



Mitigation of COVID-19 in Workplaces: When Push Comes to Shove in Offshore Oil Operation

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

As COVID-19 pandemic is a novel disease with no prior antidote or proven preventive measures; global response in occupational settings significantly defaulted to remote working otherwise referred to as 'Working from Home – WFH' or 'Remote Working'. While remote working favoured some industries and businesses, it was impractical for industries with processes requiring physical contact to operate such as in the offshore oil and gas industry. This meant workers in the offshore industry must dare the risk of exposure to access offshore work environment thereby increasing their exposure to the dreaded and incurable virus. The aim of this study was to explore and present effective response strategies to COVID-19 pandemic in offshore work environment when exposure becomes inevitable. The method adopted was an observational descriptive study (ODS) using the ad libitum sampling technique. A Walk-Through Survey (WTS) was conducted to observe and discuss the measures adopted by a representative offshore oil company in the Gulf of Guinea. The result showed significant potentials for increased transmission in the offshore oil industry. Multiple contact points and surfaces in offshore facilities, shared amenities and tools, and constrained proximity of working position constitute significant risk factors in offshore oil and gas facilities. Mitigation measures could be categories as general measures; pre-embarkation strategies; transit strategies; aboard strategies; and remedial strategies. Combined measures have been found a

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workable and effective model to mitigate the spread and transmissibility; the eminence of distancing, serial testing, personal and community hygiene, and vaccination was established as a more effective model.

Keywords: *Work-From-Home; Severe Acute Respiratory Syndrome-Coronavirus-2; vaccination; transmission; COVID-19; a Walk-Through Survey (WTS); offshore & Mitigation.*

Key Learning Points:

<p>What is already known about this subject:</p> <ul style="list-style-type: none"> • Offshore oil workers are constrained to continue offshore commute and work despite uptick in the incidence rate of COVID-19 (C-19). • Surging number of C-19 cases impacted the industry in several fronts. • Different measures have been adopted by different oil and gas players with no universally acceptable model.
<p>What this study adds:</p> <ul style="list-style-type: none"> • We now know the critical health risk factors in the offshore oil and gas industry. • A bouquet of proven measures and exemplar model has been synthesised
<p>What impact this may have on practice or policy:</p> <ul style="list-style-type: none"> • Risk management will factor the critical risk factors into C-19 response strategy in the offshore industry. • Bespoke models should be generated from the collage of proven response measures.

1. INTRODUCTION

Coronavirus disease 2019 (COVID-19 or C-19) outbreak was initially reported to have occurred in Wuhan, China on the 31st of December 2019 [1,2] as a novel type of respiratory tract infection. This was corroborated by the World Health Organisation (WHO) as a coronavirus-related pneumonia on the 9th of January 2020 and later confirmed as a pandemic on the 11th of March 2020 [3,4]. It is known to be caused by the deadly Severe Acute Respiratory Syndrome-Coronavirus-2 (SARS-CoV-2) which is transmitted as respiratory droplets through sneezing, coughing, inhalation of infected airborne droplet, and contact with infected surfaces or objects. Worldwide, C-19 pandemic negatively impacted operations of industries, commerce, and trade with the offshore oil industry amongst the worst hit. While the initial response strategy by governments was enforced lockdowns and varying degrees of restrictions of movements; industries and organisations defaulted to working remotely in a strategy dubbed 'Work from Home (WFH)' or 'Remote Working'.

The WFH response strategy meant staff would work remotely from home via online platforms and telecommunication systems. While the remote approach worked seamlessly for certain industries as a strategy for meetings, engagement, trainings, communications,

reviews, and other contactless work; industries with activities and field work requiring manual operations were handicapped as they required specialised skill pool for operations and maintenance at site [5,6]. Some of the remotely operated offshore facilities encountered telecommunication challenges at the onset of COVID-19 due to inadequate remote working technologies, insufficient internet bandwidths [5,6]. One of the global industries that could not completely operate remotely was the offshore petroleum industry because of being largely and remotely field base, and heavy dependence on industrial processes requiring human operation of technology hardware's.

