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Short Article

Response to COVID-19 outbreak in an inner-city food processing factory in Ghana: A case study

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KEYWORDS: COVID-19, factory, outbreak, monitoring of adherence, case study, Ghana

ABSTRACT

Introduction: On April 9, 2020, a factory worker from a food processing factory reported to the factory clinic with fever and respiratory symptoms which were later confirmed to be coronavirus disease 2019 (COVID-19). We describe the index case, its uniqueness, control and preventive measures. **Methods:** Using a suspected case of COVID-19 as any person in the factory with symptoms of fever or measured temperature ≥38°C and respiratory tract illness such as cough, difficulty in breathing from March 25 to April 30, 2020, we conducted active case finding. We identified and tested contacts of the index case and other cases identified. We conducted environmental assessment of the factory. **Results:** The index case was a 48-year-old factory worker who reported to the factory clinic on April 9, 2020 with complaints of cough for a duration of four days associated with fever, chills and body pains. Of 1,138 employees in the factory who were tested as part of contact tracing and active case search, 695 (61.1%) tested positive for COVID-19. Mean age of the case-patients was 39 (±9.8) years. There was no death. **Conclusion:** An outbreak of COVID-19 most likely introduced by workers from the community occurred in a food-processing factory in Ghana. The density of the workers in the factory at any given time coupled with a lack of monitoring of adherence to preventive measures probably facilitated the spread. Enforcing and monitoring the implementation of workplace safety and preventive measures for COVID-19 is necessary to prevent outbreaks at the workplace.

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Introduction

On March 12, 2020, Ghana reported its first two imported cases of COVID-19 in the Greater Accra region [1]. Following this, the national incident management system was activated to provide surge capacity in support of local response mechanisms. By April 10, 2020 community transmission of the disease had been established with the number of cases rising to 378 in six of the 16 regions of the country with six deaths (case fatality rate = 1.6%) [1].

National response and mitigation measures were swiftly implemented, including the closure of the country´s borders to human traffic, the closure of schools and churches, suspension of mass gatherings such as funerals, political rallies, festivals and sporting activities. These measures were graduated according to the rising number of cases and identification of hot spots including a partial lockdown of selected towns and cities in the country's Greater Accra and Ashanti Regions [2]. These restrictions were later eased in phases. The case count and deaths increased over the period to include all sixteen regions.

The disease gradually began to be detected in selected workplaces and other settings where the three Cs: closed spaces with poor ventilation, crowded places with many people nearby and closed-contact settings with close-range conversations were prevalent. Several organizations including health facilities, media houses, food processing companies and eateries were hit by the outbreak resulting in substantial losses such as temporary reduction of staff numbers and corresponding cutback in production of goods and services, loss of customers and sometimes total shutdown of institutions.

This case study describes an outbreak of COVID-19 in an inner-city food processing factory in the Greater Accra of Ghana guided by the CARE criteria [3].

Case description

The index case was a 48-year-old female factory worker with three children who reported to the factory clinic on April 9, 2020, with complaints of cough for a duration of four days associated with fever, chills and body pains. She had no contact with a known COVID-19 case patient nor any person with respiratory illness. She had no travel history within fourteen days prior to the presentation. Before the presentation, she had started taking antimalarial drugs. On examination, she looked unwell and her temperature at presentation was 37.6°C. She was held at the clinic holding centre, where her respiratory samples were taken on the same day for laboratory testing. Later that day, she was discharged to continue self-isolation at home. On April 17, 2020, her laboratory results tested positive for COVID-19. She was informed and linked to the case management team which took her to the national treatment centre on April 21, 2020. This investigation following the identification of the index case was prudent as it was pivotal in understanding the transmission of the virus and assessing the epidemiological surveillance measures that were effective in curbing the spread of the virus.

Methods

Outbreak setting

The outbreak occurred in a food processing factory located in an inner city which is about 50 km from Accra, Ghana´s capital. The factory has approximately 1,150 workers including casual workers. The majority of the workers live in the densely populated suburb where the factory is located. In the immediate vicinity of the factory are slums which are inundated with very brisk commercial activities. The factory has buses that transport workers to and from the factory. There is a canteen which serves the factory workers. The factory´s clinic is managed by nurses and laboratory personnel under the supervision of the company´s physician. Minor ailments and injuries are managed at the clinic with major illnesses referred to hospitals in the Greater Accra Region.

