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**Original article**

# Using Medical Referral Center Cases to Identify the Health Care Deficiencies Among Healthcare Facilities in The Kingdom Saudi Arabia 2021

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## Abstract

***Introduction:*** As communities continue to grow and age, the frequency of acute health emergencies in-creases. Notably life-threatening emergencies, acute exacerbation of chronic diseases, and many other health issues which require rapid assessment, management and need to receive the most attention. To achieve this, any reform must be informed by adequate knowledge of the healthcare system and the health of the nation in general. This study aims to provide this knowledge by highlighting some of the healthcare deficiencies in Saudi Arabia. ***Methodology:*** A cross-sectional study was conducted using data taken from NHCC. data will cover the period from 01/03/2021 to 20/06/2021. The sample size is 5593. ***Results:*** A majority of the referral cases came from Riyadh (30.1%) followed by Jizan (21.8%). In relation to referral by specialty, 22.5% were referred to internal medicine, 14.6% were referred to ICU, while 13.1% of the cases were to cardiology. With regards to the reasons for referral, 59.1% of the cases were referred because of lack of specialty, while 38.0% of the cases were referred due to lack of facilities. ***Conclusion:*** It can be deduced that sone of the possible healthcare deficiencies is inadequate specialists or facilities in some areas. It means that some regions do not have enough medical personnel to deal with particular conditions. Moreover, it shows that most facilities are not well-prepared and equipped to handle the number and complexity of cases and it is thereby for this reason that they are compelled to refer patients to other facilities with the resources to handle these cases.

**Keywords:** ***Healthcare system, lifesaving referral, referral center, healthcare command center, Saudi Arabia.***

## Introduction

The Saudi Arabian government has laid great importance upon its health care system. Gallagher states: “Although many nations have seen sizable growth in their health care systems, probably no other nation (other than Saudi Arabia] of large geographic expanse and population has, in comparable time, achieved so much on a broad national scale, with a relatively high level of care made available to virtually all segments of the population.” [1].

The population of Saudi Arabia was estimated to be about 35 million in 2020 with expatriates comprising approximately 38.7% of the total population [2]. The population growth rate was 2.38% in 2020 [2]. which has driven demand for more health care. This may overwhelm the healthcare sector especially if no adjustments are made. With the change in most common diseases causing mortality from communicable disease to cardiac(20%), MVA and toxicity (19%) and oncological disease (5%) [3]. New challenges rise such as an increased demand because of rapid population growth, high costs of health care services, inequitable access, concerns about the quality and safety of care, a growing burden of chronic diseases, a less than effective electronic health system (eHealth), poor cooperation and coordination between other sectors of care, and a highly centralized structure [3].

As communities continue to grow and age, the demand on acute health emergencies increases. Notably life-threatening emergencies, acute exacerbation of chronic diseases, and many other health issues which require rapid assessment, management and need to receive the most attention. In the eastern province, a study on the care standard of primary health centers found that bronchial asthma, cut wounds, burns, acute abdomen, and palpitations represent the most common emergency cases encountered [4]. However, physicians’ opinion was PHC settings were neither prepared (42.22%) nor provided enough supportive care (45.39%) to deal with emergency cases [5].

The Saudi Arabian health care system is going through a period of reform. This has been brought about by the new vision of the Ministry of Health and the development of a national health strategy to meet the challenges stated earlier. The implementation of

an effective referral system from all levels of health care institutions to tertiary and back to primary health care is also an important objective in the ministry's strategy [3]. The development of the primary health care workforce through further education and training and new recruitment and retention strategies to address workforce shortages is also part of the reform [3]. However, any reform must be informed by adequate knowledge of the healthcare system and the health of the nation in general. This study is aimed to provide this knowledge by highlighting the healthcare deficiencies in Saudi Arabia.

## Materials and Methods

Cross sectional design will be used to analyze referral events over 4 months and compare many masseurs including region, governate, hospital name, hospital category, age, gender, chief complaint, system involved, specialty needed, reason for referral and service need-ed. The study will be conducted by using the data from National Health Command Centre (NHCC).

