

Medical evacuations among offshore oil and gas industries in the Gulf of Thailand

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ABSTRACT

Background: Medical evacuation in the offshore oil and gas industry is costly and risky. Previous studies have found that the main cause of medical evacuation due to illness is increasing. In Thailand, there have been no studies on the causes and costs of medical evacuation in the offshore oil and gas industry. This study aims to study on the causes and costs of medical evacuation among offshore oil and gas industry in the Gulf of Thailand.

Materials and methods: A retrospective review of data of medical evacuation among the offshore oil and gas industry in the Gulf of Thailand from 2016 to 2019 for a period of 36 months.

Results: During the research period, a total of 416 cases were evacuated. The majority of the causes of Medevac (84.13%) were illness. We found that 60.1% of all Medevacs were unpreventable or difficult to prevent, and only 39.9% were preventable. The cost of Medevac ranged from 10,000 to 880,000 THB per case. The cost of Medevac occurring from preventable causes was 17,160,000 THB for this period of 36 months.

Conclusions: Reducing the cost of Medevac can be done by: 1) vaccination to prevent vaccine-preventable diseases, 2) screening to prevent people at risk of getting complications from pre-existing diseases to work offshore, and 3) increasing treatment capability of offshore facilities. Offshore oil and gas industry may consider cost-benefit of these approaches compared to status quo.

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Key words: medical evacuation, Medevacs, oil and gas industry, offshore

INTRODUCTION

Operations in the offshore oil and gas industry are operations in special areas. Workers often work under environments different from general establishments. They usually work offshore for 14 consecutive days with shifts, alternate with staying onshore for 28 days (may vary depending on the agency and job position). They have a risk of personal health problems and work safety with the condition of the job at risk both from variable weather and accidents that may occur from working with machines [1]. Including unpreventable illnesses such as acute appendicitis or acute myocardial infarction.

In general, offshore rigs and platforms have medical personnel who can provide initial treatment to workers when the illness occurs. However, only some treatment can be pro-

vided due to remoteness and lack of sophisticated medical equipment. Some may seek medical consultation through a remote medical system (telemedicine) [2, 3].

In each offshore facility, there are medics on board for 24 × 7 services but there may not be a doctor at all times. The doctor is usually on a large platform and also takes care of other small platforms nearby. The facility clinic can handle illnesses/injuries of the medical treatment scope. Beyond this scope, the decision of referral is made by the on-duty doctor. The facility clinic has some life-saving medicines, isolation units, full personal protective equipment and protocol for infectious cases handling, can cast/external immobilisation for closed fracture, can do wound suturing/cleaning, but does not have general anaesthesia, operating room, nor negative pressure room.

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If a serious illness or accident occurs and exceeds the offshore medical treatment capability, that victim requires to be moved to an appropriate, usually onshore, hospital. This is done via an aircraft or a boat and often beyond regular schedule, thus increases the cost and the risk, especially in bad weather. Therefore, such medical evacuation is seriously considered regarding its severity and emergency [2].

In Thailand, there have been no studies on the causes and costs of medical evacuation in the offshore oil and gas industry. This study aims to investigate the causes and costs of medical evacuation among the offshore oil and gas industry in the Gulf of Thailand.

MATERIALS AND METHODS

This study was a retrospective descriptive study. The study was conducted using a previous medical record of medical evacuation among the offshore oil and gas industry in the Gulf of Thailand, which is a secondary data obtained from companies that consent to disclose information excluding names of companies and victims due to non-disclosure agreement. Such data were usually kept for 36 months then deleted. For this study, we obtained data of April 2016 to March 2019.

The data collection included demographic data (age, gender, nationality, type of employment, underlying disease) and diagnosis before and after Medevac (initial and final diagnosis). Then, we classified as injury or illness, and preventable or unpreventable/difficult to prevent. We calculated and compared the costs caused by preventable or unpreventable/difficult to prevent, and suggested methods for prevention. The estimated cost of evacuation was presented as a lump sum price per time and the detail was distributed as cost per flight time, doctor and nurse fee and other expenses.

