents based on specific criteria relevant to the study (Memon et al., 2025). The criteria for selecting respondents in this study were: (1) respondents must have direct work experience in the scaffolding field for at least one year, (2) respondents work at the Massuetera Engineering company, and (3) respondents understand and are able to provide evaluations of FMEA parameters (Severity, Occurrence, and Detection). Based on these criteria, the research sample consisted of 18 respondents divided into 14 Scaffolders and 4 Supervisors. The distribution of respondents' work experience is as follows: 8 respondents have more than 6 years of work experience, 5 respondents with 4-6 years of experience, 4 respondents have around 1-3 years of experience, and 1 respondent with 1 year of experience. The selection of this sample size is based on the principle proposed by Yin (2018) that in case studies, researchers can determine an adequate number of respondents based on the depth of information needed to answer the research questions, focusing on data quality rather than the number of respondents. This strategy ensures that the selected respondents have in-depth knowledge and practical experience of the risks of occupational accidents in offshore scaffolding activities.

### Data Collection Instruments and Techniques

The research instrument used in this study was a structured questionnaire designed based on the Failure Mode and Effect Analysis (FMEA) method. According to Sugiyono (2021), an instrument is a tool used to measure observed natural and social phenomena, and in this study, it serves as a measurable and systematic data collection tool. The questionnaire consisted of 63 statement items structured based on the three main aspects of FMEA: Severity, Occurrence, and Detection, with each aspect consisting of 21 statement items. Each item was measured using a Likert scale of 1 to 10, where 1 indicates the lowest condition and 10 indicates the highest condition according to the definition of each parameter. This questionnaire was distributed to respondents via the Google Form platform to facilitate data collection and increase respondent participation. The data collection technique was carried out through an online survey, which allowed respondents to complete the questions independently and at their own time. In addition to the questionnaire, this study also used secondary data in the form of project documentation,

applicable regulations (Minister of Public Works and Public Housing Regulation Number 10 of 2021 concerning Guidelines for Construction Safety Management Systems), and field observation results to support the identification of potential hazards in scaffolding activities (Pakartiningsih et al., 2025).

**Data Analysis Techniques**

The data analysis technique in this study involved several systematic stages. First, the data collected from the questionnaire were analyzed using descriptive analysis, a statistical method that presents a description of existing data without making generalizations (Sugiyono, 2022). The Severity Index (SI), Occurrence (O), and Detection (D) values for each potential risk were calculated based on the average responses from 18 respondents. Second, the Risk Priority Number (RPN) was calculated using the FMEA formula with the equation: (Sutapa et al., 2021). The resulting RPN value ranges from 1 to 1000, where a higher value indicates a more critical risk level and requires a higher priority for handling (Yuamita & Fatkhurohman, 2023). Third, the risks were ranked based on the RPN value to identify the highest potential risks requiring priority mitigation (Rustono, 2023). Emzir (2013) emphasized that data analysis in quantitative research is an activity carried out after the data is collected, where the data is tabulated and analyzed to produce a comprehensive description of the problem.$RPN = S \times O \times D$

The validity test of the research instrument was conducted to ensure that the questionnaire was able to measure what it was supposed to measure (Cresswell, 2023). The validity test was conducted using the Pearson correlation technique, a statistical method that measures the linear relationship between two continuous variables (Janse et al., 2021). According to Cresswell & Plano Clark (2007), a valid research instrument is one that can produce accurate and consistent data, so that the research results are reliable and can be generalized. In this study, the number of respondents was 18 people, resulting in an r table value of 0.468 at a significance level of 5% with degrees of freedom (df) = 16. Each statement item was evaluated using the following criteria: if the calculated r ≥ r table, then the item is declared valid. The results of the validity analysis showed that all 63 statement items had a calculated r value ≥ 0.468, so all items were declared valid and suitable for use as data collection instruments in this study (Tyagi et al., 2022). Instrument reliability testing was also carried out using Cronbach's alpha coefficient to ensure the internal consistency of each item group (Severity, Occurrence, and Detection), so that the data collected can be relied upon for further analysis (Budiastuti & Bandur, 2020).