The sample size is 5593. The data will include all new cases of life saving referrals from 01/03/2021 to 20/06/2021. The sampling technique is non-random consecutive sampling. Non probability sampling will be used on the referred cases of the institutions of health ser-vices under the umbrella of NHCC. The database of NHCC will be used and variables such as Hospital name, governate and region, Patient demographics, Main complaint, system in-volved, specialty contacted and the reason for referral will be extracted into an EXCEL sheet. Excel will be used to enter the data, while SPSS will be used for data analysis. Per-centage and frequencies will be used to represent the categorical data. On the other hand. Mean and Standard deviation will be used to represent the numerical data. Furthermore, to compare the numerical variables, ANOVA will be used. While chi square will be used to compare the categorical variable.

## Results and Discussion

**Results**

In this study, a total of 5593 cases were examined. With regards to regions, majority of the referral cases came from Riyadh (30.1%) followed by Jizan (21.8%). The Eastern region was third with 9.9% followed by Mecca in fourth place (7.5%). The region with the least number of referral cases was the Northern Borders with 0.5%. The mean age for the patients referred was 42.39 with a standard deviation of 26.21. In terms of gender, majority of the patients referred were male 65.4%, while female patients were 34.6%. The chief complaint in the referred cases are chest pain (13.2%), shortness of breath (14.0%), neurological com-plaints (10.2%) and motor vehicle collisions (9.6%).

In relation to the referral by system, 24.9% of the referral cases were respiratory, 17.7% were neuropsychiatric, and 16.8% were cardiovascular. 7.0% of the cases due to MSK system involvement. On referral by specialty, 22.5% were referred to internal medicine, 14.6% were referred to ICU, 13.1% to cardiology, while 13.0% of the cases were referred to general surgery. 7.4% of the cases were referred to the neurosurgery specialty.

With regards to the reasons for referral, 59.1% of the cases were referred because of lack of specialty, 38.0% of the cases were referred due to a lack of necessary facilities, while 2.1% were referred due to lack of required equipment or devices. In relation to the service needed in the referral, 31.0% of the cases required critical care, 25.2% needed surgical care, 18.1% of the cases required medical care, and 9.5% of the cases required cardiac catheterization lab services.

On the relation between the number of referrals by diagnosis and patient's region, it was established that for cardiovascular diagnoses, 32.8% of these cases were from Riyadh while 28.9% were from Jizan, 8.8% from the Eastern region, 5.5% of the cardiovascular cases were from Asir, and 5.4% were from Makkah.

With regards to relation between number of referrals by diagnosis and the service needed, it was found that for cardiovascular diagnosis, 51.3% of these cases require cardiac catheterization lab services and 27.2% required medical care, while 14.0% required critical care ser-vices. For respiratory diagnosis, 58.9% required critical care services and 17.8% of them re-quired medical care, while 7.6% required ECMO. For neuropsychiatric diagnosis, 41.0% of the cases required surgical care, 20.2% required critical care services, and 18.5% of them required medical care. See table 1 in the Supplementary Material for comprehensive image analysis.

In regard to the relation between reason for referral and patient's region, it was established that for lack of specialty, 31.1% of the cases were from Riyadh, 20.8% of them of Jizan, and 7.4% of the cases were from Makkah. For 'lack of facility' reasons, 27.4% of the referrals were from Riyadh, 23.9% were from Jizan, and 9.9% of the referrals were from the Eastern region.

On relation between number of referrals by specialty with patients' region, for the internal medicine specialty, 29.8% of referrals were from Riyadh, 21.3% were from Jizan and 12.3% from the Eastern region. For ICU, 29.8% of referrals were from Riyadh, 19.4% from Jizan, and 9.4% were from Makkah. For cardiology, 32.8% of referrals were from Riyadh, 29.8% were from Jizan, and 9.2 from the Eastern region. See table 2 in the Supplementary Material for comprehensive image analysis.

With regard to the relation between the services needed and the patients' region; for critical care, 25.9% of the referrals were from Riyadh, 18.5% from Jizan and 10.9% of referrals were from Makkah. As for surgical care, 28.6% of the referrals came from Riyadh, 24.0% from Jizan, and 9.0% from the Eastern region. For medical care, 33.9% of referrals were from Riyadh, 17.5% from Jizan, and 13.2% from the Eastern region. Lastly, for cardiac catheterization lab service, 34.7% of referrals were from Jizan, 31.7% from Riyadh, and 7.8% from the Eastern region. See table 3 in the Supplementary Material for comprehensive image analysis.