The offshore petroleum industry was hence classified among essential industries granted waivers by governments. This meant workers would have to commute and work during the pandemic as the industry was found a major economic artery for several economies globally, thus portend significant risk exposure necessitating a robust risk management strategy.

While the health and safety of workers took severe hit; production and warfare of economies plummeted with several cases of mortality and morbidity reported [7]. In Mexico, Pemex (Petrleos Mexicanos), the state-owned oil and gas exploration and production company reported the death of 314 direct staff and 7 contractors from start of pandemic to September

2020 [8]. Pemex is reported to have over 240 offshore platforms in the Gulf of Mexico with an average of 200 -300 personnel working and living in clustered and shared spaces [9]. Measures deployed by Pemex include enforced social distancing, encouraged self-reporting, demanning of platforms, sanitization of work and living spaces, pre-embarkation temperature checks, rapid testing, early evacuation of suspected ill workers. In Brazil, several COVID-19 outbreaks have been severally reported in offshore platforms [9]. The nexus of oil and gas operations in the United Kingdom, the North Sea, witnessed upsurge in aeromedical evacuations from several offshore platforms due to workers testing positive to COVID-19 [10]. The oil workers federation of Brazil (FUP) reported 8,500 oil and gas workers in Brazil have tested positive to COVID-19 by December 31, 2020. Petrobras (Brazil's national oil company) had performed 450,000 COVID-19 tests; 4,030 workers have tested positive with 3 deaths by January 11, 2021. Other measures employed by Petrobras beside testing including a buffer waiting period of 14 days (quasi quarantine) before embarkation on any offshore platform, and compulsory training. In Norway, cases of COVID-19 infections have been reported on offshore

platforms [10,11]. Overall, the cumulative psychological effects of layoffs, social restrictions and lockdowns, inevitable work-related exposures, incidences of increasing COVID-19 cases and deaths, sliding economic forecast for the upstream petroleum industry, presented a perfect storm for mental health challenges for the offshore cohorts of workers. Beside the health and safety implications of the pandemic, global business outlook was heavily impacted. The industry witnessed a slump in crude demand, forced decline in crude oil production, crude oil stockpiles, debt rise, loss in share value, decrease demand for end products, decrease in asset value, decreased or near zero investment, lay-offs, increased divestment, difficulties in logistics, halted business travels, deferred for among others (see Fig. 1 and Fig. 2).

Given that the offshore petroleum industry is a significant national cash cow and continual working during the pandemic is inevitable; a robust risk mitigation strategy will be required to mitigate the impacts on workers' health and productivity. The need for mitigation is further heightened by the reported uptick in morbidity and mortality occurring in upstream oil industries across the world.

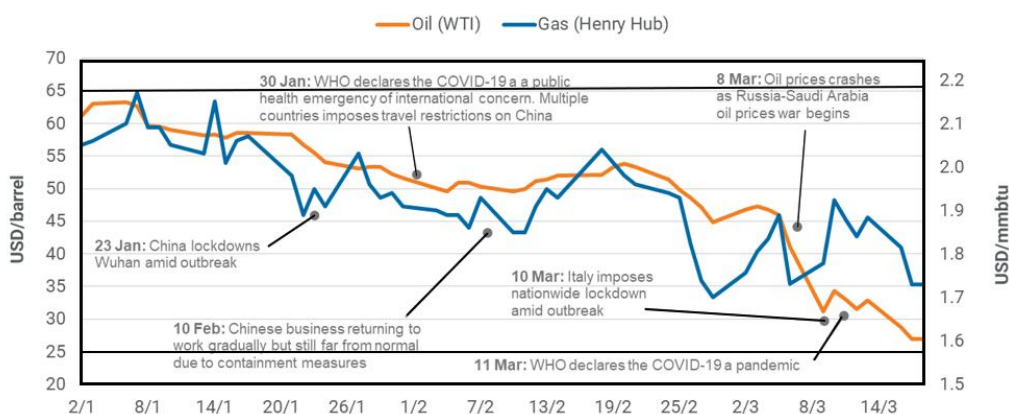


Fig. 1. Collapse of Oil Price in 2020 [10]