STATISTICAL ANALYSIS

Data analysis was performed using STATA version 14.0 (StataCorp. 2015. Stata Statistical Software: Release 14.1. College Station, TX: StataCorp LLC). Variables with normal distribution were presented as mean (standard deviation [SD]) and those with non-normal distribution were presented as median (interquartile range [IQR]). Qualitative variables were presented with counts and percentages.

After obtaining approval from the Ethics Committee of the Faculty of Medicine, Chulalongkorn University, and obtaining companies' consent to disclose information, the study was conducted in the second week of June 2019.

RESULTS

From April 2016 to March 2019, there were a total of 416 evacuated cases, 410 (98.56%) males and 6 (1.44%) females; the median age was 37 years. Forty-seven per

cent of the patients were between the ages of 30 to 39. The majority of the evacuees were 376 Thais (90.38%), followed by American 7 (1.6%) cases. The type of employment showed that evacuees were 216 (51.92%) subcontractors, 196 (47.12%) direct employees and 4 (0.96%) others (fishermen). No underlying disease data were obtained because such data were not recorded. The demographic data of the evacuees are presented in Table 1.

Other additional information received includes: types of evacuation, reasons for disembarkation, final diagnoses, outcome of treatment and work-relatedness, which is demonstrated in Table 2. Company doctor, doctor at assistance centre or offshore/rig manager decided on the need and type of medical evacuation as follows: emergency disembarking was immediate evacuation or within 24 hours

Table 1. Medevacs' demographic data

Demographic characteristics	Number and per cent of Medevacs	
Gender		
Male	410	98.56%
Female	6	1.44%
Age group [year]		
< 30	50	12.02%
30–39	196	47.12%
40–49	121	29.09%
50–59	44	10.58%
> 59	5	1.2%
Age [year]		
Minimum	22	
Median (IQR)	37	13%
Maximum	66	
Nationality		
Thai	376	90.38%
American	7	1.68%
Malaysian	6	1.44%
Indonesian	5	1.20%
Australian	5	1.20%
Canadian	4	0.96%
Filipino	3	0.72%
Myanmaese	2	0.48%
Irish	2	0.48%
Dutch	1	0.24%
Indian	1	0.24%
Laotian	1	0.24%
New Zealander	1	0.24%
Portuguese	1	0.24%
Croatian	1	0.24%
Type of employment		
Subcontractor	216	51.92%
Direct employee	196	47.12%
Other	4	0.96%

Table 2. Additional information

Additional information	Number and per cent of Medevacs	
Type of evacuation		
Emergency disembarking	39	9.38%
Non-emergency disembarking	328	78.85%
Medical referral	49	11.78%
Reasons for disembarkation		
Treatment	279	67.07%
Isolation	122	29.33%
Investigation	10	2.40%
Repatriation	5	1.20%
Final diagnosis		
No final diagnosis	274	65.87%
Known final diagnosis	142	34.13%
Outcome of treatment		
Unknown or no follow up	338	81.25%
Recovery and ready to return to work	64	15.38%
Unfit to work offshore	12	2.88%
Death	2	0.48%
Work-related diseases		
Yes	44	10.58%
No	372	89.42%

such as acute myocardial infarction. Non-emergency disembarking was evacuation within 24–72 hours such as urolithiasis or dental caries. Medical referral was evacuation for ongoing treatment, or treatment could be done offshore but the patient cannot work or can work but not fully, such as sprain and strain of ankle. Only 38 (9.13%) of the evacuees were emergency disembarking, while most evacuees (79.08%) were non-emergency disembarking. Regarding reasons for disembarkation, 279 evacuees (67.07%) were evacuated for treatment. Most evacuees (65.87%) had no final diagnoses. About 89.42% of Medevacs were not work-related diseases. Regarding outcome of treatment, 81.25% of cases were unknown outcomes or no follow-up.

