COVID-19 Pandemic Impact on Emergency Department Visits and Quality of Service: A Comparative Cross-Sectional Study in a Tertiary Centre

ABSTRACT

Background: The COVID-19 pandemic has contributed to a devastating impact on emergency departments worldwide, resulting in a global crisis with various health consequences. We aimed to evaluate this impact on an emergency department (ED) visit of critical conditions such as Acute Coronary Syndrome (ACS), Cerebrovascular accident (CVA), Sepsis and Febrile neutropenia (FN), and to assess the quality of the ED after new adaptive measures were applied.

Methods: This is a comparative cross-sectional study to assess the number of patients who presented to the ED of King Abdullah Medical city with the specified diagnosis. We collected data via the E-medical records. We compared the data over three periods pre-lockdown, lockdown and post lockdown in years 2019-2021. For quality measurement, Adaa (Ministry of Health's program) was used to calculate the percentage of patients who stayed 4 hours or less in the ED.

Results: The total number of ED visits in the specified periods of study was 8387. The total numbers of patients for 2019, 2020, and 2020 respectively were 2011 (, ACS 70.4%, CVA 16.3%, sepsis and FN 13.3%.), 2733 (ACS 73.1%, CVA 9.9%, sepsis and FN 17.0%), and 3643 (ACS 64.0%, CVA 19.4%, sepsis and FN 16.7). The average percentage of patients who stayed 4 hours or less in the ED was 60% and 57.5% for 2020 and 2021, respectively.

Conclusion: Although we expected reductions in ED visits during COVID-19 periods, we found that visits were rising through the years 2019-2021.

Keywords: Acute medical conditions; COVID-19 pandemic; Emergency department visits; Medical emergencies; quality of service

INTRODUCTION

The COVID-19 Pandemic has contributed to a devastating impact worldwide since the first case was reported in Wuhan, China in December 2019 [1]. Subsequently, it spread rapidly across the world and was declared by The World Health Organization (WHO) as a Public Health Emergency of International Concern (PHEIC) on 30 January 2020 [2]. Resulting in a global crisis with various health, social and economicconsequences [3].Various measures and implementations were taken by governments. In the Kingdom of Saudi Arabia, the first case presentation was confirmed in the country on the 2nd of March 2020 [4]. From then onwards, numbers of confirmed cases started to rise up to 525,730 and there are 8,249 related deaths as of the writing of this study [5].

To combat the crisis, strict preventative measures were implemented ranging from travel bans, Omrah suspension, quarantine, Shifting schools and universities to remote learning, postponing or suspension of sports events, social and governmental gatherings [6]. Due to the impact of the crisis, EDs worldwide were forced to reorganize their services to accommodate the volume of COVID-19-related patients [7].

Regionally, King Abdullah medical city (KAMC) is a tertiary hospital in Makkah, providing high quality and excellence of patient care, education and research. The Emergency department
of the centre had numerous measures taken since the beginning of the crisis, similar to measures taken by health care centres worldwide. These include, division of the ED to COVID- 19 and non-COVID-19 areas, Creation of isolation rooms, policies changes and alterations of staff schedules and rotations to avoid exposure and outbreaks [8].

Due to the crisis, there was an increase of mortality and morbidity rates in some critical conditions such as (ACS, Stroke and sepsis) in various countries based on studies conducted worldwide [9]. These postponed medical attentions of critical conditions are a result of various factors, including individual responsibility, fear of exposure to COVID-19 or preventive measures and actions taken by countries [10].

These factors might have led to unnecessary fatal consequences, morbidity, and mortality. Moreover, the Performance of the emergency department is measured via specific key performance indicators (KPIs), to ensure the quality of care and improve the performance of ED [11]. Some of these KPIs are already implemented in the emergency

department of KAMC, according to the quality department. Therefore, this study aims to evaluate the impact of COVID-19 on ED visits and quality of service in the pre-pandemic, pandemic, and late-pandemic periods.

This study will be conducted as a comparative retrospective cross-sectional study. This research was conducted in order to compare the numbers of critical conditions such as Acute coronary syndrome, Cerebrovascular accident, Sepsis, and Febrile neutropenia cases presenting to the emergency department before, during, and after the pandemic. Further more, to assess the quality of the emergency department after new measures were applied to adapt to the COVID-19 pandemic protocols.

LITERATURE REVIEW

COVID-19 pandemic effects are still being elucidated. Stay-at-home orders and social distancing compounded with COVID-19 concerns have caused significant disruptions in daily life. One notable effect of these variables may be a change in the number of emergency department (ED) visits.