On the relation between most referring governate and their referral by specialty, results show that for Mecca 349 referrals made, the main specialties were cardiology (24%), neuro-surgery (15.1%), internal medicine (14%), ICU (11.7%), and general surgery (10,6%). For Jeddah, out of 301 referrals the main specialties were internal medicine (20.5%), cardiology (20.2%), general surgery (12.6%), ICU (10.2%), and neurosurgery (9.9%). for Al-Duwadimi 246 referrals made, the most referred to specialty were internal medicine (23.1%), cardiology (16.2%), ICU (13%), general surgery (12.6%), and orthopedics (5.6%). Lastly, For Riyadh 190 referrals made (figure 1.d), the main specialties were ICU (23.1%), internal medicine (16.8%), neurosurgery (13.1%), cardiology (8.4%), and neonatal ICU (9.4%).

The results show that the most frequently referring regions are Riyadh, Jizan, and the East-ern region.

**Table 1: Referral by system relation to the service needed**

| Referral by system relation to the service needed | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Service Needed / System | | Adcanced Imagining (CT scan) | Blood Transfusion | Burn Unit | Cath Lab | Critical Care | ECMO | Endoscopy | Hemodialysis | Interventional Radiology | Investigation | Medical Care | Medication | Surgical Care | Surgical Operation | Others |
| Cardiovascular | Percentage within the service needed | 1.3 | 7.7 | 0.0 | 90.6 | 7.6 | 0.0 | 4.6 | 2.1 | 6.0 | 16.7 | 25.3 | 25.0 | 1.6 | 2.7 | 17.0 |
| Dermatologic | | 0.0 | 0.0 | 84.4 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 1.2 | 1.4 | 2.7 |
| Endocrinological | | 0.4 | 0.0 | 0.0 | 0.0 | 4.9 | 0.0 | 0.9 | 2.1 | 1.2 | 33.3 | 2.7 | 0.0 | 0.3 | 1.4 | 2.0 |
| ENT | | 12.4 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 1.9 | 0.0 | 1.2 | 0.0 | 0.4 | 0.0 | 7.8 | 0.0 | 0.7 |
| Gastrointestinal | | 8.9 | 3.8 | 0.0 | 0.0 | 3.0 | 0.0 | 40.7 | 2.1 | 6.0 | 0.0 | 5.9 | 0.0 | 4.3 | 6.8 | 4.8 |
| Gynecologic | | 1.8 | 38.5 | 0.0 | 0.0 | 7.3 | 0.0 | 4.6 | 0.0 | 3.6 | 0.0 | 1.1 | 0.0 | 7.6 | 14.9 | 3.4 |
| Hematologic-Oncologic | | 2.2 | 34.6 | 0.0 | 0.0 | 2.3 | 0.0 | 0.9 | 1.1 | 3.6 | 0.0 | 4.9 | 0.0 | 2.3 | 4.1 | 6.8 |
| Hepatic | | 0.9 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 6.5 | 0.0 | 3.6 | 0.0. | 1.9 | 0.0 | 0.9 | 2.7 | 4.8 |
| Musculoskeletal | | 7.6 | 0.0 | 3.1 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 | 7.1 | 0.0 | 1.3 | 0.0 | 21.7 | 28.4 | 4.8 |
| Nephrological & Urological | | 0.0 | 0.0 | 0.0 | 0.0 | 3.8 | 0.0 | 1.9 | 63.8 | 3.6 | 0.0 | 7.7 | 0.0 | 1.8 | 0.0 | 5.4 |
| Neuropsychiatric | | 46.7 | 3.8 | 0.0 | 0.4 | 11.6 | 0.0 | 5.6 | 6.4 | 47.6 | 16.7 | 18.2 | 50.0. | 28.9 | 18.9 | 15.6 |
| Ophthalmological | | 0.4 | 3.8 | 0.0 | 0.0 | 0.1 | 0.9 | 1.9 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 1.9 | 4.1 | 2.0 |
| Respiratory | | 8.0 | 3.8 | 12.5 | 7.9 | 47.3 | 98.1 | 15.7 | 19.1 | 6.0 | 33.3 | 24.5 | 25.0 | 5.3 | 0.0 | 23.8 |
| Surgical | | 6.7 | 0.0 | 0.0 | 0.2 | 2.2 | 0.0 | 10.2 | 0.0 | 8.3 | 0.0 | 2.5 | 0.0 | 11.8 | 10.8 | 4.8 |
| Other | | 2.7 | 3.8 | 0.0 | 0.9 | 5.8 | 0.9 | 4.6 | 3.2 | 2.4 | 0.0 | 3.1 | 0.0 | 2.6 | 4.1 | 1.4 |