REASONS FOR MEDEVACS IN THE GULF OF THAILAND

Reasons for Medevacs in the Gulf of Thailand were grouped by ICD-10 version 2016 [4] and shown in Table 3. During the research period, the majority of the causes of Medevac (diagnosis before Medevac) were diseases of the respiratory system 95 (22.84%) cases, the majority of this group was influenza 84 cases, followed by group of Injury, poisoning and certain other consequences of external causes 64 (15.38%) cases, the majority of this group was injury and wound 31 cases, certain infectious and parasitic diseases 51 (12.26%) cases, the majority of this

Table 3. Reasons for Medevacs (Initial diagnosis ICD-10 group) by incident year

Initial diagnosis ICD-10 group	Incident year			
	1 st	2 nd	3 rd	Total
Certain infectious and parasitic diseases	15	8	28	51
Endocrine, nutritional and metabolic diseases	0	0	1	1
Mental and behavioural disorders	0	1	2	3
Diseases of the nervous system	2	6	4	12
Diseases of the eye and adnexa	3	9	3	15
Diseases of the ear and mastoid process	1	3	2	6
Diseases of the circulatory system	3	4	3	10
Diseases of the respiratory system	12	55	28	95
Diseases of the digestive system	17	19	13	49
Diseases of the skin and subcutaneous tissue	2	9	11	22
Diseases of the musculoskeletal system and connective tissue	3	14	7	24
Diseases of the genitourinary system	4	10	10	24
Pregnancy, childbirth and the puerperium	1	1	0	2
Congenital malformations, deformations and chromosomal abnormalities	0	0	0	0
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	8	17	12	37
Injury, poisoning and certain other consequences of external causes	20	25	19	64
External causes of morbidity and mortality	0	0	1	1
Total	91	181	144	416

1stApril 2016 – March 2017, 2ndApril 2017 – March 2018, 3rdApril 2018 – March 2019

group was chickenpox 23 cases, diseases of the digestive system 49 (11.78%) cases. The majority of diseases of the digestive system were dental caries (23 cases). Symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified 37 (8.89%) cases, of which the majority was fever, unspecified 12 cases. By diagnoses after Medevac, we found that diseases of the digestive system increased by 2 cases, diseases of the respiratory system increased by 1 case, diseases of the circulatory system increased by 1 case, diseases of the genitourinary system increased by 1 case, injury, poisoning and certain other consequences of external causes increased by 1 case, congenital malformations, deformations, and chromosomal abnormalities increased by 1 case, diseases of the musculo-skeletal system and connective tissue decreased by 1 case and increased by 1 case, symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified decreased by 5 cases, diseases of the nervous system decreased by 1 case, and diseases of the eye and adnexa

decreased by 1 case. There were no diving injuries during this 36-months period.

Next, we classified reasons for Medevacs as injury or illness, and preventable or unpreventable or difficult to prevent, and showed in Table 4. We found that most of the reasons were illness in 350 (84.13%) cases. Then, we analysed it together with age group and found that in every age group, illness was more common than injury. The highest proportion of illnesses was found in over 59-year-old group (100%), followed by 50 to 59 years (86.36%), 30 to 39 years (85.2%), 40 to 49 years (82.64%), and less than 30 years (80%), respectively. Older workers were evacuated due to illness more than younger workers and younger workers were evacuated due to injury more than older workers, as noted in Figure 1. Regarding the preventability, the majority of the causes of Medevac were unpreventable/difficult to prevent (250 cases, 60.1%) and the minority were preventable (192 cases, 39.9%). Then, we analysed it together with the estimated cost of evacuation and found that the cost of those preventable were 17,160,000 THB, and the cost of those unpreventable/difficult to prevent were 19,755,000 THB.

Table 4. Reasons for Medevacs (illness or injury and preventable or unpreventable)

Reasons for Medevacs	Number	Per cent
Illness or injury		
Illness	350	84.1%
Injury	66	15.87%
Preventable or unpreventable		
Unpreventable	250	60.10%
Preventable	166	39.90%

COSTS FOR MEDEVACS IN THE GULF OF THAILAND

In this study, costs of Medevacs depended on the mode of evacuation, flight time, dedicated chopper and medical escort, and are shown in Table 5. The majority of the mode of movement was helicopter (361 cases, 86.78%) and boat (55 cases, 13.22%). Regarding flight time, 356 (85.58%) cases were day flight. About 79% of Medevacs were not dedicated chopper, and 89.42% were unescorted.