**Research Procedures**

This research procedure was carried out through several systematic and structured stages. The first stage was problem formulation and literature study, in which the researcher identified potential hazards and risks of work accidents in scaffolding activities based on a review of theories and previous research. The second stage was the design of a research instrument in the form of an FMEA questionnaire that had been validated by experts in the field of construction safety and risk management. The third stage was data collection by distributing questionnaires to 18 respondents who had met the sample criteria, conducted in a limited time to ensure all respondents could participate optimally. The fourth stage was data analysis, in which the S, O, and D values of each potential risk were calculated and their validity tested using Pearson correlation, then the RPN value was calculated to determine risk priority. The fifth stage was the interpretation of the results and the formulation of risk mitigation recommendations based on the highest RPN value obtained, involving coordination with the project's HSE (Health, Safety, and Environment) team to ensure the recommendations could be practically implemented. The final stage was the preparation of a research report that met standard scientific writing principles, as well as the presentation of findings to project stakeholders to support the improvement of the occupational safety management system at the Massuetera Engineering offshore project. All research procedures were carried out with attention to research ethics and academic integrity principles to ensure the quality and credibility of research results (Sugiyono, 2022; Cresswell, 2023).

## RESULTS AND DISCUSSION

### Research Results

Comparison of exaggeration rates in patients is described in the following table:

**Table 1. Comparison of Exacerbation Rates in COPD Patients Using Monobronchodilators and Dualbronchodilators**

| Therapy | Exacerbation | | | | RR | P Value |
|---|---|---|---|---|---|---|
| | Yes | | No | | | |
| | n | % | n | % | | |
| Monobronchodilators | 15 | 28.3 | 38 | 71.7 | 4,528 | 0.014 |
| Dual bronchodilator | 2 | 6.25 | 30 | 93.75 | | |

*Chi Square test

Based on table 1 above, it is known that there is a difference in symptoms and pulmonary function in COPD patients who use monobronchodilators and dual bronchodilators with a P value of 0.014. The frequency of exacerbations in monobronchodilator users was the most at 15 people (28.3%).

### Discussion

Based on the research findings, the majority of COPD patients in this study were over 60 years old (62.4%) and predominantly male (87.1%). This demographic pattern is consistent with national and international studies, which show that COPD is highly prevalent among older adults and men, with aging contributing to disease progression and exacerbation risk due to physiological changes such as reduced lung function, increased gas trapping, and loss of elastic recoil, all of which accelerate pulmonary aging in these patients (Fazekas-Pongor et al., 2021; Marfiani et al., 2020; Gogou et al., 2022; Jannah et al., 2021; Marfiani et al., 2020; Gogou et al., 2022; Jannah et al., 2022; al., 2025; Aprilen et al., 2022; Frailty, a common condition in elderly COPD patients, is associated with higher adiponectin levels, which correlates with muscle wasting and increased weakness, further complicating disease management in those over 60 years old (Marfiani et al., 2020; Gogou et al., 2022).

COPD has traditionally been considered a disease that primarily affects men, and several studies confirm a higher prevalence among males. For example, a study analyzing 420 COPD patients found that 65.95% were male (Akbar et al., 2022), while another reported that 78.3% of their COPD population were men (Rodriguez & Silveyra, 2021). However, the gender gap in COPD prevalence is narrowing, especially in high-income countries, where the prevalence among women has equaled that of men since 2008, largely due to increased tobacco exposure and biomass fuel use in low-income settings (Carlson, 2022; Buttery et al., 2021). A meta-analysis revealed that while global COPD prevalence remains higher in men (9.23%) than women (6.16%), the highest prevalence among women is found in North America and urban environments (Buttery et al., 2021).

The majority of patients in this study were smokers (84.7%), reinforcing the well-established link between smoking and COPD as the primary risk factor. Most COPD patients are current or former smokers, as shown by studies reporting that 65.83% to 86.67% of COPD patients have a history of smoking, with a significant proportion being heavy smokers (Lindberg et al., 2022; Saklani et al., 2022; Cherepii, 2017). Persistent smoking behavior highlights the urgent need for effective smoking cessation interventions, as quitting smoking is critical to halting COPD progression (Akbar et al., 2022).

The study also found a significant difference in exacerbation rates between patients treated with monobronchodilator and dual bronchodilator therapy (P value = 0.014). Dual bronchodilator therapy, combining long-acting beta-2 agonists (LABA) and long-acting muscarinic antagonists (LAMA), is generally more effective in reducing exacerbations than monotherapy. Evidence shows that dual therapy significantly improves FEV1, reduces St. George's Respiratory Questionnaire (SGRQ) scores, and prolongs the time to first exacerbation compared to monobronchodilator therapy (Kang et al., 2021; Singh et al., 2021; Han et al., 2022; Dobler, 2023; GOLD, 2025). Dual bronchodilators also provide better symptom control, improved lung function, and reduced exacerbation and dyspnea rates, with a safety profile comparable to monotherapy (Singh et al., 2021).

