Responding to the global alert by the World Health Organization (WHO) on the Coronavirus disease 2019 (COVID-19) pandemic on 20 January 2020, most countries undertook immediate actions to contain the spread of this disease. Nevertheless, the number of people infected by COVID-19 has increased exponentially since January 2020 due to traveling and contact with COVID-19 infected individuals. Various measures have been contemplated in various parts of the world to curb the proliferation of COVID-19. Despite such undertaking, as of 15 April 2020, more than 2 million cases were confirmed with 138,000 reported deaths worldwide.\(^1\)

COVID-19 emerged in Wuhan, China, in December 2019, and currently, most countries are at different stages of disease transmission.\(^2\) Despite its similarities to the Severe Acute Respiratory Syndrome coronavirus (SARS-CoV) and the Middle East Respiratory Syndrome coronavirus (MERS-CoV),\(^3\) COVID-19 is distinct in terms of community spread and severity. Specifically, the nature of COVID-19 and its behavior across populations is still under research. In this regard, the experience from public health preparedness and response for COVID-19 is building up, and these experiences must be described and reported for peer review of public health experts and utilization by various stakeholders.

The WHO has defined four transmission scenarios/phases for COVID-19 worldwide: 1) countries with no cases (no cases); 2) countries with one or more cases, imported or locally detected (sporadic cases); 3) countries experiencing cases clusters in time, geographic location, and/or common exposure (clusters of cases); and 4) countries experiencing larger outbreaks of local transmission (community transmission).\(^1,2\) Evidence from China reported the positive impact of quarantine, social distancing, and isolation of infected populations to contain the epidemic in China, which encouraged many other countries to do the same.\(^4\) These measures have saved lives and allowed many...
countries to increase readiness for the appearance of COVID-19. On 10 March 2020, His Majesty the Sultan of Oman, Sultan Haitham bin Tariq Al-Said, gave orders to initiate a supreme committee to implement the necessary measures at the appropriate scale to reduce COVID-19 transmission and any anticipated public and socio-economic impacts. The committee was chaired by the Minister of Interior Affairs and included different governmental sectors, including the Ministry of Health (MoH). The preparedness and response initiated by the MoH for COVID-19 were thus scaled up, aimed at strengthening the health emergency response systems, increase capacity to screen/detect and manage patients, ensure availability of adequate medical supplies and necessary personnel, and develop life-saving medical interventions.

Primary health care (PHC) is the gate to health care and captures the vast majority of the population, making it an ideal setting for the first line of defense from COVID-19. Ideally, the PHC provides curative, preventive, health-promoting, and rehabilitative services. Delivery of PHC services in Oman conducted by trained physicians, nurses, and allied professions such as health educators and dietitians.

At the beginning of 2018, the national population estimates were 4,660,153, with approximately 45% being non-Omanis, indicating significant growth (or immigration). About 32% of the total population live in Muscat. In Muscat governorate, there are 30 PHC centers, three polyclinics, and three hospitals all under the direct administration of the Directorate General of Health Services. The health centers are scattered across six wilayats/regions in Muscat: A’Seeb (n = 9), Bawshar (n = 6), Mutrah (n = 5), Muscat (n = 3), Al Amirat (n = 4), and Qurayyat (n = 3).

The purpose of this paper is to summarise the trend of COVID-19 positive cases in Muscat governorate from 1 January to mid-April 2020 and describe the related responses to COVID-19 in PHC settings. The descriptive analysis frameworks are the epidemiology of case scenarios in Oman and the six WHO building blocks of the health care system framework. The stepped case scenarios include phase one: preparedness, phase two: high risk of imported cases, phase three: imported cases, phase four: clusters of secondary local transmission, and phase five: clusters of community transmission.

**METHODS**

This is a descriptive cross-sectional study aimed to describe the trends of laboratory-confirmed positive COVID-19 cases in Muscat and the responses against the disease utilizing the health system building blocks including: 1) health care leadership and governance; 2) health workforce; 3) service delivery; 4) medical products and technologies; 5) health information systems; and 6) health system financing.

Data were extracted from the health information system within the department of diseases surveillance and control, Muscat. Information on the scaled-up organizational response was derived from the regional alert reports prepared fortnightly by the department of disease surveillance and control. Responses were categorized to fit the definitions of WHO health system building blocks. The categorization was cross-checked independently by three researchers (LA, HA, and FA). The final categorization was revised by an expert researcher (KP) as a further measure of inter-rater reliability. Continuity of reporting responses was ensured by one researcher (TA), responsible for the data management and analysis. Written responses were re-visited whenever conflicting interpretations occurred. Ethical approval was obtained from the regional research review and ethical approval committee.