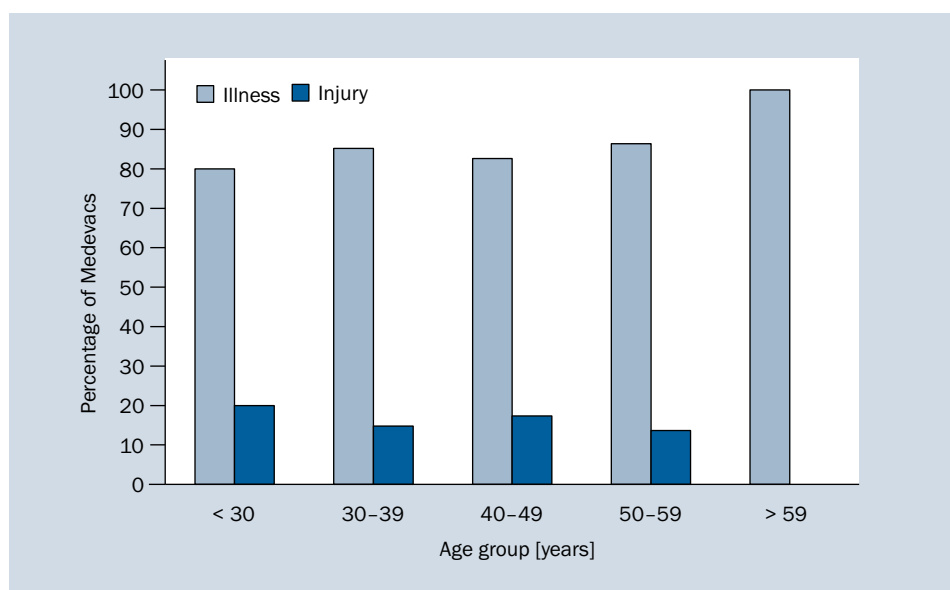


Figure 1. Medevacs by age group and type (illness or injury)

Table 5. Cost of Medevacs details

Cost of Medevacs details	Number and per cent of Medevacs	
Mode of movement		
Helicopter	361	86.78%
Boat	55	13.22%
Flight time		
Day flight	356	85.58%
Night flight	5	1.20%
Not applicable	55	13.22%
Dedicated chopper		
Yes	32	7.69%
No	329	79.09%
Not applicable	55	13.22%
Medical escort		
Unescorted	372	89.42%
1 nurse	32	7.69%
2 nurses	7	1.68%
1 doctor, 1 nurse	3	0.72%
1 doctor, 2 nurses	2	0.48%

Tables 6 and 7 show cost estimates for medical evacuation from the Gulf of Thailand, which were between 10,000 and 880,000 THB. 76.20% of all Medevacs costed 50,000 THB each. If evacuation by boat, the cost per seat is 10,000 THB. But if evacuated by helicopter, the cost will

Table 6. Cost estimates of Medevacs from the Gulf of Thailand details

Mode of movement	Flight time	
	Day flight (Thai Baht)	Night flight (Thai Baht)
Crew boat (one seat)	10,000	10,000
Helicopter (one seat) for passenger	50,000	NA
Helicopter (one seat) for escort nurse	50,000	NA
Helicopter (dedicated flight)	500,000	800,000
1 escort nurse and equipment	30,000	50,000
2 escort nurses with equipment	50,000	80,000
1 escort doctor and 1 escort nurse with equipment	65,000	85,000
1 escort doctor and 2 escort nurses with equipment	75,000	95,000