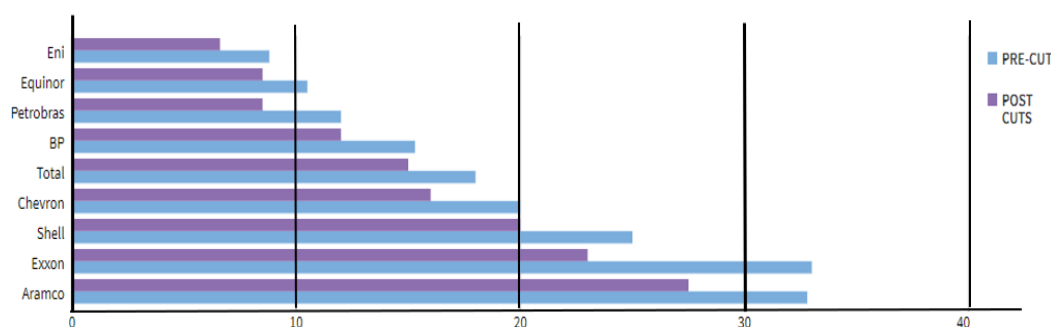


Fig. 2. Oil Majors 2020 capex cuts [11]

The novelty of the COVID-19 pandemics further necessitates sharing generalisable mitigation practices that could be adapted by other players in industry. The aim and objective of this study is to identify potential risk factors in the offshore oil and gas industry and present workable measures that could mitigate exposures and protect the health of at-risk workers.

2. METHODS

This is an observational descriptive study (ODS) conducted using the ad libitum sampling technique. A Walk-Through Survey (WTS) was undertaken to conduct the observational study between January 2020 and April 2021. The WTS involved direct observation of COVID-19 mitigation processes and review of procedures adopted by an offshore petroleum industry in the Gulf of Guinea. WTS is a research process used to obtain primary information about a workplace through direct observation and discussion [12,13,14]. This involved the observation of the processes put in place to mitigate workers exposure, embarkation and disembarkation, social distancing measures, masking compliance, hygiene, hand washing and hand sanitization. Informal and unstructured interviews were held with supervisors, workers, and asset manager to understand how they intend to cascade information about COVID-19 and how to achieve compliance in their processes.

The study setting was an offshore oil and gas servicing facility in the Gulf of Guinea with over 1500 workforce. The Observational Descriptive Study (ODS) technique was adopted in this study because of its usefulness and adequacy in accurate description of observed processes and procedure [15]. It is known to be accurate, factual, verified source of primary data. Technique constitutes 70% -80% of research in scientific journals [15,16]. It is the commonly used research technique used in scientific research to observe and was achieved in this study through filed visits, note taking, discussion, meaning making and reflection. Permission was granted by the process owners for educational purposes; however, the organisation requested to be de-identified.

3. RESULTS

The walk-through survey (WTS) revealed a study setting replete with COVID risk factors and mitigation measures that has been grouped into general, pre-embarkation, transit, onboard and

remedial strategies. Commute to offshore location involves staff reporting at the local airstrip from their respective homes to board flight to offshore locations. At the airstrip workers will undergo check-in protocol, safety briefing and board helicopters. There are usually 7-9 passengers onboard the 1-hour flights to the offshore platform. On arrival and disembarkation, workers undergo briefing and induction about the facility and disperse to their respective rooms. Other shared and communal amenities include the toilets, large restaurant, library, meeting rooms, banking hall and workshops. Work cycle is 28 days off and on rotational cycle. Besides the several machinery units are the living areas which accommodate 4 persons in each room of two double bunk bed. Other communal and shared areas offshore include the mess, meeting rooms, open-plan offices, gymnasium, and workshops. Categories of workers include the operations, maintenance, and support staff. While operation staff undertake activities needed to produce oil and gas, maintenance staff undertakes corrective and preventive maintenances while the support staff cater for welfare and material management.

The WTS revealed significant health risk factors associated with working in an offshore oil and gas facility. These include use of shared amenities including mess, open plan offices, accommodation (rooms), meeting spaces or concourse, recreational spaces, transport medium, computer stations, communication facilities (phone & handheld radios), laundry services, hand tools and equipment; clustered layout of machinery, office settings and accommodation; multiple contact points and surfaces including operational controls (buttons, levers, wheel, jockeys); compulsory handling of rails of stairways, walkways, gangways and door handles; interconnected ventilation ducts and multinational workforce. These risk factors could potentially trap and foster temporary storage of COVID-19 from an infected worker and potentially facilitate its transmission to unaffected workers. The WTS further showed the response strategy and measures to include general, pre-embarkation, transit, aboard and remedial strategies.