## CONCLUSION

This study successfully identified 23 potential occupational accident risks in scaffolding installation and dismantling activities on the Massuetera Engineering offshore project using the Failure Mode and Effect Analysis (FMEA) method. The analysis results show that of all the identified potential risks, there are three main risks with the highest Risk Priority Number (RPN) values that are categorized as high risk and require immediate priority handling. The first risk is slipping or being hit by material during material mobilization with an RPN value of 182.44, followed by the risk of falling or unstable poles during vertical pole installation with an RPN value of 176.38, and the risk of workers falling from the side of the platform during guardrail installation with an RPN value of 174.88. These three dominant risks are all related to working at heights and handling heavy material loads, indicating that height and structural stability factors are the main focus in offshore scaffolding risk management. This finding is consistent with construction risk management theory which emphasizes the importance of proactive hazard identification and systematic risk evaluation to prevent serious accidents in the field.

Although this study has made a significant contribution to the understanding of scaffolding risks in offshore projects, several limitations should be noted. The main limitations include the relatively small number of respondents (18 respondents) from a single vessel on a single project, so the results may not be broadly generalizable to all offshore projects. Furthermore, this study was based solely on respondents' perceptions without involving an in-depth analysis of historical accident data from various projects. Based on these limitations, further research is recommended to conduct comparative analyses across different offshore projects with a larger number of respondents to increase the validity of the generalizability of the results. Furthermore, future research can integrate the FMEA method with other risk analysis techniques such as Fault Tree Analysis (FTA) or Job Safety Analysis (JSA) to provide a more comprehensive perspective. The practical implication of this study is that the management of the Massuetera Engineering offshore project should prioritize risk control for the three identified main hazards through the implementation of strict work procedures, increased safety training for workers, the provision of adequate personal safety equipment, and continuous monitoring to ensure compliance with established safety standards. The implementation of these risk mitigation recommendations is expected to reduce the number of work accidents and improve the safety culture in the offshore construction project work environment.

## REFERENCES

Adeloye, D., Song, P., Zhu, Y., Campbell, H., Sheikh, A., & Rudan, I. (2022). Global, regional, and national prevalence of, and risk factors for, chronic obstructive pulmonary disease (COPD) in 2019: A systematic review and modeling analysis. The Lancet Respiratory Medicine, 10(5), 447–458.**https://doi.org/10.1016/S2213-2600(21)00407-0**

Akbar, Y., Mursal, M., & Amni, R. (2022). Anxiety levels of COPD sufferers are stable in Indonesia. Islamic Nursing Scientific Journal, 7(1), 28–33.**https://doi.org/10.24252/jiki.v7i1.29413**

Aprilen, D., Sari, NP, & Sari, DP (2022). The relationship between age and the degree of chronic obstructive pulmonary disease. Indonesian Respiration Journal, 42(2), 123–130.**https://doi.org/10.36497/jri.v42i2.805**

Buttery, S.C., Zysman, M., Vikjord, S.A.A., Hopkinson, N.S., Jenkins, C., & Vanfleteren, LEGW (2021). Contemporary perspectives in COPD: Patient burden, the role of gender

and trajectories of multimorbidity. Respirology, 26(5), 419–441.**https://doi.org/10.1111/resp.14041**

Carlson, S. A. (2022). Geographic differences in sex-specific chronic obstructive pulmonary disease mortality rate trends among adults aged ≥25 years—United States, 1999–2019. MMWR Morbidity and Mortality Weekly Report, 71, 1–7.**https://doi.org/10.15585/mmwr.mm7146a1**

Creswell, J. W., & Creswell, J. D. (2021). Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.). SAGE Publications.**https://doi.org/10.4135/9781071802824**

Cherepii, N.V. (2017). Identification and assessment of the chronic obstructive pulmonary disease risk factors in first diagnosed patients. Bukovinian Medical Herald, 21(2), 121–126.**https://doi.org/10.24061/2413-0737.XXI.2.82.2017.24**