Community engagement and visit to the factory

We engaged the political and administrative leaders of the area through virtual and in-person meetings to get first-hand information on the nature of the situation, seek their consent and obtain permission to collect data as part of the outbreak response measures. The management team of the factory was engaged to gain cooperation in the outbreak investigation and response. The general public was also engaged through media education and health education on COVID-19 causes, established risk

factors and means of prevention using public address systems on vans.

After undertaking the initial administrative procedures, we visited the factory to meet with the management team and assess the environment for workplace safety and preventive measures, procedures for workflow and for receiving visitors at the factory. We also reviewed plans for preventing COVID-19 transmission at the workplace.

Case finding and contact tracing

Interview of case patient and contacts

We interviewed the case patient and obtained data on demographic characteristics, signs and symptoms as well as potential risk factors for contracting the disease. The management team and health workers of the factory were also interviewed to obtain data for contact identification, listing and follow-up.

Active case finding and contact tracing

We defined a suspected COVID-19 case as "any person in the factory with symptoms of fever or measured temperature ≥38°C and respiratory tract illness such as cough, difficulty in breathing from March 25 to April 30, 2020". A confirmed case was any person from whom SARS-CoV-2 was isolated. Using the case definition, we searched for more cases by interviewing the factory workers and the health workers at the factory clinic. We reviewed the clinic record to look for more cases. We screened the factory workers by collecting nasopharyngeal and later sputum and saliva samples when the country ran out of stocks of swabs. Sputum and saliva samples are reliable tools for SARS-CoV-2 detection [4-6]. Samples were sent to NMIMR for testing for SARS-CoV-2 using reverse transcriptase PCR. We identified all contacts including household contacts of the suspected case and all those who tested positive and listed them for follow-up. Given that most of the contacts could not be linked to the case, the factory management team with the consent of all the workers decided to screen all workers for COVID-19. We collected nasopharyngeal, sputum and saliva samples from all available workers and transported samples to NMIMR for testing. Follow-up involved testing at the time of identification and not earlier than 14 days from the last day of contact with a confirmed case and discharge according to the country's protocol. The local health team collected data on all the test results of the contacts of the index case as well as other factory workers who were tested.

Descriptive epidemiology analysis

We performed a descriptive analysis of the outbreak data. We calculated the mean and standard deviation for uniformly distributed continuous data. Categorical data are presented as frequencies and relative frequencies. Data was analysed using Microsoft Excel. We also describe the response measures implemented.

Ethical considerations

The outbreak investigation was considered a response to a public health emergency for which approval was granted by the Ghana Health Services. Consent was obtained from all the persons whose samples were taken for laboratory testing. Samples were collected for laboratory testing in the best interest of the individuals and the society at large. Permission was also sought from the local stakeholders and the factory management prior to testing and visiting of the factory premises. Permission was also sought from relevant authorities to access the data from the line list used.

Results

Of 1,138 employees in the factory who were tested as part of contact tracing and active case search, 695 (61.1%) tested positive for SARS-CoV-2. The mean age of the case patients was 39 (± 9.8) years. There was no death. The majority, 350 (50.4%) of the case-patients were females and 233 (33.5%) were in the 30-39-years age group. Except for the 20-29 years age group, there were more females than males in each of the other age groups (Figure 1).

The case-patients were residing in various communities in 16 out of the 29 districts in the Greater Accra Region including communities with well-established community transmission of the disease and those identified as hot spots of COVID-19.

The index case was a 48-year-old factory worker and a single mother with three children who reported to

the factory clinic on April 9, 2020, with complaints of cough for a duration of four days associated with fever, chills and body pains. She had no contact with a known COVID-19 case patient nor any person with respiratory illness. She had no travel history within fourteen days prior to the presentation. Prior to the presentation, she had started taking antimalarial drugs. On examination, she looked unwell and her temperature at presentation was 37.6°C. She was held at the clinic holding centre, where her nasal and throat swabs were taken the same day for laboratory testing. She was discharged home the same day to continue self-isolation. On April 17, 2020 the clinic received her laboratory results showing that she had tested positive for COVID-19. She was informed and linked to the case management team which took her to the national treatment centre on April 21, 2019.