General strategies include measure's workers observed when not at work in their personal spaces. These include regular handwashing with soap and free flowing water, use of sanitisers and mask, social distancing of at least 1.5 meters, compliance with lockdowns and

restriction by jurisdictions, avoidance of potentially super spreader events, hospital call when respiratory and symptoms are developed.

Pre-embarkation strategies involved measures undertaken by the company and staff before embarking on flight to offshore locations. These measures include completion of online medical questionnaire form eight days prior to travelling, detailing their present state of health with regards to presence or absence of respiratory tract infection, sore throat, cough, fever, a recent travel history and close relation of any febrile or ill person suspected of having symptoms. A normal case would however visit a pre-travel quarantine centre in a selected, prepared, and secured hotels not available to the public. While completion of a normal questionnaire will automatically activate chip in staff identity card to access quarantine centre; the presence of symptoms will however deny access to the premises but will trigger the C-19 remedial response strategy by referring the person to specialised hospital equipped to manage respiratory cases including C-19. At the quarantine centre, a PCR C-19 test will be conducted before being accommodated in the centre for 7 -days. A negative test result is followed by a confirmatory test on the fourth day of quarantine. Staff with two negative tests are transported in a bus to the airstrip for onward trip to offshore location; the bus and helicopters are periodically decontaminated.

Transit strategies involved measures committed to mitigating exposures during commute in company buses from quarantine centres to the airstrip and onboard flight from the airstrip to offshore location. Strategies include a pre-boarding briefing on covid safe measures, temperature scan, hand sanitization, mask, social distance and helicopter. On alighting, the bus and helicopter undergo light cleaning with deep cleaning done weekly.

Aboard strategies involved measures undertaken to mitigate exposures while on-board the offshore facility. These include, arrival temperature check with the telethermographic system to assess temperature on disembarkation, safety induction which includes safe COVID-19 measures, departure temperature check, mandatory use of N95 mask, placement of disinfectant wipes and sanitizer stations, use of sanitizers after touching 'high-touch-surfaces', arrangement of workstation desks to be 1.5 feet apart from each other in the

offices, weekly cleaning, replacement of air filters in ventilation systems, floor markers of 6-feet apart to maintain physical distancing in common areas, two hourly cleaning of high touch surfaces (doorknobs, lift call buttons etc) and conveniences and twice daily disinfection of employee workstation.

Remedial strategies refer to measures deployed when anyone test positive to PCR test or presents suspicious symptoms. The person is isolated in a secured room, medic and attendants wear disposable hazmat suit with air supplied respirator. Medical screening is commenced, an antigen and PCR C-19 test is performed, and treatment is started after a positive confirmation in consultation with supervising physician. As soon as reasonably practicable, the individual is evacuated. Once onshore, the patient is transported to an appropriate medical facility. All environmental cleaning and disinfection procedures are followed consistently and correctly. Increased diligence in sanitary measures and infection control is implemented once a possible case of a communicable disease is identified. Identification of close contacts who may be infected or other individuals at risk for infection commence. The appropriate public health authority is notified and with advice on further actions.

4. DISCUSSION

Our study showed that COVID-19 poses significant threat to the health of offshore oil workers as evidenced by surging cases of positive cases in different scenarios, multiple health risk factors and the need for a collage of mitigation measures. The strength of this study lies in the validity of using a tested process and study setting. The non-availability of incidence rate before and after the study potentially weakens measurement of impact of the mitigation measures. The quest for crude oil in offshore locations pitch the workforce against the dreaded virus as offshore facilities are remotely located requiring exposure to several C-19 risk factors. While robust measures were mobilised to mitigate the exposures in this facility; the study by Wilbanks, Abulhassan and Kilpatrick revealed that additional measures should be included as shown in Table 1. Although there are similar measures in both models, the authors differ in opinion on 'no air travel or hotel and opening of all doors to avoid contact'. Authors of this study posit that with suitable and adequate measures put in place air travel and closed doors could still

be achieved. Measures such as frequent cleaning of door handles and other touch surfaces could mitigate transmission by contact. Contrary to the two models, the BOHS strategy (see Table 2) opined the importance of Covid Risk Assessment (CRA) which assesses similar exposure groups in occupational settings, exposure scenarios or events, control banding and control options. The response approach should target the pathogen at the source, pathway, and receptor point. While the model in this study were seemingly robust, it would have been more potent if there was strategic engagement at the source, pathway and receptor or receiver end.