Continuous variables were expressed as whole numbers to show/describe trends over time. Due to the descriptive nature of this study, there were no inferential statistics performed.

**RESULTS**

The first case of COVID-19 in Muscat governorate was confirmed on the 23 February 2020 linked to travel from abroad. There has been an exponential increase in the number of cases reaching 832 cases in mid-April [Figure 1].

The increase was prominent in community clusters within Mutrah [Figure 2], especially among the expatriates/non-nationals (> 70.0%).

Organizational responses at the PHC level across the WHO building blocks for health care system [Table 1].
With the first alert from China about the COVID-19 in January 2020, the national and regional public health emergency task force groups in MoH were activated. The regional operation center (ROC) is composed of 12 teams, all under the direct command of the director-general of health services. These teams coordinate with one another throughout the phases of the disease to adhere to daily action plans:

1. Ports of entry (POE).
2. Clinical health care (primary, secondary, and hospital) and support services.
3. Infection prevention and control (IPC).
4. Disease surveillance and response.
5. Health information system.
6. Information technology.
7. Health services for isolated/quarantined individuals.
8. Pharmacy and medical supplies.
9. Private establishments.
10. Health awareness and social media.
11. Administration and finance.
12. Studies and research.

In phase one of the epidemiological scenario, the focus was preparedness and risk assessments in all POE, namely Muscat International Airport and Al Fahal and Sultan Qaboos seaports [Table 1]. With the increase in the number of positive cases among travelers from the affected areas, the supreme committee in March 2020 provided coordination between all national sectors. The supreme committee requested a complete closure of air, sea, and land ports and the shutdown of Mutrah where multiple clusters were initially identified, followed by the closure of the whole of Muscat governorate on 10 April 2020. These measures were accompanied by a range of social distancing measures, including the closure of schools, universities, mosques, sports activities, cinemas, parks, and even restricting all movement in some of the most affected regions (Mutrah and Muscat).

Several measures were put in place as the epidemiological case scenarios were progressing. Initially, staff numbers and duties were revised. Then, exposure risk assessment and classification were enhanced throughout the phases. In phase three and four, outreach teams and public-private partnerships were established. Volunteers from the community and non-governmental organizations were actively involved from phase three onwards. They were all trained on IPC measures by the concerned team in the ROC.

Adaptations across primary, secondary, and tertiary care services included strengthening the emergency response mechanisms, risk communication and public engagement, public health measures, IPC, case management, and drills with simulation exercises.

Despite reductions in out-patient department visits from 115,324 in January to 109,719 in March, essential health services were ensured in all health centers, primarily for vulnerable groups, women, and children.
Table 1: Responses to COVID-19 across the epidemiological case scenarios utilizing the WHO health system building blocks.