Since being declared a pandemic by the World Health Organization on March 11, 2020 coronavirus disease (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has spread rapidly causing significant suffering worldwide [12]. In the United States (US) alone there were 895,766 reported cases and 50,439 reported deaths as of April 26, 2020 [13]. In addition to the physical effects of COVID-19, the disease has also challenged the psychological resilience of many individuals and altered behavioural patterns. For instance, a study, which surveyed the Chinese public (from January 31, 2020 to February 2, 2020), found that 54% of respondents rated the psychological impact of the COVID-19 pandemic as moderate or severe. Another study which surveyed the German public (from March 19, 2020 March 23, 2020) found that 28.2% of respondents were afraid of being infected by COVID-19 [14,15]. The fear that the public is experiencing due to COVID-19 is likely exacerbated by measures causing social isolation including quarantines, stay-at-home orders, travel restrictions and closures of non-essential businesses [16,17]. As people practice social distancing, self-isolation, and begin working remotely, the potential for injuries such as trauma due to motor vehicle collisions (MVCs) may decline considerably.

Following WHO’s declaration of COVID-19 as an official pandemic, a study found a significant drop in overall visits to our ED. Patients presenting to the ED with respiratory and

infectious issues sharply increased, while visits related to many other complaints decreased. Musculoskeletal- and trauma-related complaints appear to be the most impacted; this may in part have been due to social distancing and stay-at-home public health messaging resulting in fewer outdoor activities and vehicles on the road. It is important to note the drop in absolute numbers of patients who presented to the ED with potentially life-threatening CTAS 1 and 2 acuities (−47 patients/day; a 37.3% decline), strokes (−1.0 patient/day; a 17.6% decline), and myocardial infarction (MI) (−1.6 patients/day; a 49.9% decline). This a concerning proportion of patients with time-sensitive emergencies who were not presenting to the ED immediately following the pandemic declaration, given that there are no known physiological reasons for the prevalence of these conditions to be lower [18].

Another study conducted in the United States found that the mean number of ED visits per week for the last four weeks of available data during the pandemic was significantly less than the four weeks prior to COVID-19 pandemic ($p = 0.008$). The ED visit decrease per week varied by region, with Region 1 having the greatest decrease (45%). MVCs decreased substantially across all cities studied, with New York City and Baton Rouge experiencing the greatest decrease (66%) during the pandemic [19].

A number of factors have likely contributed to the substantial decrease in ED visits observed in the literature. In light of these findings, it is important to raise patient awareness regarding acute conditions that are deadlier than COVID-19 and require immediate medical intervention to ensure recovery.

It has become clear that COVID-19-related illness has the potential to overwhelm critical care capacity in many, if not all, regions of the world. Telemedicine and telehealth are crucial tools in disease mitigation, preservation of medical staff and equipment, extension of limited resources, and expansion of capacity for effective, safe, and efficient healthcare delivery. In the past two weeks, healthcare organizations across the world have rapidly implemented telemedicine solutions in an effort to care for patients at home, reduce traffic in hospitals and waiting rooms, and coordinate with other care providers [20].

Many hospitals and health systems have invested heavily in large hub-and-spoke telecritical care systems. These integrated and powerful systems should be used and expanded where they are available. But as system stresses continue to worsen, further expansion and linkage of existing efforts will be required, particularly in the management of the expected surge of critical illness [21].

During this global pandemic, telehealth is emerging as an effective and sustainable solution for precaution, prevention and treatment to stem the spread of COVID-19.

Telehealth is bridging the gap between people, physicians and health systems, enabling everyone, especially symptomatic patients, to stay at home and communicate with physicians through virtual channels, helping to reduce the spread of the virus to mass populations and the medical staff on the frontlines. Critically, hospitals are quickly adopting telehealth to treat quarantined patients infected with COVID-19 [20].

In addition, the CDC is urging the public and medical staff to use telehealth solutions for non-urgent communication in an effort to reduce the pressures facing emergency rooms and clinics. By deploying telehealth solutions and programs, people who are suffering from other medical ailments during this time can receive care from home, without entering medical facilities, minimizing their risk of contracting the virus. Telemedicine is being used extensively in the "forward triage" of patients long before they arrive in the primary care clinics [21].

The primary care physicians are working tirelessly in the frontlines at ground zero. Telemedicine enables to divide the patients into the at-risk and not-at-risk groups. Appropriate measures can then be taken to minimize the risks to healthcare workers and patients. The right actions can then be taken for the patients who have been pre-screened, saving precious time and minimizing risks of transmission to all.