Given the itinerant and multicultural demography of the offshore workforce, activities in the industry is buoyed by significant intranational and international business travels making the sector vulnerable to transmission of the virus. The industry being a major employer of labour, engages staff, contractors and sub-contractors running in thousands especially multinationals upstream organisations. There exists significant potential for transmission within offshore facilities given the bunched-up layout with linear ventilation system. It possesses several shared features that portend the risk of C-19 transmission such as control rooms, training rooms, public conveniences, meeting rooms, handles of entrances and exits, group safety and team meetings, walkways, and stairways less

than 1.5 m width, shared ventilation systems (Heating Ventilation Air Conditioning – HVAC system). Potential activities include crew change activities, meetings, trainings, eating, handling, and touching of surfaces, ventilation within open plan offices, field accommodations and use of handled tools, controls, and surfaces. Risk factors above supports and corroborates the identification of the Oil and Gas industry as a major frontline sector requiring response in the United State OF America [3]. More importantly, the following category of workers constitutes a high-risk group amongst offshore workers, namely the cleaners, laundry workers, logistic personnel, utility workers, stewards, security, medical, team leaders and emergency response team workers.

While above strategies may have contributed to slowing down the transmission of the virus as evidenced by low incidence rate in this organisation, the advent of the Delta strain might after the period under consideration may have increased the number of infected workers given the significant potentials, clustered layout in offshore environment and logistic medium. Inclusion of vaccination into the bouquet of strategies will drastically reduce transmission, mitigate exposure, improve resilience, and enhance productivity. It is however important to align the strategies with an adapted hierarchy of controls [17] (see Fig. 3).

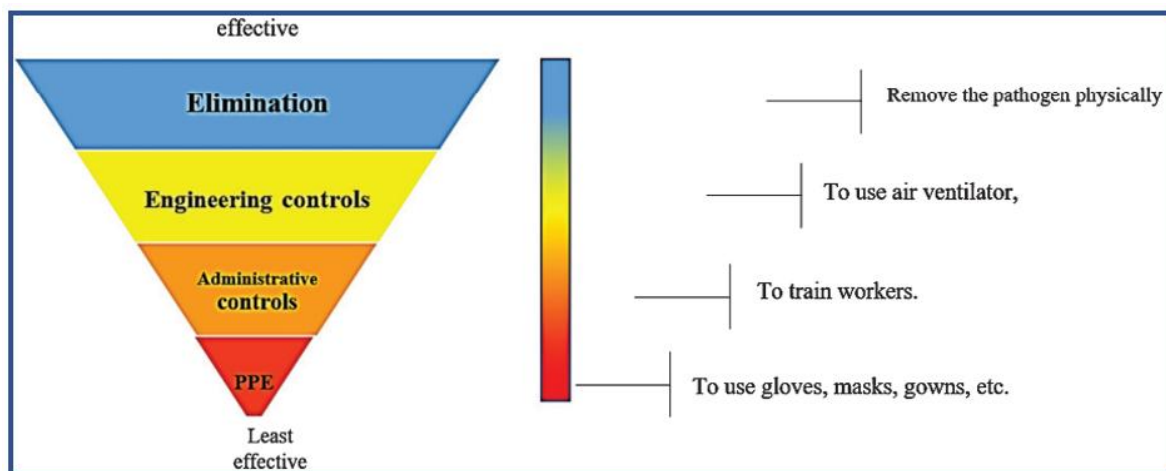


Fig. 3. Hierarchy of Controls [17]