NA – not available

Table 7. Cost estimates for Medevacs from the Gulf of Thailand

Mode of movement	Total cost rate (Thai Baht)		Number of Medevacs by medical escort					Total
			Unescorted	1 nurse	2 nurses	1 doctor and 1 nurse	1 doctor and 2 nurses	
	Time of movement	Day time Night-time	0	30,000 50,000	50,000 80,000	65,000 85,000	75,000 95,000	
Boat	10,000		55	–	–	–	–	55
	50,000		317	–	–	–	–	317
Helicopter	130,000 (50,000+50,000+30,000)		–	12	–	–	–	12
	530,000 (500,000+30,000)		–	17	–	–	–	17
Dedicated chopper	550,000 (500,000+50,000)		–	–	5	–	–	5
	565,000 (500,000+65,000)		–	–	–	3	–	3
	575,000 (500,000+75,000)		–	–	–	–	2	2
Night flight	850,000 (800,000+50,000)		–	3	–	–	–	3
	880,000 (800,000+80,000)		–	–	2	–	–	2
Total			372	32	7	3	2	416

start at 50,000 THB per seat. Also, dedicated flight started at 500,000 THB for day flights and 800,000 THB for night flights. As for the medical escort team, if one nurse is needed in evacuation by a helicopter, it will normally cost an additional 50,000 THB for the nurse's seat. If it is a dedicated flight, there will be an additional cost for 1 nurse with equipment equal to 30,000 THB for day flights and 50,000 THB for night flights. The cost for 2 nurses with equipment is 50,000 THB for day flights and 80,000 THB for night flights. The cost for 1 doctor and 1 nurse with equipment is 65,000 THB for day flights and 85,000 THB for night flights. The cost for 1 doctor and 2 nurses with equipment is 75,000 THB for day flights and 95,000 THB for night flights.

EMERGENCY MEDEVACS IN THE GULF OF THAILAND

During the study period, 38 patients were emergency disembarking and 7 patients were high cost due to dedicated flight, a total of 45 cases. All evacuees were male, between the ages of 22 to 60 years, the mean age being 40.33 years. Most of them (37 patients, 82.22%) were Thai. Regarding type of employment, 22 (48.89%) evacuees were direct employee. Regarding injury or illness, 28 (62.22%) evacuees were illnesses. The top 4 causes of emergency Medevacs in the Gulf of Thailand were group of Injury, poisoning and certain other consequences of external causes (17 cases, 37.78%) with 7 cases of lower limb injuries (77.78% of injury groups). Nine (20.00%) cases were diseases of the digestive system. About 78% of diseases of the digestive system were acute appendicitis (7 cases, 15.56% of all Medevacs). Five cases were diseases of the circulatory system (11.11%). Four of the diseases of the circulatory system were acute coronary syndrome, accounting for 8.89% of all Medevacs. Four (8.89%) cases were diseases of the nervous system. Two cases were epilepsy and 2 cases were acute stroke, respectively, as shown in Table 8.

DISCUSSION

The purpose of this study was to explore the causes and costs of medical evacuation among offshore oil and gas industry worker in the Gulf of Thailand. We reviewed the previous medical record during April 2016 and March 2019 (36 months) which obtained from companies that consent to disclose information.

The majority (84.13%) of the causes of Medevac were illness, in line with previous studies in the North Sea from 1976 to 1984 with 2,162 Medevacs. They found that after the 1980s, the proportion of illness increased in contrast to the decrease of injuries [5]. Later, Health and Safety Executive conducted a study in the North Sea from 1987 to 1992, and found that there were 3,979 Medevacs, of which

55% were illnesses and 45% were injuries. Of note is that in the last year of the study, illness increased to 65% of all Medevacs. This was a result of increased safety management and the transition from exploration and construction to operation and maintenance [6]. Thibodaux et al. [7] reported that 77% of all Medevacs were due to medical reasons, and 23% due to occupational reasons [7]. Toner et al. [8] found that 80% of Medevacs were caused by illness and 20% by injury.