Many chronic patients can from home have scheduled teleconsultations to avoid face-to-face clinic visits and hence minimize their risks of exposure to COVID-19. Chronic medicine can be delivered to their house. Also, many in-clinic visits with mild acute respiratory infection can be followed up very closely, almost on a daily basis. Should there be any changes in their clinical states, appropriate actions can be taken immediately. Telemedicine provides a 24/7 lifeline for patients to connect to their providers. This offers great comfort and assurance to the patients in these trying times [20].

Telemedicine can be a tool for managing COVID19. However, there is one glaring disconnect that must resolve. The basis for out-of-hospital management is testing. The linchpin of management of a pandemic is widespread testing and conventional telemedicine today may not offer that. Perhaps a 'crisis-based' evolution of telemedicine can help find local testing centers and also manage the flow of patients seeking a test [21].

With respect to COVID19, the data suggests that most people will have a mild infection and the clinical course will be unremarkable. In these instances, telemedicine may not really be all that necessary. However, for a smaller subset of higher risk patients, the clinical course may not be consistent with conventional telemedicine. These patients often present with a more serious condition that results in rapid decompensation and requires hospitalization. The reality might be that for COVID19, telemedicine, as it exists now, needs to be modified to help manage early testing, diagnosis and triage for those who may require in-patient care [20-21].

METHODS

Study design

This study was a comparative cross-sectional to evaluate the impact of the COVID -19 pandemic on the emergency department. We compared the number of patients visiting the ED with (CVA, ACS, sepsis, febrile neutropenia) in three different periods. The first period was from first of March 2019 until 30th June 2019, which will be identified as a pre pandemic period. The second period was from first of March 2020 until 30th of June 2020, which was identified as a during-pandemic period. The third period was from first of March 2021 until 30th of June 2021, which was identified as a post-pandemic period. The data were collected from the hospital electronic system, medical records, and triage system.

Study population

a) All Patients presenting to the Emergency Department at KAMC

b) Inclusion /Exclusion Criteria

Inclusion criteria:

- All Non-Covid19 patients attending to KAMC Emergency Department in the duration of the study.
- All Covid19 patients presenting with other symptoms attending to KAMC Emergency Department in the duration of the study.
- Patients who have files in KAMC
- Referred patients from other health care centres.
- Patients admitted as a case of lifesaving.

Exclusion criteria:

- Patients < 16 years old.
- Patients who arrived at the emergency department deceased.
- Pregnant patients.
- Unavailability of medical records.

Study procedures

All patients who attended the emergency department during the period specified were included in a retrospective comparative cross sectional study. This study was conducted via data collection from the Emergency department in KAMC. Medical records were used to identify the following:

- MRN
- Episode Type
- Date of presentation.
- Time of presentation.
- Triage code
- Diagnosis
- Disposition of patient
- Date of discharge
- Discharge Status

A period of 2 weeks was required for data collection.

All participants in this study participated the data collection.

Study duration

The study was estimated to complete enrolment within 2 months from study initiation; however, enrolment remained open until the study goal is met. The duration of this study for each subject was a maximum of 6 months.

Outcome assessment

Primary outcome: The number of all patients who presented to the ER and were diagnosed with ACS, CVS, Sepsis, Febrile neutropenia were collected from three periods. The first period was from 1st of March 2019 till 30th June 2019, which was identified as a pre pandemic period. The second period was from 1st of March 2020 till 30th of June 2020 which was identified as a during-pandemic period. The third period was from 1st of March 2021 till 30th of June 2021 which was identified as a post-pandemic period. After numbers were collected, we compared between the three intervals using descriptive studies analysis.

Secondary outcome: To compare the percentage of key performance indicators used to measure quality in the emergency department of KAMC. These included door to doctor, doctor to decision, decision to disposition, percentage of non-urgent patients, and doctor to painkiller time. These were compared over three periods similar to the ones specified above. From the years (2019, 2020, and 2021) from the 1st of March till the 30th of June for each period.

Data collection and management

In this comparative cross-sectional study, data were collected from the KAMC medical records, reviewed and documented in data collection form. Data entry were performed in an excel sheet. Patients were identified by MRN, episode Type, date of presentation, time of presentation, triage code, diagnosis, disposition of patient, date of discharge, discharge Status. After verification, data were transferred to the statistical database directly.