| Phase       | Phase 1                          | Phase 2                          | Phase 3                          | Phase 4                          | Phase 5                          |
|-------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Definition  | No cases (preparedness)          | First case detected (imported    | Clusters of secondary local      | Clusters of cases                 | Clusters of community transmission |
| Aim         | Preparedness planning, risk      | Quarantine, stop transmission,    | Limit extend of transmission to   | Containment measures, slow        | Expand geographical isolation of  |
|             | assessment, coordination, and    | and prevent spread               | contain within clusters and      | transmission, and community       | areas (Muscat governorate)        |
|             | resource mobilization            |                                  | continuing mitigation efforts    | outbreaks                         | 10 April 2020                     |
| Focus       | Preparedness and risk            | Screen arrivals from affected     | Social distancing measures       | Early identification of hotspots   | Enhance surveillance activities   |
|             | management (using declaration     | countries activate quarantine    | Revise industrial policies       | and detection of cases            |                                  |
|             | forms at ports of entry)         | facilities and emergency         |                                 | Isolation of positive cases       |                                  |
| Leadership  | National and regional COVID-19   | Supreme national committee       | Add other countries to quarantine | Activation of the National        |                                  |
| and         | task force                       | suspend flights from the affected | list (China, South Korea, Japan, | Committee of Civil Defence        |                                  |
| governance  |                                  | countries                        | Singapore, and Iran)             |                                  |                                  |
| Health      | Human resource deployment and    | Enhance health care workers       | Initiation of outreach teams     | Augment medical services access   |                                  |
| workforce   | remobilization                   | exposure risk assessment and      | Facilitate public-private        | for all at the ground level by    |                                  |
|             |                                  | classification                    | partnership                      | reorienting HCW                   |                                  |
| Service     |                                  |                                   | Organize support from volunteers | Establish efficient triaging      |                                  |
| delivery    |                                  |                                   |                                  | mechanism for detection of high   |                                  |
| Health care | Revise essential health care     | Identify COVID-19 primary care    | Strengthen referral protocols,   | Expand services at Mutrah health   | Activate emergency response       |
| services    | needs, human resources, and     | center (North Al Khuwair)        | IPC, swab taking, and transfer   | center                            | mechanisms Scale-up emergency     |
|             | working hours                    |                                  | of specimens to the central      | Preparation of a community areas  | response mechanisms               |
|             | Liaise with hospitals            |                                  | laboratories                     | tent to perform a community       |                                  |
|             | Prepare plans for a surge in the | Identify doctors on call to answer| Arrange continuity of services    | Identify outreach teams            |                                  |
|             | number of cases                  | public queries                    | for vulnerable groups and         | Expand isolation facilities        |                                  |
|             | Use telemedicine                 |                                  | immunization program             | especially for foreigners         |                                  |
|             |                                  |                                  |                                  | Provide multiple testing facilities|                                  |
|             |                                  |                                  |                                  | (Mutrah, Darseet, Asharadi,       |                                  |
|             |                                  |                                  |                                  | and Russail)                      |                                  |
| Emergency   | Preparedness phase               | Enhancing patient referral        | Activate emergency response       |                                  |                                  |
| response    |                                  | pathways and coordination         | mechanisms                       |                                  |                                  |
| mechanisms  |                                  | between tertiary hospitals and    | Scale-up emergency response      |                                  |                                  |
| Risk        |                                  | with private institution          | mechanisms                       |                                  |                                  |
| communication|                                  |                                  |                                  |                                  |                                  |
| and public  | Educate and actively communicate | Engaging opinion leaders          | Activate multi-sectoral          |                                  |                                  |
| engagement  | with the public through risk     | Activation of 24 hours call center| preparedness, response, and      |                                  |                                  |
|             | communication and community      |                                  | gradual recovery                 |                                  |                                  |
|             | engagement                        |                                  |                                 |                                  |                                  |
|             |                                  |                                  |                                 |                                  |                                  |
|             |                                  |                                  |                                 |                                  |                                  |
Table 1: Responses to COVID-19 across the epidemiological case scenarios utilizing the WHO health system building blocks.

| Case management and related guidelines | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 |
|----------------------------------------|--------|--------|--------|--------|--------|
| Set-up screening and triage protocols at points of access to the primary care | Setting up facilities for isolation of suspected cases (arrivals from abroad) _22 hotel | Test suspected cases according to the case definition | Scale-up surge plans for health and isolation facilities (suspected and positive cases) | Set-up COVID-19 hotlines to strengthen the referral system to hospitals | Prepare mass isolation facilities for positive mild cases |
| | | | | | Strengthen outbreak control measures in Mutrah area |
| | | | | | Enhancing passive surveillance in other willayats |
| | | | | | Enhancing capacity for testing and medical services in Mutrah health center (HC) |
| | | | | | Support private sector participation in Mutrah HC |
| | | | | | Practice regular exercises to test plans, protocols, communication, multi-sectoral coordination, and operational capabilities. |
| | | | | | Enhance capacity building and strengthening activities |
| Drills and simulation exercises | | | | | |
| Medical products and technologies | Laboratory testing | Pharmacy | | | |
| | Test all individuals meeting the suspected case definition. | Review daily inventories and requirements | Scale-up stock from regular consumption | Provide institutional isolation facilities with the required supplies | Activate laboratory contingency plans |
| | Ensure availability of testing tools. | | | | Implement prioritized testing and measures that can reduce spread |
| Surveillance activities | Case finding, contact tracing and management | Conduct active case finding, contact tracing, and monitoring; quarantine of contacts | Prepare resources. | Enhance active case finding, contact tracing, monitoring, quarantine of contacts, and isolation of cases | Intensify case finding, contact tracing, monitoring, quarantine, and isolation facilities |
| | | | | | Continue active case finding, contact tracing where possible, especially in newly infected areas |
| | | | | | Implement COVID-19 surveillance |
| | | | | | Start “al trassud” web-based notification (government and private) |
| | | | | | Assign focal points in all institutes for data update |
| Health system financing | | | | | Ministry of Health |

ROC: regional operation center; HCW: health care worker; IPC: infection prevention and control; POE: point of entry; GIS: geographical information system; ARI: acute respiratory tract infection.
A COVID-19 model health center was established in phase two to provide coordinated support with all ROC teams. With the situation escalating in Mutrah, health centers in Mutrah were opened for 24 hours to ensure that testing and isolation procedures were in place.

Care services were restructured to implement COVID-19 triaging, screening, and quarantine/isolation algorithms as indicated. All staff underwent several trainings and exercises on protocols, communication, multi-sectoral coordination, and operational capabilities, swab taking, referrals and management of symptomatic/asymptomatic patients.