Table 1. Response strategies

Screening	Worker interaction	Barriers	Touchable surfaces	Cleaning/ disinfecting	Communication	Reporting and quarantine
<ul style="list-style-type: none"> • All access control point • Screening • Temperature checks • Identity cards access linked to screenings • Infrared scanning, cameras, kiosks • Self-screening • Daily questionnaires • Developed organisations app • PCR testing Electronic door screening 	<ul style="list-style-type: none"> •Spreading shifts •Visitor access controls •Online meetings •Work process modification. •Telehealth • Embargo on air, sea travel and hotel Accommodation 	<ul style="list-style-type: none"> •Physical transparent barriers in open plan offices •Face mask required unless stationary and social distancing can be achieved •Social distancing Markers on the floor • Face shields •Partitions 	<ul style="list-style-type: none"> • Open doors to reduce contact • Disposable or Single use packaging • Installation of hands-free or foot door • Electronic form screening •Hands-free testing 	<ul style="list-style-type: none"> •Trained and adequate cleaning personnel • Automatic hand sanitizer stations •Easy access disinfectant wipes stations •Electrostatic cleaning •Ultraviolet sterilizer at high-traffic areas •Post-cleaning swab (ATP) testing •Portable or mobile disinfection misting devices 	<ul style="list-style-type: none"> •Awareness training for all personnel and visitors prior to entry •Daily and periodic employee communication • Additional newsletters, electronic board messaging brochures, postings, handouts •Precautionary signage • Inter and Intra departmental pandemic response marshals 	<ul style="list-style-type: none"> • Procedures • Self-quarantine and return-to-work guidelines published • Engagement with union On COVID-19 procedures • Mandatory compensatory leave if confirmed case or exposed to confirmed case • Periodic COVID-19 drills • Contact tracing procedures • Configuring badge system for use in contact tracing and QR-coding

Source: Adapted [4]

Table 2. Practices

Control Options		
Source	Pathway	Receptor
Infection control measures and patient isolation, restricted access, regular surface disinfection with acceptable chemicals. Visor or face covering on medical staff and patient	Cleaned and maintained Local Exhaust Ventilation (LEV), General ventilation, regular surface disinfection	Powered Air Purifying Respirator (PAPR), otherwise minimum Filtering Face Piece (FFP3) and visor, gown, gloves and/or personal hygiene - hand washing/hand sanitizing.
Isolation of patient, restricted access, regular surface disinfection. Visor or face covering on both staff and patient	Barrier or enclosure. General ventilation, regular surface disinfection	Minimum FFP3 and visor, gown, gloves and/or hygiene - hand washing/hand sanitizing.
Distancing, hand washing, sanitisation.	Barriers, regular surface disinfection of touch points and surfaces, one-way systems as far as reasonably practicable, general ventilation, avoid handling cash.	FFP2 should be considered for prolonged contact, otherwise fluid resistant masks, visor, gloves and or hygiene - hand access.
Distancing, frequent hand washing and sanitisation.	Barriers, regular surface disinfection of touch points and surfaces.	Visor or safety spectacles & fluid resistant mask and hygiene - hand washing and sanitizing
Distancing, frequent hand washing and sanitisation	Regular surface disinfection of touch points and surfaces.	Visor or safety spectacles and fluid resistant mask and hand washing and sanitization.
Social distancing	Surface disinfection of touch points and surfaces.	Hand washing and sanitization.

Source: Adapted from British Occupational Hygiene Society [16]

5. CONCLUSION

In conclusion, we found that there are significant potentials for transmission and spread of C-19 in the offshore oil industry occasioned by the travel pattern of the workforce, commute method, design of offshore oil facility, presence of several shared facility and abundant touch points. Combination of response strategies will be a potent approach to mitigating exposure and transmission of COVID-19 in an offshore facility and operations. The strength of this study lies in the validity of measures implemented in the study workplace which beside being tested and proven, are corroborated by the BOHS, Wilbanks, Abulhassan and Kilpatrick models. Limitation lies in the short duration of the study and inability to validate the measures for 1 year to authenticate in the long term.

Limitations of this study include the possibility of a prospective serial testing among the workforce to understand the transmission pattern. It is therefore suggested that future research in occupational setting should focus on serial testing among the workforce.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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