Sample size calculation

Numbers of all ED visitors during the pre-pandemic (1st of March 2019 to 30th of June 2019), during-pandemic (1st of March 2020 to 30th of June 2020), and post-pandemic (1st of March 2021 to 30th of June 2021) were collected.

Statistical analysis

Data obtained were entered and analysed using SPSS program version 23 computer software. Sociodemographic data are presented using descriptive statistics as means, median, percentages and standard deviation. Independent T test and one-way Anova are used to show statistical significance among patients' characteristics and tool scores. Chi square test is used

to show relationship between categorical variables. Statistical significance is set at a P value of 0.05 or less.

Ethical consideration

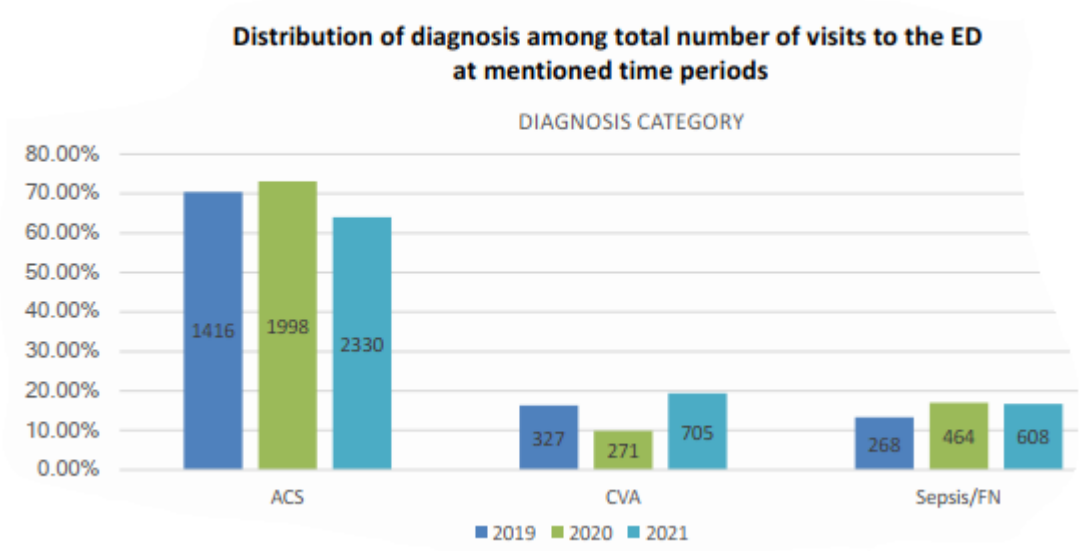
- All investigators will ensure that the study is performed in accordance with ICH – GCP principle.
- No study activities will be started until the IRB approval is obtained.
- Ethical approval will be sought from KAMC IRB.
- To ensure confidentiality, the data will be obtained from the hospital electronic medical records, as it shows no patient identity and has no sensitive information in nature.

RESULTS

The total number of ED visits in the specified periods of study was 8387. The total numbers of patients for 2019, 2020, and 2020 respectively were 2011 (, ACS 70.4%, CVA 16.3%, sepsis and FN 13.3%.), 2733 (ACS 73.1%, CVA 9.9%, sepsis and FN 17.0%), and 3643 (ACS 64.0%, CVA 19.4%, sepsis and FN 16.7). The average percentage of patients who stayed 4 hours or less in the ED was 60% and 57.5% for 2020 and 2021, respectively.

Figure 1 shows the distribution of the ER diagnosis distribution by year. We see that acute coronary syndrome is the leading cause of ER visits among study participants.

Fig 1



On the other hand, figure 2 shows the discharge status of patients. It is noticed that most patients are discharged to home with stable conditions.