Coordination

A multi-sectoral approach to outbreak investigation and response was used. In addition to the Ministry of Health, Local Government and Information Ministries plus the Environmental Protection Agency were involved with support from the national response team. The outbreak was coordinated by the National Incident Management System (IMS) with the regional and district public health emergency rapid response teams investigating and implementing the public health actions. Data from the local health authorities was shared through the regional health authorities to the national IMS.

Contact tracing

The total number of contacts of the initial case at the workplace was not established due to a high level of interaction and recall bias. However, all 1,138 employees were tested and followed - up until those who were positive were declared recovered as per national guidelines. Three close contacts including two work colleagues of the index case, who were living with her at home and the physician who attended to her at the factory clinic tested positive for COVID. All her three children aged 24, 22 and 20 years tested negative for COVID-19.

Environmental, safety and preventive assessment

Safety and preventive measures were put in place by the factory before the outbreak (Table 1). The factory at the time of assessment had handwashing facilities comprising running water, soap and hand dryers at the entrances. The temperature of all persons entering the factory was taken using a handheld laser thermometer. In addition, a "no face mask no entry" policy was in place with notice to that effect boldly posted on the entrance doors. All the workers at the factory were observed to be wearing face masks. There were floor markings at the factory plant to ensure physical distancing. The number of persons per table at the canteen was reduced and that notice was posted on the canteen door. The staff of the factory clinic wore appropriate personal protective equipment such as face masks, hand gloves and boots depending on their workstation. There was a well-resourced room at the factory clinic which was dedicated as a holding centre. In addition, the factory had a business continuity plan.

Surveillance

The management indicated that, prior to this event, it had instituted measures to prevent infection of their staff. These included educating the entire staff on COVID-19 causes, established risk factors and prevention using a public address system at the workplace. They had also increased their fleet of staff buses to enable staff observe physical distancing whilst on board and provided hand hygiene facilities such as alcohol-based sanitizers and hand washing facilities at vantage points. All persons who entered the factory had their identities verified and entered into a register. The management team indicated that all the measures observed were put in place prior to the confirmation of the first COVID-19 cases in the country.

The local health team collected data on all the test results of the contacts of the index case as well as other factory workers who were tested.

Closure and phased re-opening of the factory

With the large number of cases recorded and the risk of infecting other workers, the factory was temporarily shut down. With support from the environmental protection agency, the factory was fumigated and persons who tested negative and had completed their quarantine were allowed to commence work. The duty roster was revised to ensure only a limited number of persons were at post at a particular time. The positive cases were isolated

and followed up with testing to ensure they had tested negative before resuming work. During this process, the case management guidelines were revised to exit asymptomatic persons from case management pathway after 14 days of remaining asymptomatic irrespective of laboratory test results. All the workers who tested positive were exited from case management pathway according to the national guidelines.

Discussion

Congregate work and residential settings where physical distancing and hygiene measures are difficult to implement have served as fertile grounds for COVID-19 transmission [7]. COVID-19 outbreaks have been reported in prisons [8], nursing homes [9] and workplaces [10]. A notable example is the outbreak of COVID-19 in Diamond Princess cruise ship which caught global media attention [11]. COVID-19 outbreaks in food processing factories are not uncommon given the setup of processing factories [7].

In this outbreak which occurred in a food processing factory, even though several factory workers were identified as testing positive for SARS-CoV-2, only the index case was symptomatic at the point of diagnosis. It is unknown where they got infected. While it can be argued that, the lack of physical distancing measures at the workplace, typical of food processing workplaces, could have provided fertile grounds for the person-to-person spread, it is also likely that some of these workers contracted the disease from the communities where they live rather than the workplace [7]. Many of the workers resided in densely populated communities, which are hotspots for COVID-19 transmission. Inadequate transportation and social amenities outside work environments could have increased the risk of contracting the virus.

