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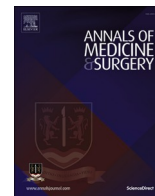
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Cross-sectional Study

Covid-19 pandemic: Economic burden on patients with musculoskeletal injuries in a tertiary care hospital of LMIC; retrospective cross sectional study

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A B S T R A C T

Covid-19 has adversely impacted the health care organizations by over burdening with Covid patients and suspending the elective surgeries and clinics. Hospitalization during pandemic may increase health cost of patients for elective and emergency procedure due to extra cost of covid testing and isolation. A single center retrospective study was conducted to quantify losses due to postponement of elective surgeries and extra cost for procurement of PPEs. The secondary objective was to see the effect of Covid –19 on the total costs of inpatient care during Covid era.

Patient and method: We included all the patients admitted in orthopedic section for operative intervention of fractures and elective procedures from January 1, 2020 to May 31, 2020. We divided this period into two halves; the first half was from January first to March 15 named as PreCovid Era and second half was from March 16, to May 31, 2020, termed as Covid Era. The total number of trauma procedures and elective procedures were compared in both eras. We compared six procedures each from upper and lower limit for cost analysis and length of stay. We also analyzed the extra cost for procurement of PPEs.

Results: A total 625 patients were admitted during study period; 417 in precovid and 208 in covid era. There was 50% reduction in patients admissions during Covid era. There was no statistically significant difference in age and gender of both groups. A total of 840 (591 in preCovid era and 251 in Covid era) procedures were performed on these 625 patients. Elective and emergency procedures were significantly reduced in Covid era. There was 55.7% drop in the collective revenue generated in covid era as compared to that of Precovid era. The average length of stay was decreased in Covid era. No statistically significance difference was found in inpatient hospital charges of both groups except for two procedures ankle and proximal humeral fractures; that was significantly reduced in Covid era. There was significantly increase in use of PPE in covid era

Conclusion: The financial income of our service decreased more than 55% due to postponement of elective work. The number of elective and procedures related to musculoskeletal trauma also decreased. The cost for inpatient care did not increase during covid era. There was significant reduction in inpatient hospital stay during covid era. The hospital management had to spent additional expenses on procurement of PPEs.

1. Introduction

World health Organization pronounced Covid-19 as pandemic on March 11, 2020 [1]. Currently world is experiencing another pandemic after swine flu in 2009. Pandemics are large-scale outbreaks of infectious disease that severely threaten health care systems due to difficulty in forecasting number and severity of cases, unavailability of immediate vaccines, and insufficient antiviral stockpiles to meet demand [2]. After the report of novel coronavirus from Wuhan, China, the world's dynamics have changed in every aspect. It has spread in 210 countries and Territories around the world with reported a total of 13,019,470

confirmed cases of the coronavirus COVID-19 and a death toll of 570, 918 deaths [3].

The first corona case in Pakistan was reported from our University Hospital on 26th February 2020 [4] who travelled from Iran and contacted the virus from there. Since then the tally has risen to 253,604 cases and 5320 deaths till today 14th July 2020. Steps have been taken pre-emptively by the government to prevent the spread of the disease and reinforced across the country via law enforcement agencies (military, police and paramilitary staff). Awareness among people to take strict precautions which include hand hygiene, use of masks, physical and social distancing haven been reinforced repeatedly [5]. Covid-19

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has adversely impacted the economy of Pakistan that was already burdened with poor and challenged socioeconomic conditions [6]. American hospital Association has recently published a report regarding the catastrophic financial challenges faced by the private hospitals due to Covid –19 pandemic that has shifted all efforts of hospital management and health care workers towards treatment and prevention of Covid –19 [7].

Recently Khullar et al. [8] pointed out that major source of earning of private hospitals is through inpatient elective surgeries especially orthopedic and outpatient clinics. With outbreak of Covid –19 all the elective surgeries have been postponed and deferred, that had made financial survival of hospital difficult.

The containment and control of the outbreaks costs substantial amounts of funds and resources. Based on the above observations we proposed this retrospective study to quantify losses due postponement of elective surgeries and procurement of PPEs and see the effect of Covid –19 on the total costs of inpatient care during Covid era. We also wanted to see the percentage decrease in elective surgeries in covid era and its financial implications. Another objective of this retrospective review was to analyze factors associated with increased cost of the patients if any admitted in orthopedic units during COVID-19 pandemic versus those admitted before pandemic.