Phone consultations and virtual communications were utilized to respond to public queries. Moreover, public health awareness campaigns on the importance of social distancing and hand hygiene were carried out. Importantly, the nursing cadre took the responsibility of setting up isolation facilities for suspected cases (arrivals from abroad) and positive cases; and thus, 22 hotels were arranged for this purpose. Additionally, mass isolation facilities for positive mild positive cases in phases three and four were arranged (e.g., the Oman National Engineering and Investment (ONEIC)).

Overall, shortages of supplies have been reported on personal protective equipment (PPE) and face masks, and it has been a concern in all regions leading to strict measures of use. Every effort was made to reduce the influx of patients to health centers via scaling up pharmacy stock from regular consumption and implementing WhatsApp and home delivery services to transport regular drugs to patients.

Furthermore, two central stores for PPE (Mutrah and A’Seeb) were opened in phases three and four to accommodate the escalating demand. Also, the pharmacy and medical supply team in ROC was responsible for providing institutional isolation facilities with the required pharmaceutical supplies.

The use of technology was implemented throughout the epidemiological phases, as most health centers conducted phone consultations and video conferencing to share experiences. The geographical information system was introduced in February 2020 to ease data management and graphical interpretations.

Data sharing, specifically the number of confirmed cases, was widely considered to have been provided by authorities at all levels promptly via social media.

Because MoH is a public health care delivery system, finance management was not within this paper’s scope. However, with the economic recession, additional financial resources are warranted to support the implementation of COVID-19 interventions.

**DISCUSSION**

This is the first paper to report the changes in primary care responses with the increase in cases of COVID-19 utilizing the WHO health system building blocks in an Arabic speaking country, Oman. Based on the experiences described in Table 1 and ‘real-life’ scenarios, this discussion is structured to highlight approaches to strengthen the medical and public health responses to mass crisis.

A comprehensive multi-sectoral approach was especially crucial as new cases of the COVID-19 continued to surge in Muscat. This approach potentially alleviated the fear of exhausting current health care resources and shortages of competent health care personnel and essential medical supplies. With the experience from Muscat governorate, It was clear that an effective pandemic response required a whole-of-government, whole-of-society approach. This mandated the involvement and partnership with multi-sectoral capacities and resources including the private sector, non-governmental organizations and civil society.

Additionally, with the disease surge among expatriates (the case in Mutrah willayat), there was a growing acknowledgment that the public and the private partnerships were compulsory to solidify Universal Health Coverage defined as equity and social justice to accessing health care. In Oman, the Sultan of Oman, declared free of charge medical services against COVID-19 to all expatriates living in Oman in April 2020 until a decreased transmission rate is achieved.

Similar to the experience in Muscat (Mutrah willayat and ONEIC), a private network in the UAE made staff and hospital bed capacity available to government use as needed. Also, in Bahrain, licenses were provided to private healthcare providers for the management of COVID-19. However, the role of the private health sector could be expanded to enroll hospitals and laboratories to fill gaps in healthcare provision and coverage.
Other potential areas of engagement could be nursing home facilities and social support and care to vulnerable populations.

Responding to the COVID-19 outbreak in Muscat revealed the need for public health/field epidemiologist expertise in PHC. In crises of such an overwhelming scale, using the best available evidence is essential to save lives. Public health responses to emerging pandemics works on sound principles of established infectious disease epidemiology. Hence, knowledge of such principles and skills are essential in health care. Further research is required to explore effective methods to institutionalize and strengthen public health/epidemiological strategies within the health care setting.17

Technologies such as the use of geographical information technologies for big data are fundamental to maximize public health responses.18 Countries such as Taiwan, used location sharing in phones to track people in quarantine.18 Future direction may consider accelerating the use of novel technology, such as artificial intelligence, digital tools, and machine learning to achieve better medical and public health outcomes.

This pandemic has demonstrated that sharing real-time information is critical and mandatory. Lack of data sharing and a transparent reporting system may weaken health systems and may open windows for ‘infodemic’, false social media.19,20 The efforts in Muscat governorate in line with the national level mandates have been building a platform for data sharing and this has been affected by the surveillance platform that integrated quarantine services, patient records, laboratory data as well as follow-up information of confirmed cases. This platform is a success story in the development of robust, sustainable platforms for the future.

CONCLUSION

PHC is considered as the first responder for a mass crisis, namely COVID-19. It is crucial to enhance capacities and resources across the health system building blocks as the epidemiological case scenarios surge. Building a comprehensive, multi-sectoral approach, partnership with the private sectors, use of innovative technologies, and data sharing are the core for an effective medical and public health response.

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