From our assessments, the factory had implemented crucial COVID-19 preventive measures before the outbreak, yet having these measures alone seemed insufficient to prevent disease transmission [12]. Enforcement and monitoring of compliance are essential. The new preventive measures, including mask-wearing and physical distancing, might not have been strictly adhered to due to their novelty, necessitating increased enforcement [12]. Moreover, the absence of information and education materials on COVID-19 in the factory during the assessment raises concerns about awareness and communication.

Mitigation measures for preventing community transmission are crucial, considering a majority of cases resided in external communities with ongoing COVID-19 transmission [13]. The workers commuting daily from these communities to the factory might have contributed to the outbreak, emphasizing the need for the cohesive workplace and community-level measures during large-scale infectious disease outbreaks.

The factory was opened following a set of guidelines based on the national protocol. Initially, workers who had tested negative for COVID-19 were self-quarantined and were allowed to resume work after the factory was fumigated and they had completed their quarantine. Those who tested positive had to get two negative test results 24 hours apart before they could resume work. However, many workers were able to leave care after case management protocols were revised [12,13]. It is important to acknowledge that managing COVID-19 is complex and requires protocol changes as our understanding of the virus evolves.

Interpreting findings within the context of national COVID-19 response protocols is vital due to the evolving nature of guidelines [12,13]. Challenges like stigmatization hindered cooperation, especially in contact tracing, which was challenging due to extensive interactions in community settings. In this case study, it was observed that it took six days (April 9 - April 17, 2020) to obtain her COVID-19 test results, indicating a long turnaround time. Prolonged laboratory turnaround times as evidenced by the 8 days wait for the index case further delayed obtaining results, highlighting the intricate dynamics and challenges in managing infectious disease outbreaks.

Study limitations

A key limitation of this study was the delay in case reporting and the extended laboratory turnaround time, along with the stigmatization associated with the COVID-19 outbreak. The reporting lag likely hindered the timely implementation of rapid response measures, while prolonged laboratory

processing times may have facilitated the spread of the virus, particularly from asymptomatic carriers to uninfected individuals. Additionally, the apparent stigmatization of suspected cases compromised contact tracing efforts, as affected individuals were often reluctant to engage with investigation teams and to provide accurate information.

Conclusion

A large outbreak of COVID-19 occurred in a food processing factory in the Greater Accra region of Ghana. The outbreak was most likely introduced into the factory by factory workers who acquired the infection from the community as some of the workers lived in communities with evidence of community transmission. The density of the workers in the factory at any given time coupled with lack of monitoring of adherence to preventive measures probably facilitated the spread of the infection among the factory workers. There is therefore the need for enforcing implementation and monitoring adherence to workplace safety and preventive measures for COVID-19 to prevent similar outbreaks in future.

What is known about this topic

- Several African countries have reported cases of COVID 19
- COVID-19 can easily occur in close setting and overcrowded places

What this study adds

- The study highlights lapses in the implementation of safety and preventive measures for COVID-19 at the food processing factory

Competing interests

The authors declare no competing interest.

Authors´ contributions

Sally Quartey: Data collection, Data Analysis, Revised manuscript for intellectual content. Donne Kofi Ameme: Data collection and analysis, Drafted manuscript. Franklin Asiedu-Bekoe: Data analysis, Revised manuscript for intellectual content. Mary Amoakoh-Coleman: Data analysis, Revised manuscript for intellectual content. Madgalene Akos Odikro: Data analysis, Revised manuscript for intellectual content. Abraham Baidoo: Data collection and analysis, Revised manuscript for intellectual content. Joseph Asamoah Frimpong: Data analysis, Revised manuscript for intellectual content. Luiz Octaviano Amoussou-Gohoungo: Data analysis, Revised manuscript for intellectual content. Keziah Malm: Data analysis, Revised manuscript for intellectual content. Ernest Kenu: Data analysis, Revised manuscript for intellectual content.