The top 8 causes of Medevacs in the Gulf of Thailand were influenza 20.19%, injury and wound 7.45%, chickenpox 5.53%, fracture, dislocation, sprain, and strain 4.09%, urolithiasis 3.85%, dental caries 3.13%, acute appendicitis 2.88%, and low back pain 2.88%, respectively. While previous studies on Medevacs in the offshore oil and gas industry revealed that the most common causes of Medevacs were gastrointestinal diseases, especially dental problems and abdominal pain, cardiovascular disease, especially myocardial infarction, diseases of the nervous system including seizures, diseases of the musculoskeletal system and injuries, respectively [3, 5, 7–10].

Regarding age of evacuees, we found that older workers were evacuated due to illness more than younger workers and younger workers were evacuated due to injury more than the older workers. This is consistent with most studies in foreign countries, such as the Norman et al. [5] study found that the age increase in the proportion of causes due to injury decreased but the illness increased. In December 2012, United Kingdom report on oil stations injuries in the North Sea indicated that 60.9% of these injuries are in those aged 25 to 49 years and those between the age of 30 and 34 years have the highest incidence rate at 15.8% [11]. Greuters et al. [10] studied the medical records of 115 patients who were repatriated by plane between 1998 and 2002. Those patients were divided into two groups: younger than 50 years ($n = 38$) and 50 years and older ($n = 77$). In the younger group, 32% were repatriated due to traumatic fractures. While 52% of the older group were repatriated due to cardiopulmonary disease [10]. Thibodaux et al. [7] found that younger workers were Medevacs due to occupational injuries more than older workers and medical conditions were the main cause of Medevacs among older workers [7].

In terms of work-relatedness, our study found that 89% of Medevacs were not work-related. This is in consistent with Thibodaux et al. [7] that 77% of all Medevacs were caused by non-occupational medical injury or illness.

There were 2 death cases in this 3-year study period, one cardiac arrest and one intracerebral haemorrhage.

We define "preventable" as prevention of Medevacs and/or reduction of emergency Medevacs are possible. This can be achieved by:

- Vaccination for vaccine-preventable diseases;

Table 8. Reasons and costs of emergency Medevacs from the Gulf of Thailand

Mode of movement	Total cost rate (THB)	Reasons for Medevacs	Age [years]	Nationality	Type of employment	Incident month	Incident year
ED	880,000	NSTEMI	42	Thai	Direct employee	January	2018
ED	880,000	Unspecified injury of thorax	32	Thai	Direct employee	July	2016
ED	850,000	ACS	53	Indonesian	Direct employee	September	2016
ED	850,000	Unspecified acute appendicitis.	38	Indonesian	Subcontractor	October	2017
ED	575,000	NSTEMI	42	Thai	Subcontractor	August	2018
ED	575,000	Dislocation of right shoulder joint	40	Thai	Subcontractor	December	2018
ED	565,000	Cerebellar stroke syndrome	33	Thai	Subcontractor	May	2018
ED	565,000	ACS	41	Thai	Subcontractor	December	2018
ED	565,000	Local infection of the skin and subcutaneous tissue, unspecified	46	Thai	Direct employee	December	2018
ED	560,000	Unspecified injury to unspecified level of lumbar spinal cord	27	Thai	Others	April	2017
ED	560,000	Epilepsy	41	Thai	Direct employee	May	2016
ED	550,000	Unspecified injury of head	42	Thai	Subcontractor	October	2017
ED	530,000	Unspecified fracture of right foot, initial encounter for closed fracture	46	Thai	Direct employee	January	2019
ED	530,000	Cerebellar stroke syndrome	50	Thai	Direct employee	February	2019
ED	530,000	Unspecified acute appendicitis	31	Thai	Direct employee	March	2017
ED	530,000	Other intestinal obstruction unspecified as to partial versus complete obstruction	42	Canadian	Direct employee	March	2018
ED	530,000	Traumatic pneumothorax	22	Myanmaese	Others	May	2018
ED	530,000	Low back pain	40	Thai	Direct employee	June	2017
ED	530,000	Chest pain, unspecified	47	Thai	Subcontractor	June	2018
ED	530,000	Pain localised to other parts of lower abdomen	59	Malaysian	Subcontractor	June	2018
ED	530,000	Unspecified acute appendicitis	38	Thai	Subcontractor	July	2017
ED	530,000	Pneumonia, unspecified organism	47	Thai	Direct employee	July	2017
ED	530,000	Gastritis, unspecified, with bleeding	40	Thai	Direct employee	September	2018
ED	530,000	Traumatic pneumothorax	42	Laotian	Others	September	2018
ED	530,000	Unspecified acute appendicitis	32	Thai	Subcontractor	November	2017
ED	130,000	Atrioventricular block, second degree	42	Thai	Direct employee	March	2017
ED	130,000	Unspecified acute appendicitis	54	Australian	Direct employee	March	2017
ED	130,000	Epilepsy	41	Thai	Subcontractor	April	2018
ED	130,000	Schizophrenia, unspecified	39	Thai	Direct employee	April	2018
ED	130,000	Fracture of lower end of femur	31	Thai	Direct employee	June	2017
ED	130,000	Unspecified acute appendicitis	29	Thai	Direct employee	November	2016
ED	50,000	Other peripheral vertigo, unspecified ear	60	Thai	Subcontractor	February	2017
ED	50,000	Burn of cornea and conjunctival sac, left eye, sequela	37	Thai	Direct employee	March	2017