2. Methodology

This is a single hospital retrospective study conducted in the orthopedic section of MSM service line in country's largest tertiary care hospital and level-1 trauma center certified by the Joint commission International (JCI). The study proposal was approved by the Ethical Review Committee (ERC) of the institute (ERC number- 2020-4988-10955).

We included all the patients admitted in orthopedic section for operative intervention of fractures and elective procedures from January 1, 2020 to May 31, 2020 over 5 month period of time. We divided this period into two halves; the first half was from January first to March 15 named as PreCovid Era and second half was from March 16, to May 31, 2020, termed as Covid Era. The lockdown in Pakistan was announced from March 15, 2020. All the patients admitted during 5 months were further segregated into two groups; trauma and elective procedures group. The trauma group included all the fractures, lacerations, open injuries of nerves, tendon and vessels while elective procedures included joint replacements, tumor surgery, tendon reconstruction, tendon transfer, corrective osteotomies etc. The commonest orthopedic procedures of fracture fixations (dynamic hip screw (DHS), hemiarthroplasty of hip, open reduction and internal fixation of distal radius with locking compression plate, fixation of humeral shaft and proximal humerus, intra-medullary nailing of tibia and femur), nail bed injury, open lacerations of limbs and acute tendon repairs were included in our study. First group included the patients who underwent procedures in the pre COVID era i.e. from 1st January 2020 to 15th March 2020, when lockdown in the city was not imposed and elective surgical procedures were being done along with musculoskeletal trauma. The second group included patients who underwent procedures in the COVID-19 era i.e. from March 16, 2020 to May 31, 2020, when lockdown in the city was imposed and only emergent and semi emergent surgeries took place. The total number of trauma procedures and elective procedures were compared in both eras preCovid vs Covid- Only 12 procedures; 6 from upper limb and six from lower limb were selected for comparisons in both eras to see the difference in hospital stay, percentage in cost difference, extra cost for PPEs extra laboratory tests for corona and isolation of patients.

Patients presenting with other bone morbidities that did not require surgical interventions including rickets, osteomalacia, osteogenesis imperfecta, marble bone disease (osteopetrosis), Paget disease of bone, and fibrous dysplasia, patients with incomplete medical records were excluded from the study.

2.1. Data collection and analysis

Clinical and demographic characteristics of patients during their hospitalizations were collected by a review of medical records of patient files and hospital management information system. The data collection was through a preformed structured proforma, that included demographic data, comorbidities, length of stay, surgical procedure performed, and screening symptoms for COVID-19, nasal or Oropharyngeal swab COVID-19 Polymerase chain reaction (PCR), the expense of PPEs in Covid era and isolation if a patient was kept in isolation due to suspicion or proven covid.

SPSS v24 was used for data entry and statistical analysis. Nominal and categorical variable were recorded as frequency and percentages while discrete and continuous data was expressed as means and standard deviation. Quantitative data was analyzed using student *t*-test while qualitative data will be analyzed using Chi-square or Fischer exact test where applicable. A *p*-value of ≤ 0.05 was considered as significant.

Data collected was managed by the principal investigator and the investigating committee only. All data was kept confidential.

The work has been reported in line with STROCSS criteria [9].

3. Results

A total 625 patients were admitted during study period. 417 patients were admitted in precovid and 208 were admitted in covid era; a 50% reduction in admission during Covid era. There was no statistically significant difference in age (*p*-value 0.66) and gender (*p*-value 0.31) in both groups. A total of 840 (591 in preCovid era and 251 in Covid era) procedures were performed on these 625 patients, with a 57.5% reduction in procedures during the Covid era. The actual numbers of performed procedures were more than the admissions as many patients with poly trauma and open injuries required multiple procedures. The distribution of elective procedures in PreCovid era was 297 and 85 in Covid; a significant reduction of 71.57% in numbers of procedures in Covid era. The emergency procedures in Precovid were 292 vs 166 in Covid era; 43.15% reduction in emergency procedures (Table 1).

There was 55.7% drop in the collective revenue generated in covid era as compared to that of Precovid era.

We selected six procedures each from upper and lower limb for comparison to see if cost of procedure increased due to isolation and tests for Covid-19. No statistically significance difference was found in inpatient hospital charges of both groups in patients who underwent bipolar hemiarthroplasty (*p*-value 0.13), dynamic hip screw fixation (*p*-value 0.19), intramedullary nail femur (*p*-value 0.057), intramedullary nail tibia (*p*-value 0.94), open reduction internal fixation periarticular fracture around the knee (*p*-value 0.90) from lower limb fractures. The only statistically significance difference was found in patient who

Table 1
Patient characteristics, admission and procedures performed.