**Table 2: Referral by specialty relation to the service needed**

| Referral by specialty relation to the service needed | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Service Needed / Specialty | Al Bahah | | Al Jouf | Al Madinah | Al-Qassim | Asir | Eastern | Hail | Makkah | Jazan | Najran | Northern Borders | Riyadh | Tabuk |
| Cardiology | Percentage within the region | 13.0 | 5.4 | 6.3 | 10.8 | 10.7 | 12.3 | 9.6 | 9.7 | 17.9 | 12.7 | 3.8 | 14.3 | 8.9 |
| Gastroenterology | | 2.3 | 2.7 | 2.2 | 1.1 | 1.3 | 1.3 | 0.9 | 1.4 | 1.7 | 2.1 | 7.7 | 2.5 | 2.7 |
| General Pediatrics | | 5.3 | 5.4 | 5.6 | 3.2 | 6.1 | 3.1 | 3.5 | 3.3 | 4.8 | 5.3 | 11.5 | 4.3 | 2.7 |
| General Surgery | | 9.9 | 13.5 | 13.3 | 11.5 | 15.7 | 13.6 | 7.8 | 15.6 | 11.5 | 18.5 | 23.1 | 12.3 | 15.8 |
| ICU | | 9.9 | 13.5 | 13.3 | 11.5 | 15.7 | 13.6 | 7.8 | 15.6 | 11.5 | 18.5 | 23.1 | 12.3 | 15.8 |
| Internal Medicine | | 21.4 | 13.5 | 21.0 | 22.9 | 19.5 | 28.1 | 31.3 | 23.9 | 22.0 | 19.6 | 3.8 | 22.3 | 18.5 |
| Neonatal ICU | | 4.6 | 13.5 | 3.6 | 3.6 | 6.1 | 1.3 | 2.6 | 4.5 | 2.5 | 3.2 | 15.4 | 4.7 | 6.2 |
| Nephrology | | 0.0 | 2.7 | 4.6 | 4.7 | 1.9 | 4.0 | 2.6 | 1.2 | 2.6 | 0.5 | 0.0 | 1.6 | 2.1 |
| Neurology | | 3.1 | 0.0 | 6.0 | 1.1 | 3.7 | 4.7 | 4.3 | 2.4 | 2.3 | 4.8 | 0.0 | 2.4 | 4.1 |
| Neurosurgery | | 4.6 | 5.4 | 8.2 | 9.0 | 8.5 | 4.0 | 7.8 | 6.9 | 9.7 | 5.3 | 3.8 | 6.8 | 7.5 |
| Obstetrics and Gynecology | | 8.4 | 0.0 | 6.5 | 4.7 | 7.2 | 3.1 | 3.5 | 5.2 | 3.4 | 3.2 | 3.8 | 3.4 | 4.8 |
| Orthopedics | | 2.3 | 8.1 | 2.4 | 2.5 | 2.1 | 5.1 | 0.9 | 2.6 | 3.1 | 4.2 | 3.8 | 6.3 | 2.7 |
| Pediatrics ICU | | 6.1 | 10.8 | 5.3 | 4.7 | 5.9 | 3.1 | 5.2 | 4.0 | 3.8 | 4.8 | 3.8 | 3.4 | 9.6 |
| Others | | 1.5 | 0.0 | 1.0 | 0.4 | 0.5 | 2.2 | 2.6 | 0.9 | 1.6 | 0.5 | 0.0 | 1.2 | 0.0 |