Fig 2

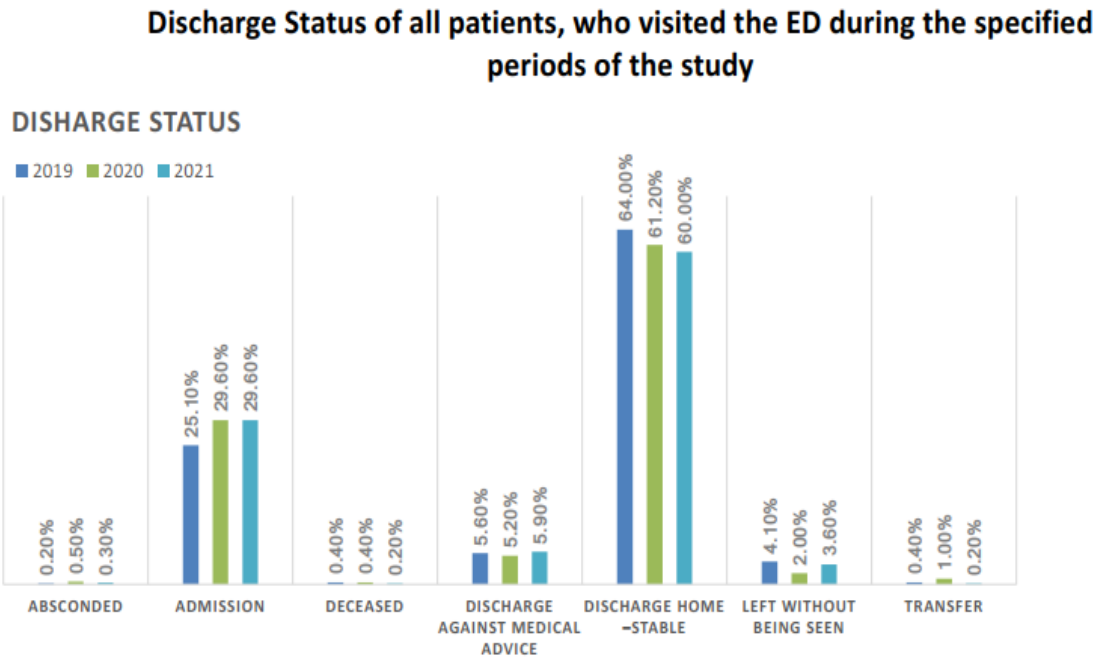
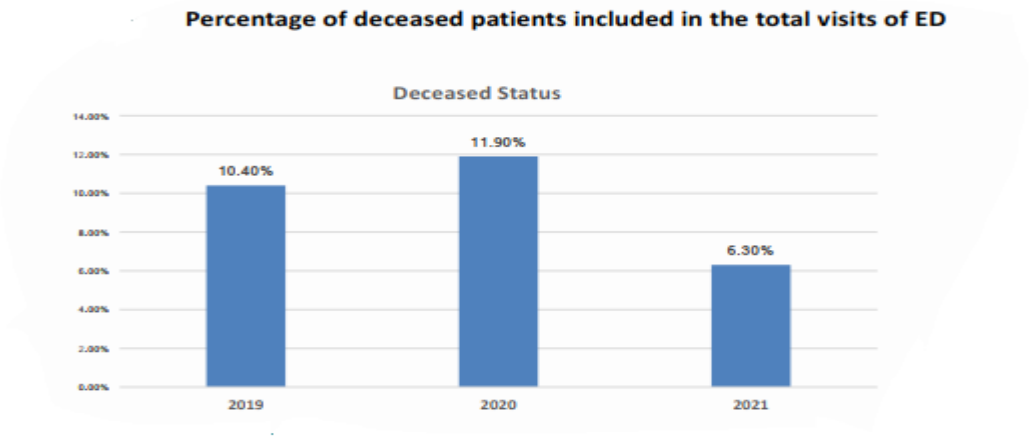


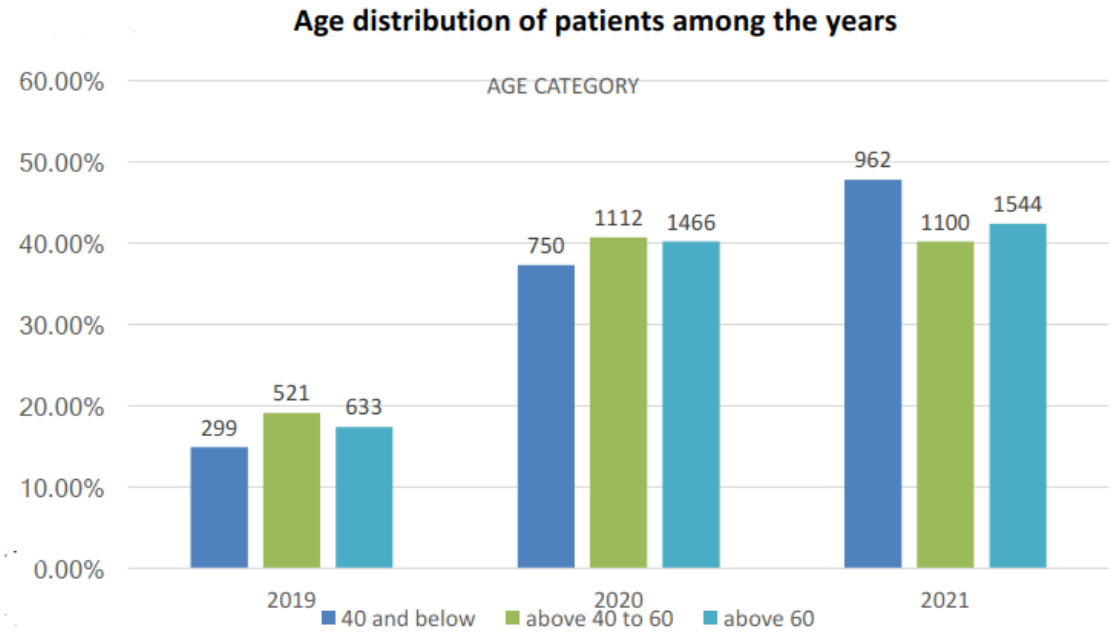
Figure 3 demonstrates the numbers of deceased patients included in the sample visited to the emergency department.