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Table 8 cont. Reasons and costs of emergency Medevacs from the Gulf of Thailand

Mode of movement	Total cost rate (THB)	Reasons for Medevacs	Age [years]	Nationality	Type of employment	Incident month	Incident year
ED	50,000	Displaced fracture of distal phalanx of right middle finger, initial encounter for open fracture	41	Thai	Direct employee	May	2016
ED	50,000	Unspecified acute appendicitis	34	Thai	Subcontractor	June	2018
ED	50,000	Crushing injury of right ring finger	27	Malaysian	Subcontractor	August	2017
ED	50,000	Crushing injury of right foot, initial encounter	35	Thai	Direct employee	September	2016
ED	10,000	Unspecified asthma with (acute) exacerbation	56	Thai	Subcontractor	December	2016
NED	850,000	Unspecified fracture of right lower leg, initial encounter for closed fracture	45	Thai	Subcontractor	March	2017
NED	560,000	Unspecified fracture of right lower leg, initial encounter for closed fracture	29	Thai	Direct employee	September	2016
NED	560,000	Anxiety disorder, unspecified	24	Thai	Subcontractor	September	2017
NED	530,000	Unspecified injury of left foot, initial encounter	47	Thai	Subcontractor	May	2017
NED	530,000	Cellulitis of right lower limb	58	Thai	Subcontractor	June	2018
NED	530,000	Displaced fracture of lateral malleolus of left fibula, initial encounter for closed fracture	42	Thai	Direct employee	November	2017
Medical referral	530,000	Strain of muscle, fascia and tendon of lower back, subsequent encounter	31	Thai	Subcontractor	April	2017

ACS – acute coronary syndrome; ED – emergency disembarking, NED – non-emergency disembarking; NSTEMI – non-ST segment elevation myocardial infarction

- Screening to prevent people at risk of complications of underlying diseases from going to work offshore; or keeping their underlying diseases in good control while they are offshore. Examples of this approach are appropriate dental examination and treatment, appropriate fitness for work examination (such as non-communicable diseases) before allowing the workers go offshore, more than adequate individual medication (in case of longer offshore stay/work), etc.;
- Increasing the treatment capability of offshore facility, such as more sophisticated medical equipment and medications, more competent medical personnel, and more consultation via telemedicine. This approach may reduce Medevacs or postpone the time to evacuate from emergency to normal. However, this may be costly and not cost-effective.

We also define “unpreventable” as non-vaccine-preventable diseases, and those with no effective screening, such as fracture or severe injury.

And we define “difficult to prevent” as prevention of Medevacs is possible but costly, such as acute appendicitis or severe injury which are beyond usual offshore treatment

capability. Establishing an offshore surgery is possible but will cost more than referring patients to a more-equipped onshore facility.