S#	Variables	Pre-COVID Era N = 589 n (%)	COVID Era N = 251 n (%)	% decrease	<i>p</i> -value
1	Mean Age (in years)	40.51 ± 22.1	41.31 ± 24.2		0.66
2	Gender				0.31
	Male (n = 530)	365	165		
	Female (n = 312)	226	86		
3.	Number of admissions	417	208	–50.1%	
3	Admission type	423	144	–65.95%	<0.001
	Clinic	(71.6%)	(57.4%)	–36.30%	
	ER	168 (28.4%)	107 (42.6%)		
5.	Total revenue generated	x	0.55x	–55.7%	

underwent surgery for open reduction internal fixation of ankle fracture (p-value 0.036). Analyzing the cost difference from upper limb fractures; no statistical difference was found in patients who underwent open reduction internal fixation humerus shaft fracture (p-value 0.93), open reduction internal fixation fracture around elbow (p-value 0.95), open reduction internal fixation radius ulna shaft fracture (p-value 0.66), open reduction internal fixation distal radius fracture (p-value 0.67), open reduction internal fixation hand fractures (p-value 0.15). The only difference was seen in patients who underwent open reduction internal fixation proximal humerus fracture (p-value 0.02) (Tables 2 and 3).

Comparing the length of stay of patients in which 12 procedures were compared, there was decrease in the number of days in Covid era. Majority of these patients were discharged earlier to encourage social distancing for the patients and attendants and their rehabilitation was facilitated at home by trained physiotherapists.

4. Discussion

We sought to determine the economic impact of Covid-19 on earning of MSM service line and cost difference for inpatient care with musculoskeletal trauma admitted during covid era. The major finding was that there was significant reduction in the number of hospitalization and

Table 2
Comparison of cost of lower limb procedures.

S#	Procedure	%age difference in covid era (+for increase/- for decrease)	P-values	Length of stay		p-value
				Pre-covid	Covid	
1.	Bipolar hemiarthroplasty N = 5/12					
	Ward	-38.02%	0.02	9.0 ± 4.0	5.58 ± 2.64	.134
	Semi-private Private	+7.89% -25.58%	0.85 0.28			
2.	DHS N = 31/12					
	Ward (n = 22/10)	0.7%	0.96	5.29 ± 2.4	4.17 ± 2.5	0.19
	Semi-private Private (n = 9/2)	- -20.9%	- 0.25			
3.	Intramedullary nailing of femur N = 16/6					
	Ward (n = 11/2)	-0.28%	0.99	4.31 ± 2.2	3.83 ± 1.5	0.57
	Semi-private (n = 4/1)	-5.34%	0.26			
	Private (n = 1/2)	-1.67%	0.13			
4.	Intramedullary nailing of tibia N = 8/3		0.5153	2.75 ± 0.9	2.67 ± 1.5	0.94
	Ward (n = 6/2)	-1.33%	0.97			
	Semi-private Private (n = 2/1)	- +0.96%	- 0.90			
5.	ORIF ankle fractures N = 13/8					
	Ward (n = 4/4)	-41.37%	0.04	4.31 ± 1.9	2.13 ± 2.0	0.036
	Semi-private (n = 4/2) Private (n = 5/2)	-21.4% -9.92%	0.25 0.81			
6.	Peri-articular fractures around knee N = 9/6					
	Ward (n = 7/5)	+15.28%	0.19	4.0 ± 3.3	3.83 ± 1.8	0.90
	Semi-private Private (n = 2/1)	- +33.03%	- 0.60			

Table 3
Comparison of cost of upper limb procedures.

S#	Procedure (precovid/covid)	%age difference in covid era (+for increase/- for decrease)	P-values	Length of stay		p-value
				Pre-covid	Covid	
1.	ORIF distal radius N = 13/13			1.692 ± 1.7	1.923 ± 0.9	0.67
	Ward (n = 10/9)	+18.98%	0.13			
	Semi-private (n = 2/1) Private (n = 1/3)	-38.2% +2.89%	0.28 0.79			
2.	LCP for humerus N = 7/5			2.29 ± 2.0	2.2 ± 1.3	0.936
	Ward (n = 5/4)	-22.84%	0.32			
	Semi-private Private (n = 2/1)	- +31.08%	- 0.35			
3.	Radius + Ulna shaft ORIF N = 6/4			1.33 ± 0.5	1.5 ± 0.58	0.66
	Ward (n = 4/3)	-14.23%	0.38			
	Semi-private (n = 2/1) Private	-28.8% -	0.37 -			
	Total					
4.	PHILOS for humerus N = 5/4			5.2 ± 1.6	2.75 ± 0.9	0.029
	Ward (n = 3/1)	+35.1%	0.53			
	Semi-private Private n=(2/3)	- -25.86%	- 0.47			
5.	Fractures around elbow (distal humerus and proximal ulna + radius) N = 20/5			1.75 ± 0.9	1.8 ± 1.7	0.95
	Ward (n = 15/3)	+14.05%	0.54			
	Semi-private (n = 4/1) Private (1/1)	-17.26% -37.26%	0.49 -			
6.	Hand fractures N = 12/5			2.08 ± 1.8	1.0	0.15
	Ward (n = 11/3)	-43.09%	0.09			
	Semi-private (n = 1/2) Private	+56.61% -	0.585 -			