Fig 3



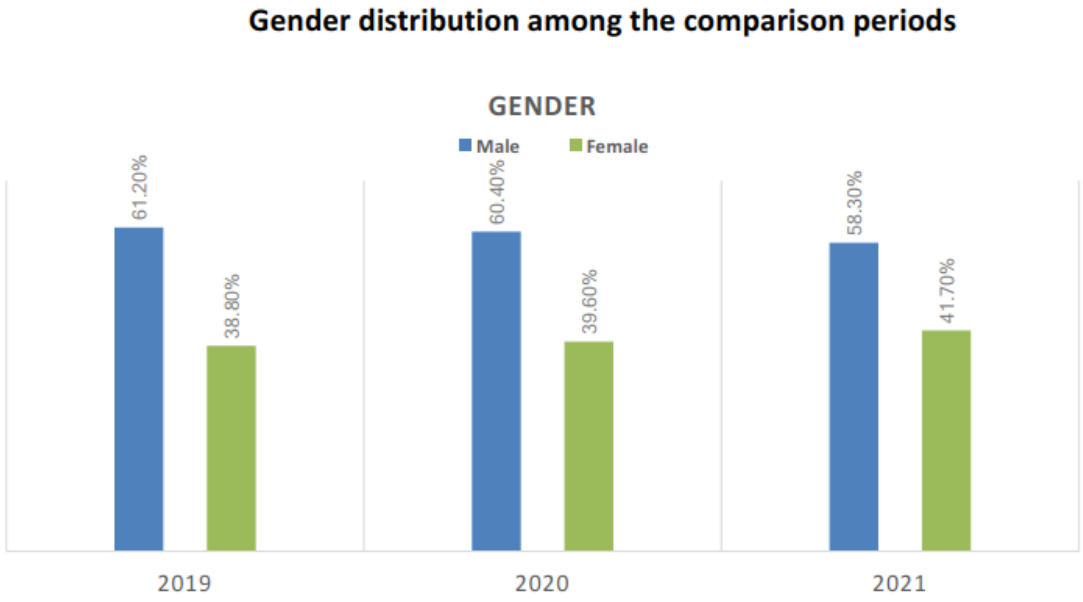
It is noticed from figure 4 that most of emergency room visits are from the age group 40-60 years of age.

Fig4



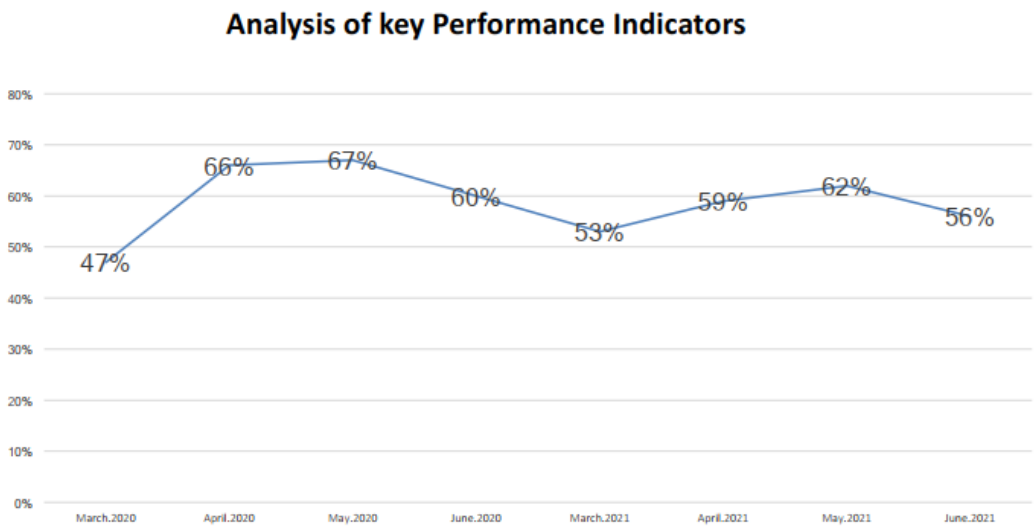
Male population are more prone to ER visits than female population as illustrated in figure 5.