**Table 3: Service needed relation to region**

| Service needed relation to region | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Region / Service Needed | Al Bahah | | Al Jouf | Al Madinah | Al-Qassim | Asir | Eastern | Hail | Makkah | Jazan | Najran | Northern Borders | Riyadh | Tabuk |
| Adcanced Imagining (CT scan) | Percentage within the region | 2.3 | 2.7 | 5.3 | 4.3 | 1.9 | 5.8 | 4.3 | 3.3 | 2.4 | 3.7 | 0.0 | 5.3 | 2.1 |
| Blood Transfusion | | 0.8 | 0.0 | 0.5 | 0.7 | 0.0 | 0.5 | 0.0 | 0.7 | 0.4 | 0.0 | 0.0 | 0.5 | 0.7 |
| Burn Unit | | 1.5 | 0.0 | 0.5 | 0.4 | 0.0 | 0.7 | 0.0 | 0.7 | 0.4 | 0.5 | 0.0 | 0.8 | 0.0 |
| Cath Lab | | 10.7 | 0.0 | 5.1 | 4.7 | 8.8 | 7.6 | 7.0 | 4.3 | 15.2 | 9.5 | 0.0 | 10.0 | 8.2 |
| Critical Care | | 38.2 | 35.1 | 35.5 | 38.0 | 32.5 | 26.8 | 46.1 | 44.8 | 26.4 | 40.2 | 26.9 | 26.7 | 33.6 |
| ECMO | | 1.5 | 5.4 | 3.4 | 0.7 | 1.6 | 2.0 | 1.7 | 0.2 | 2.2 | 1.1 | 15.4 | 2.0 | 1.4 |
| Endoscopy | | 1.5 | 0.0 | 1.2 | 1.8 | 1.6 | 1.6 | 0.9 | 0.5 | 1.9 | 1.1 | 3.8 | 2.8 | 2.7 |
| Hemodialysis | | 0.0 | 2.7 | 3.4 | 2.9 | 0.8 | 1.6 | 1.7 | 0.2 | 2.8 | 0.5 | 3.8 | 1.1 | 1.4 |
| Interventional Radiology | | 0.8 | 0.0 | 0.5 | 0.4 | 2.1 | 1.6 | 4.3 | 0.5 | 2.3 | 1.6 | 0.0 | 1.4 | 0.7 |
| Investigation | | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.2 | 0.0 | 0.2 | 0.0 | 0.5 | 0.0 | 0.1 | 0.0 |
| Medical Care | | 16.8 | 10.8 | 15.5 | 18.6 | 15.7 | 24.3 | 15.7 | 18.2 | 14.6 | 15.3 | 11.5 | 20.4 | 19.2 |
| Medication | | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| Surgical Care | | 24.4 | 37.8 | 26.8 | 22.6 | 28.8 | 23.0 | 16.5 | 23.5 | 27.8 | 23.3 | 34.6 | 23.9 | 27.4 |
| Surgical Operation | | 0.8 | 0.0 | 1.0 | 0.7 | 2.7 | 1.3 | 0.0 | 1.2 | 1.2 | 1.1 | 0.0 | 1.7 | 0.0 |
| Others | | 0.8 | 5.4 | 1.0 | 4.3 | 3.5 | 2.9 | 1.7 | 1.7 | 2.3 | 1.6 | 3.8 | 3.2 | 2.7 |

## Discussion

The results show that the most common referred diagnosis is respiratory issues. This is followed by cardiovascular issues. The main reasons for the referral are lack of specialty followed by facility. This means that patients suffering from respiratory problems and cardio-vascular conditions are referred because the hospitals in which they are diagnosed have no specialists in these conditions or the facility itself is prepared to handle such cases. These referrals show that there is a significant number of hospitals and other healthcare facilities are inadequately developed meaning that they may need further development for them to be able to handle such cases. It is possible that majority of these hospitals are able to handle such cases but due to the number of patients that exceed the facility capacity.

The results also show that most referrals are from Ministry of health (MOH) hospitals. These are government sponsored hospitals. With most referrals from these hospitals, it might be due to the fact that they account for 56.9% all hospitals or that they need to develop their facilities and hire more specialist.