decrease in hospital revenue during covid era than precovid era but inpatient care of patients with fracture admitted during COVID-19 era did not increase the cost of care compared with that for precovid era.

Measures to control the spread of infection involved isolation and quarantine, social distancing, lockdown of an entire city, cancellation of flights which had social and economic impacts [10]. Care of inpatients required the use of personal protective equipment (PPE) by health care provider [11] to prevent the spread of infection which caused extra financial burden on the patient in addition to surgical charges. Furthermore, our hospital policy of COVID-19 screening of all patients requiring general anesthesia caused extra financial burden which has economic impact on the patient and caused delay in surgery of patient. While waiting in isolation negative suction room for screening report to become available before treatment is started resulted in extended stay and increase cost. Taken together, these findings underline and partly explain the high cost associated with inpatient care of orthopedic patient. But in our study no significance difference was found in inpatient charges in both groups. The main reason was there was significant reduction in inpatient hospital stay during covid era which resulted in

significant reduction in the cost of care. The only statistically difference was found in ankle fracture and proximal humerus fractures groups which are due to short hospital stay.

Surgical procedures contribute a large percentage of revenues to the hospital. Elective procedures account for 48% of hospital costs. The cessation of elective surgery and decrease in the number of semi elective surgery has jeopardized the financial solvency of many health-care organizations already in distress as a result of the crisis [12]. In our study we found 50.1% decline in admission rate and surgical procedure rate in covid era than precovid era which has resulted in 55.7% decline in the revenue generated by MSM service line.

The use of PPE was increased 100% during Covid period as compared to Precovid era. More over the hospital management had to spend additional money to procure PPEs and this extra cost was not charged to the patient. The hospital management had to bear the brunt of financial losses due to decreased revenue and increase expenditure for PPEs. In spite of financial difficulties, hospital did not cut down the number and salaries of employees.

5. Conclusion

We conclude that inpatient admissions, elective procedures and procedure related to musculoskeletal trauma decreased during upsurge of Covid-19, which ultimately impacted the financial revenue generation of a private teaching Hospital. We also found that care of noninfected patient admitted with fracture during covid era did not substantially increased the cost of care, compared with costs for inpatient care of patient admitted in precovid era. There was significant reduction in inpatient hospital stay during covid era.

Limitations

This study compares the effect of COVID-19 on financial earning of MSM service line and economic burden for orthopedic patient presented to our institution only, which limits its generalizability.

Guarantor

The Guarantor is the one or more people who accept full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish.

All Authors take responsibility.

Ethical approval

Research studies involving patients require ethical approval. Please state whether approval has been given, name the relevant ethics committee and the state the reference number for their judgement.

Yes given by the Aga Khan University Ethical Review Committee, ERC # 2020-4988-10955.

Author contributions

Pervaiz Hashmi; Design of the protocol, conducting the study and data collection, manuscript writing and final approval.

Shah Fahad; Design of the protocol, conducting the study, analysis and manuscript writing and final approval.

Hammad Naqi Khan; Design and manuscript review and final approval.

Marij Zahid; Design and manuscript review and final approval.

Anum Sadrudin; Design of the protocol, analysis.

Shahryar Noordin; Design and manuscript review and final

approval.

Registration of research studies

Name of the registry: [ClinicalTrials.gov](https://clinicaltrials.gov).

Unique Identifying number or registration ID: NCT04482205.

Hyperlink to your specific registration (must be publicly accessible and will be checked): <https://register.clinicaltrials.gov/prs/app/action/SelectProtocol?sid=S000A203&selectaction=Edit&uid=U0004FMN&ts=2&cx=-i6h8sr>.

Consent

NA.

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Declaration of competing interest

All authors must disclose any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work. Examples of potential conflicts of interest include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amsu.2020.09.049>.

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