When dividing the preventable causes into three groups mentioned above, we found that 126 patients were in group 1: influenza, chickenpox, zoster, and mumps. Group 2 included 58 patients: acute coronary syndrome, urolithiasis, acute stroke, dental problems, hypertension, type 2 diabetes mellitus, gout, hernia, psychiatric disorders, asthma with acute exacerbation and gallstone. Group 3 included 66 patients: pain in extremities (any part), myalgia, skin infection, low back pain, acute conjunctivitis, acute gastroenteritis, acute upper respiratory infection, dermatitis, allergic reaction, dengue fever, chikungunya virus disease, dizziness, urticaria, urinary tract infection, impacted cerumen, folliculitis, functional dyspepsia, gastritis, and gastro-oesophageal reflux disease.

Over the 3-year study period, the preventable cause was established in 192 (39.9%) cases and costs of Medevacs for these preventable causes were 17,160,000 THB. About 50% of the preventable causes were in group 1, which can be prevented by vaccination, including influenza. Eighty-four

cases of influenza were 41 direct employees and 43 subcontractors. The company may vaccinate direct employees, but the subcontractors may not be vaccinated, causing the spread of the disease. The costs of influenza-caused Medevacs were 3,450,000 THB. If each influenza vaccination cost 500 THB, we will be able to vaccinate up to 6,900 people with this amount of money.

In Thailand, companies have medical screening for health based on the United Kingdom Oil and Gas Industry Association Limited, trading as OGUK, standard and company standard which aligned with International Association of Oil and Gas Producers. There is not a code of practice; evacuation guideline is developed by each company. They have tried to develop a national guideline but no agreement among companies since they are also competitors.

They have employee wellness programmes. Non-occupational health risk is identified individually. Those with high risk and/or high consequence are focused and monitored continuously. Those with identified risk will be enrolled to appropriate health program accordingly, such as smoke cessation, exercise, weight reduction, diet control/restriction, lifestyle modification, etc.

Pre-placement examination and periodic examination, including health promotion and disease prevention programmes can reduce the severity of the disease and prevent the emergency Medevacs. Non-communicable diseases, such as diabetes mellitus, hypertension, cardiovascular and cerebrovascular diseases, caused high cost of Medevacs. For instance, there were only 4 patients evacuated with acute coronary syndrome, but the costs of Medevacs were up to 2,870,000 THB. Only 2 acute stroke patients costed up to 1,095,000 THB. Hypertension and diabetes mellitus costed 380,000 THB. Dental problems costed 720,000 THB. With appropriate dental examination and treatment, this cost could be reduced or avoided.

In group 3, pain in extremities (any part), myalgia, and low back pain costed up to 1,380,000 THB. Skin infection costed 725,000 THB. Acute conjunctivitis costed 450,000 THB. Functional dyspepsia, gastritis, and gastro-oesophageal reflux disease costed 360,000 THB. If these diseases can be treated offshore, the cost of Medevacs could be avoided.

LIMITATIONS OF THIS STUDY

This study is a retrospective descriptive study; therefore, only recorded data can be retrieved. We could not get some useful information such as patients' underlying diseases and job type data, so we did not have them. It is the limitation of this kind of secondary data. Moreover, some of the information received is incomplete, such as the final diag-

nosis. We did not know the majority of the final diagnoses because the company did not follow up nor record.

We obtained secondary data only from companies that have agreed to disclose information. Some companies do not consent to disclose this information, causing us not to obtain data from every company in the oil and gas industry in the Gulf of Thailand.

CONCLUSIONS

Medical evacuations among oil and gas industry workers in the Gulf of Thailand are very costly. The major causes of medical evacuations are illnesses. Reducing the cost of Medevac can be done by: 1) giving vaccines to prevent vaccine-preventable diseases, 2) screening to prevent people at risk of getting complications from pre-existing diseases to work offshore, and 3) increasing treatment capability of offshore facilities. Offshore oil and gas industry may consider cost-benefit of these approaches compared to status quo.

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