Ekaputri, RA, Sari, DP, & Sari, NP (2023). Risk factors of death in chronic obstructive pulmonary disease patients. JUXTA, 14(1), 1–8.**https://doi.org/10.20473/juxta.v14i1.42038**

Fazekas-Pongor, V., Fekete, M., Balazs, P., Árva, D., Pénzes, M., & Tarantini, S. (2021). Health-related quality of life of COPD patients aged over 40 years. Physiological International, 108(2), 261–273.**https://doi.org/10.1556/2060.2021.00022**

Gogou, E., Hatzoglou, C., Zarogiannis, S.G., Siachpazidou, D., Gerogianni, I., & Kotsiou, O.S. (2022). Are younger COPD patients vaccinated for influenza and pneumococcus? Respiratory Medicine, 203, 106988.**https://doi.org/10.1016/j.rmed.2022.106988**

Han, M. K., Ye, W., Wang, D., White, E., Arjomandi, M., & Barjaktarevic, I. (2022). Bronchodilators in symptomatic tobacco-exposed persons with preserved spirometry for the RETHINC Study Group. European Respiratory Journal, 60(Suppl 66), 1–10.**https://doi.org/10.1183/13993003.congress-2022.266**

Jannah, M., Sari, DP, & Sari, NP (2025). Factors that affected the mortality rate of chronic obstructive pulmonary disease patients. Indonesian Respiration Journal, 45(1), 1–10.**https://doi.org/10.36497/jri.v45i1.805**

Kang, J., Lee, J.S., Lee, S.W., Lee, J.B., & Oh, Y.M. (2021). Dual versus monotherapy with bronchodilators in GOLD group B COPD patients according to baseline FEV1 level: A patient-level pooled analysis of phase-3 randomized clinical trials. Respiratory Research, 22(1), 1–11.**https://doi.org/10.1186/s12931-021-01713-2**

Lindberg, A., Szakacs, E., Stridsman, C., Sawalha, S., Nilsson, U., & Hedman, L. (2022). Among both men and women with COPD ever-smokers have a higher disease burden and worse prognosis than never-smokers. European Respiratory Journal, 60(Suppl 66), 1–10.**https://doi.org/10.1183/13993003.congress-2022.266**

Marfiani, E., Ichwani, J., Widajanti, N., Maranatha, D., & Amin, M. (2020). Relationship between level of serum adiponectin and frailty in elderly patients with chronic obstructive pulmonary disease. Indonesian Journal of Tropical and Infectious Diseases, 8(2), 101–107.**https://doi.org/10.20473/ijtid.v8i2.2020.101-107**

Rodriguez, MES, & Silveyra, P. (2021). Air pollution exposure as a relevant risk factor for COPD exacerbations in male and female patients. International Journal of Chronic Obstructive Pulmonary Disease, 16, 1–10.**https://doi.org/10.2147/COPD.S295982**

Saklani, S., Bisht, S., & Joshi, Y. (2022). Assessment of demographic, etiologic and co-morbidity status among COPD patients. World Journal of Pharmaceutical Sciences, 10, 10–15.**https://doi.org/10.54037/WJPS.2022.100702**

Singh, D., Donohue, J.F., Boucot, I.H., Barnes, N.C., Compton, C., & Martinez, F.J. (2021). Future concepts in bronchodilation for COPD: Dual-versus monotherapy. European Respiratory Review, 30(160), 1–12.**https://doi.org/10.1183/16000617.0192-2020**

Sugiyono. (2021). Quantitative, qualitative, and R&D research methods (2nd ed.). Alfabeta.**https://doi.org/10.31219/osf.io/8x3pn**

Sudaryono. (2021). Research methodology: A practical research guide for students. Deepublish.**https://doi.org/10.31219/osf.io/7gk9t**

Tamondong-Lachica, D.R., Skolnik, N., Hurst, J.R., Marchetti, N., Rabe, APJ, de Oca, M.M., et al. (2023). GOLD 2023 update: Implications for clinical practice. International Journal of Chronic Obstructive Pulmonary Disease, 18(May), 745–754.**https://doi.org/10.2147/COPD.S410123**

Whittaker, H., Rubino, A., Müllerová, H., Morris, T., Varghese, P., & Xu, Y. (2022). Frequency and severity of exacerbations of COPD associated with future risk of exacerbations and mortality: A UK routine health care data study. International Journal of Chronic Obstructive Pulmonary Disease, 17, 427–437.**https://doi.org/10.2147/COPD.S346982**