Fig 5



Key performance indicators analysis is presented in the following figure.

Fig 6



In this graph, the percentages of patients who stayed 4 hours or less in the ED were compared between the 4 months period of 2020 and 2021

Table 1: DISCHARGE_STATUS * Year Cross tabulation

			Year			Total
			2019.00	2020.00	2021.00	
DISCHARGE_STATUS	Absconded	Count	5	15	10	30
		% within Year	0.2%	0.5%	0.3%	0.4%
	Admission	Count	504	809	1077	2390
		% within Year	25.1%	29.6%	29.6%	28.5%

	Deceased	Count	9	12	7	28
		% within Year	0.4%	0.4%	0.2%	0.3%
	Discharge Against Medical Advice	Count	113	141	216	470
		% within Year	5.6%	5.2%	5.9%	5.6%
	Discharge Home – Stable	Count	1288	1672	2194	5154
		% within Year	64.0%	61.2%	60.2%	61.5%
	Left without being seen	Count	83	56	130	269
		% within Year	4.1%	2.0%	3.6%	3.2%
	Transfer	Count	9	28	9	46
		% within Year	0.4%	1.0%	0.2%	0.5%
Total		Count	2011	2733	3643	8387
		% within Year	100.0 %	100.0 %	100.0 %	100.0 %

Table 2: Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	59.696[a]	12	<.001
Likelihood Ratio	60.469	12	<.001
N of Valid Cases	8387		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.71.

Table 3: Case Processing Summary						
	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Deceased Status * Year	8387	100.0%	0	0.0%	8387	100.0%

GENDER * Year	8387	100.0%	0	0.0%	8387	100.0%

Deceased Status * Year

Table 4: Crosstab

			Year			Total
			2019.00	2020.00	2021.00	
Deceased Status	NO	Count	1801	2408	3412	7621
		% within Year	89.6%	88.1%	93.7%	90.9%
	YES	Count	210	325	231	766
		% within Year	10.4%	11.9%	6.3%	9.1%
Total		Count	2011	2733	3643	8387
		% within Year	100.0%	100.0%	100.0%	100.0%

Table 5: Chi-Square Tests				
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)
Pearson Chi-Square	63.438[a]	2	<.001	<.001
Likelihood Ratio	65.031	2	<.001	<.001
Fisher-Freeman-Halton Exact Test	65.051			<.001
N of Valid Cases	8387			

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 183.67.

GENDER * Year

Table 6: Crosstab						
			Year			Total
			2019.00	2020.00	2021.00	
GENDER	Female	Count	781	1082	1520	3383
		% within	38.8%	39.6%	41.7%	40.3%

		Year				
	Male	Count	1230	1651	2123	5004
		% within Year	61.2%	60.4%	58.3%	59.7%
Total		Count	2011	2733	3643	8387
		% within Year	100.0%	100.0%	100.0%	100.0%

Table 7: Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)
Pearson Chi-Square	5.426[a]	2	.066	.066
Likelihood Ratio	5.425	2	.066	.067
Fisher-Freeman-Halton Exact Test	5.417			.066
N of Valid Cases	8387			

a. 0 cells (0.0%) have expected count less than 5. The minimum expected

count is 811.16.

Table 8: age_category * Year Cross tabulation

			Year			Total
			2019.00	2020.00	2021.00	
age_category	40 and below	Count	299	521	633	1453
		% within Year	14.9%	19.1%	17.4%	17.3%
	above 40 to 60	Count	750	1112	1466	3328
		% within Year	37.3%	40.7%	40.2%	39.7%
	above 60	Count	962	1100	1544	3606
		% within Year	47.8%	40.2%	42.4%	43.0%
Total		Count	2011	2733	3643	8387
		% within Year	100.0%	100.0%	100.0%	100.0%

Table 9: Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	31.728[a]	4	<.001
Likelihood Ratio	31.702	4	<.001
Linear-by-Linear Association	10.191	1	.001
N of Valid Cases	8387		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 348.39.			