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Tables and figures

Table 1: Safety and preventive measures for COVID-19 implemented at the food processing factory, Ghana, 2020
Figure 1: Age and sex distribution of cases

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Table 1: Safety and preventive measures for COVID-19 implemented at the food processing factory, Ghana, 2020		
Classification	**Considerations for COVID-19 prevention**	**Recommended changes at workplace**
Structural	Reducing the density of persons at the factory and the buses	Stop accepting vendors and visitors to factory
		*Staggering the working hours by increasing the number of shifts
		Increasing the fleet of buses and reducing the number of persons per bus
		Reducing the number of people per table in the canteen
	Maintaining physical distancing during entry and exit of the factory	*Use of bigger gates for entrance and exit
Functional	Maintaining physical distancing in production line	Reduce the number of workers per shift and per working space
		Drawing floor markings to space out workers in the factory
		Using virtual means of conducting meetings
	Excuse symptomatic workers from duty	Thermal screening of workers at entrance of facility
		Instituting sick leave with pay for workers who become symptomatic
	Adherence to infection prevention and control measures	Installing hand hygiene devices at vantage points
		*Regular cleaning and disinfecting of surfaces
		Wearing of appropriate PPE including face mask by all workers
		*Training of workers to don and doff PPEs
		*Developing an infectious disease preparedness and response plan
Socioeconomic	Workers living in densely populated and highly interactive communities	Educate workers on general preventive measures when out of the factory
	Employees share facilities with others in the community	Performing hand hygiene and using face mask when using shared facilities like marketplaces, toilet facilities, and public transportation
*Measures not observed to be in place and recommended		

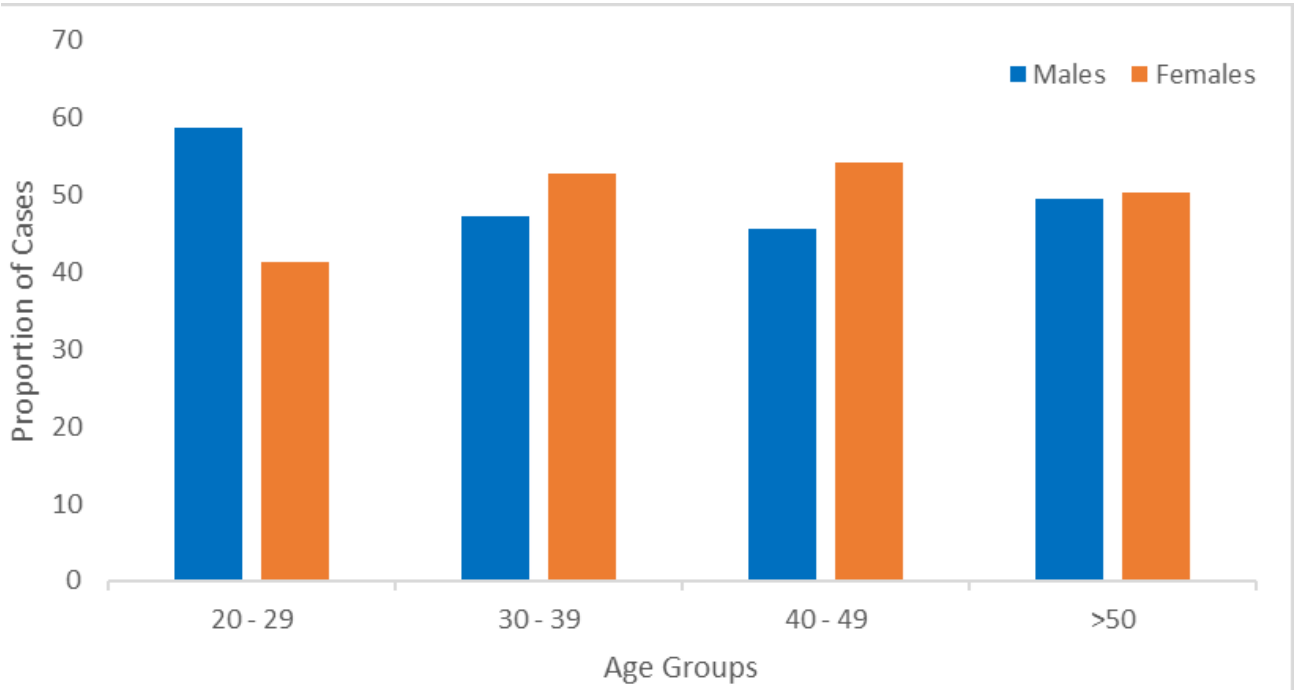

Figure 1: Age and sex distribution of cases