Original Article

Is Stress ECG a Cost-Effective tool to Determine Rescue Team Fitness to Work? The BASF Indonesia Experience.

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Article history

Received 13/06/2024
Accepted (Panel 1) 29/08/2024

ABSTRACT: *Rescue teams (RTs) perform physically demanding tasks, necessitating medical fitness to reduce risks to themselves and others. At BASF Indonesia, stress electrocardiogram (ECG) is a key component of RT fitness-to-work (FTW) assessments. Between 2019 and 2023, 313 stress ECGs were conducted to evaluate RT FTW. Of these, 301 participants (96.2%) were deemed fit after the initial test. Twelve participants (3.8%) required additional testing, resulting in 11 (91.7%) being declared fit and one (8.3%) deemed unfit. The detection rate of unfit individuals via stress ECG was 0.3% (1/313). The total cost for initial stress ECGs was USD 9,892, with an additional USD 2,829 incurred for follow-up tests, totalling USD 12,721. Consequently, the cost to identify one unfit individual among 313 participants was USD 12,721. No medical complications were reported among RT members certified as fit during training or responses. Given the potential risks (including severe medical complications, fatalities, or safety compromises) and associated costs (medical, litigation, moral etc.), stress ECG appears to be a cost-effective method for determining RT FTW and mitigating these risks.*

Keywords: *Stress ECG, Fitness to Work, Rescue Team Stress ECG, Fitness to Work, Rescue Team*

1.0 INTRODUCTION

BASF is a chemical company headquartered in Ludwigshafen, Germany, with operations in 90 countries. Established in 1976, BASF Indonesia employs approximately 700 individuals across three production sites in Cimanggis, Cengkareng, and Merak. In BASF Indonesia, rescue teams (RT) are responsible for retrieving victims and performing physically demanding tasks such as climbing vertical ladders while using heavy equipment like self-contained breathing apparatus (SCBA) and personal protective equipment (PPE), including chemical protection suits.

Fitness to work (FTW) assessments are essential preventive measures in the workplace. These evaluations assess an individual's functional capacity in relation to job demands. The examining physician must determine whether the individual can perform the required tasks physically and psychologically without posing significant risks to themselves or others. For RT members at BASF, FTW assessments include medical history reviews and physical examinations such as visual acuity testing, otoscopy, full blood count, fasting blood sugar, alanine transaminase (ALT), gamma-glutamyl transferase (GGT), urinalysis, air conduction audiometry, chest X-ray, spirometry, resting ECG, and stress ECG. Special considerations include cardiopulmonary and musculoskeletal health, metabolic disorders, claustrophobia, and the ability to achieve a full face-mask seal (BASF, 2024).

Stress ECG, also known as exercise ECG or treadmill test, is a non-invasive diagnostic procedure that monitors the heart's electrical activity under stress during physical exertion. Its primary purposes include detecting arrhythmias that emerge during exercise, diagnosing coronary artery disease by identifying reduced blood flow to the heart, evaluating exercise capacity, and assessing treatment effectiveness for heart-related conditions. Stress ECG offers several advantages. It is non-invasive, safe, and widely available in medical facilities, making it accessible for patients and healthcare providers. Additionally, stress ECG is cost-effective compared to alternatives such as stress echocardiograms or nuclear stress tests. However, stress ECG has limitations. It has lower accuracy in detecting coronary artery disease than other stress tests, with false positives and negatives potentially leading to unnecessary testing or missed diagnoses. Results may also be inconclusive due to factors like pre-existing ECG abnormalities, obesity, or certain medications. Furthermore, stress ECG does not provide direct visualisation of heart structures, limiting its ability to detect some heart conditions (Cardiac Stress Tests - Stress ECG, Stress Echo and Nuclear Stress, 2024). Stress ECG can also assess blood pressure responses during exercise, aiding in the early detection of hypertension and circulatory issues. Before undergoing stress ECG testing at BASF Indonesia, contraindications were carefully evaluated.

To our knowledge, no published studies have examined the cost-effectiveness of stress ECG as a tool to determine RT FTW. This study aims to assess the detection rate of unfit RT members and evaluate the associated costs based on BASF Indonesia's experience.

2.0 METHOD

This study was conducted over 5 years (2019–2023) and included all RT members at BASF Indonesia. Stress ECG results and associated costs were analysed and summarised. No pilot studies or statistical analyses were performed.

3.0 RESULTS

During this study period 313 stress ECGs (305-male, 8-female) were done for RT members in BASF Indonesia (Table 1). The average age of participants was 43 years.

Table 1 Stress Tests Done by Gender

Gender	Number of stress ECGs	Percentage
Male	305	97.4
Female	8	2.6
Total	313	100

301 cases or 96.2% were fit after the first test (Table 2).

Table 2 Recommendations After First Test

Recommendation after first test	Number of stress ECGs	Percentage
Fit	301	96.2
Further assessment required	12	3.8
Total	313	100

12 personnel or 3.8% had to undergo additional test and out of the 12, 11 personnel or 91.7% were declared fit after the additional test. Only 1 person was declared unfit which was 8.3%. Hence, out of the 313 stress ECGs done, 1 person or 0.3% of stress ECGs done was declared unfit.

Table 3 Recommendation After Further Assessment

Recommendation after further assessment	Number of cases	Percentage
Fit	11	91.7
Further assessment required	1	8.3
Total	12	100

The reason for the 12 personnel to undergo additional tests were due to positive ischaemic response. Cardiac CT scan and cardiologist assessment were done for all. One was declared unfit due to calcium plaque with stenosis at left anterior descending artery and diabetes.

The total direct cost of the first 313 stress ECGs was USD 9,892. The direct cost for the additional tests for 12 personnels was USD 2,829. Total costs for both tests were USD 12,721.

During the study period, none of the RT members developed medical issues during training or rescue activities.

4.0 DISCUSSION

FTW assessments often involve various tests and standards; however, published data on the cost-effectiveness of stress ECG for RT screening remains limited. In this study, the total cost of USD 12,721 enabled the identification of one high-risk case, potentially preventing severe medical complications, fatalities, safety risks, and related costs such as medical expenses and litigation.Additional benefits include the opportunity for early intervention and reinforcing the company's commitment to employee safety by ensuring RT members are FTW before engaging in physically demanding tasks. From the authors' perspective, these findings suggest that stress ECG is a cost-effective tool for RT FTW assessments.

In this study, stress ECG was conducted for asymptomatic individuals as part of routine FTW screening.Participants with a positive ischaemic response underwent cardiac CT scans regardless of risk factors, aligning with the Indonesian Guidance for Stress ECG (Perhimpunan Dokter Spesialis Kardiovaskular Indonesia, 2016). Some international experts recommend stress echocardiograms or myocardial scintigraphy instead of cardiac CT scans for further evaluation of positive stress ECG results, particularly in individuals at high risk of arteriosclerosis (e.g., older adults, smokers, those with high cholesterol or glucose levels, or a family history of heart disease). This approach may better identify high-risk cases; however,

it could also increase assessment costs if additional examinations, such as stress echocardiograms, are required alongside cardiac CT scans. This study has some limitations, including its small sample size and focus on a single company in one country. Broader studies are recommended to confirm these findings.

5.0 CONCLUSION

USD 12,721 was spent to screen 313 cases whereby 312 were fit, 1 was unfit for work as RT and those certified fit did not experience any cardiovascular complication during training or response to an incident. The authors' view is that based on this figure the cost of using Stress ECG as a tool to determine Rescue Team Fitness to Work is reasonable. Larger studies with more sophisticated cost analysis are recommended to confirm this assumption.

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