Geographically, results show that most referrals are from Riyadh followed by Jizan. One of the possible reasons for the high level of referrals from these two regions is there are fewer specialists in these regions to handle most of the complicated cases such as cardiovascular and respiratory problems. Another possible reason is the facilities in these two regions can-not accommodate all patients due to higher prevalence of diseases. This is reflected in the relation between reason for referral and region. For example, in Jizan, 41.6% and 56.3% of the referred cases are due to lack of facility or Specialty respectively. while in Riyadh, 34.5% and 61.1% of the referral cases are due to lack of facility or Specialty respectively.

Demographically, it was established that Male patient were referred more than female 65.4% and 34.6% respectively. This may implies that most men suffer from conditions that require specialized treatment. Such conditions include cardiovascular diseases and respiratory problems. This conclusion is supported by research, especially in relation to cardiovascular diseases. For example, in their study Bots et al [6] established that coronary heart disease and stroke, two of the main cardiovascular diseases, were more prevalent among men when compared to women.

In relation to the service is needed for the referral, critical care and surgical care where are the most common by 31% and 25% respectively. When comparing the service needed be-tween regions, several regions show higher need to certain services than others. For example, burn units where needed in Al Bahah accounting for 1.5% of referrals within the region compared to the average of 0.42%. Moreover, referrals due to the need of ECMO was 15.4% in northern borders, while the average in all regions is 3.2%.

In relation to the most referred to specialty, it was established that internal medicine was the most prevalent specialty followed by ICU. This might be explained by the rise of COVID 19 cases during the same period of the sample. In addition, these two specialties handle more complex cases and covers more subspecialties. Some regions have higher referral rate to certain specialties compared to other regions. For example, Northern borders has higher referrals to gastroenterology, general pediatrics, neonatal ICU and general surgery, while Al Jouf has higher referral rate to neonatal ICU, Orthopedics and pediatrics ICU.

Lastly, another possible healthcare deficiency is a healthcare system that does not meet the required standard in some regions of the kingdom. As seen from the results, there are some governates with high level of referrals. For example, as Mecca, Jeddah, and Riyadh are some of the governates with the highest number of referrals. While this may be an indication of a higher disease burden in these governates, it is also possible that in general, there are fewer specialists and/or few facilities available to handle all cases. This compels these governates to refer most of their patients to other facilities.

One of the implemented solutions is the Saudi Command and Control Center (CCC), which performs epidemiological surveillance and coordination between MOH and all health facilities across all regions of the kingdom. It also minimizes the likelihood of a health crisis through prevention measures and ensure the required medical infrastructure is available. Furthermore, Tele-health is another solution which have been implemented in ICU settings during the pandemic. Although further Study is needed, it has been found that it reduces mortality and length of stay in the ICU [7].

## Conclusions

From the results, it can be deduced that one of the possible healthcare deficiencies in Saudi Arabia is inadequate specialists in some areas, which include internal medicine, intensive care, cardiology, and even general surgery. It means that most regions do not have enough medical personnel to deal with particular conditions such as cardiovascular diseases and respiratory problems. Another possible healthcare deficiency is healthcare facilities that do not meet the required standard. From the results, it can be seen that facility is one of the reasons for the referrals in Saudi Arabia. As indicated, it shows that most facilities are not well-prepared and equipped to handle the number of cases and it is thereby for this reason that they are compelled to refer patients to other facilities with capabilities to handle these cases.

We believe that the result of this study help to point out to where is the most needed facilities to be established or upgraded to meet the growing demands our health system as well as bridge the gap in some of the needed subspecialties most as the results shows the most need-ed services were critical care followed by surgical services. furthermore, providing virtual services can help to close the gap and provide an innovated solution with fraction of the cost.

## Ethics approval and consent to participate

This study was approved by the Minstry of Health Central Institutional Review Board National Registration Number with NCBE-KACST, KSA;(H-01-R009) (approval no. 21-35M).

## Data Availability

The datasets generated during the current study are available from the corresponding author on reasonable request

## Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this pa-per.

## Funding Statement

Not applicable.

## Authors' contributions

The authors confirm contribution to the paper as follows: study conception and design: N. Aljerian, M. Arafat, A, Aldhabib; data collection, analysis and interpretation of results: I. Almohaimeed, A. Alsultan, S. Sagor, A. Almowina; draft manuscript preparation: A. Alho-saini, O, Alzuman, T. Alqarni, L. Ashry, A. Almowina. All authors reviewed the results and approved the final version of the manuscript.

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