Chi square tests is used to test for the hypothesis that there is a relationship between the diagnosis category and the year. Interestingly the hypothesis is accepted.

Table 10: Diagnosis category * Year Crosstabulation						
			Year			Total
			2019.00	2020.00	2021.00	
Diagnosis	ACS	Count	1416	1998	2330	5744

category		% within Year	70.4%	73.1%	64.0%	68.5%
	CVA	Count	327	271	705	1303
		% within Year	16.3%	9.9%	19.4%	15.5%
	SEPSIS	Count	262	449	597	1308
		% within Year	13.0%	16.4%	16.4%	15.6%
	FEBRILE NEUTROPENIA	Count	6	15	11	32
		% within Year	0.3%	0.5%	0.3%	0.4%
Total		Count	2011	2733	3643	8387
		% within Year	100.0 %	100.0 %	100.0 %	100.0 %

Table 11: Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)

Pearson Chi-Square	125.062[a]	6	<.001	.[b]
Likelihood Ratio	131.169	6	<.001	
Linear-by-Linear Association	25.451	1	<.001	
N of Valid Cases	8387			

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.67.

b. Cannot be computed because there is insufficient memory.

DISCUSSION

The total number of ED visits per week across all study regions began to decline precipitously during the week of March 8, 2020 following months of relative stability. This drop in the total number of ED visits per week was also preceded by an increased percentage of visits beginning around the week of February 23, 2020, which correlated with increased public awareness of COVID-19 as indicated by Google search interest. The increased percentage of visits can likely be explained by a number of factors including a substantial increase in actual COVID-19 cases [9,10].

Interestingly, the drop in ED visits per week during the week of March 8, 2020 coincides with both the World Health Organization declaration describing the COVID-19 outbreak originated in Wuhan, China as a pandemic on March 11, 2020, and increased Google search interest (indicating greater public awareness of COVID-19) [1].

The number of ED visits per week for the last four weeks of available data (from the week of March 15, 2020 to the week of April 5, 2020) was also found to be significantly less than a period of four weeks (from the week of December 15, 2019 to the week of January 5, 2020) prior to increased COVID-19 awareness as determined by Google search trends.

This significant decrease in ED visits per week may partly be explained by desire to maintain social distancing and a desire to avoid contact with infected individuals. A recent poll conducted by the Kaiser Family Foundation in the US from March 25-30th, 2020 identified that 57% of respondents were concerned about being exposed to COVID-19 due to an inability to stay home and miss work [20]. The results of the poll also demonstrated that 82% of respondents were concerned that they will be unable to obtain needed medical care due to the health care system being overrun [20].

This study has several limitations. First, in the process of data collection, we were faced with a systemic dilemma, where records of patients from the months March and April of 2019 were not completely available as there was a technical transformation of the health care system used in KAMC (from Medicaplus to Trakcare). Therefore, only admitted visits records were accessible. Second, the Key Performance Indicators measurement system in the emergency department of KAMC was implemented after the Adaa (MOH program) was introduced in the hospital in December of 2019. Due to this access to KPIs data from the months of 2019 specified in our study were not available.

CONCLUSION

This study was conducted to study if there were reductions in emergency department visits before, during and after lockdown. However, we found that visits to the emergency department were rising through the years 2019-2021, respectively. Various possibilities might have participated in this including, the stability of the health care system in Saudi Arabia, early measures, presentations, restrictions and actions taken by the country . Finally, the important role that our ED here in KAMC played during the crisis. Nevertheless, these findings do not exclude the fact that, awareness of these deadly medical conditions should be raised, and actions must be taken at all times.

This study recommends doing a comparison between the triage system of the ED of KAMC (Canadian triage system) and another tertiary centre that uses the same triage system. In addition, to compare the key performance indicators of the Emergency department of KAMC. Possibly, in the coming year with the current results we have achieved in the study.

List of abbreviations

Emergency Department (ED)

Acute Coronary Syndrome (ACS)

Cerebrovascular Accident (CVA)

Sepsis and Febrile Neutropenia (FN)

World Health Organization (WHO)

Public Health Emergency of International Concern (PHEIC)

King Abdullah Medical City (KAMC)

Key Performance Indicators (KPIs)

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)

United States (US)

Motor Vehicle Collisions (MVCs)

Myocardial Infarction (MI)

Statistical Package for Social Sciences (SPSS)

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