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Effect of COVID-19 on Hip and Knee Arthroplasty Surgical Volume in the United States

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ABSTRACT

Background: In an effort to help combat the COVID-19 pandemic and preserve essential health care resources, starting in mid-March 2020, surgeons have been instructed to only perform essential surgical procedures. The vast majority of hip and knee arthroplasty surgery does not meet the definition of essential surgery. This study estimated the number of arthroplasty procedures that would be canceled because of these important restrictions.

Methods: The US hip and knee arthroplasty procedure volume projections for 2020 were estimated from four recently published studies. Data from the American Joint Replacement Registry were utilized to determine what percentage of these cases would be considered nonessential surgery. Monthly and weekly estimates of nonessential hip and knee arthroplasty procedures that would have occurred had there not been any restrictions due to COVID-19 were calculated.

Results: After excluding essential procedures, it was estimated that approximately 30,000 primary and 3000 revision hip and knee arthroplasty procedures will be canceled each week while COVID-19 restrictions regarding nonessential surgery are in place. If only 50% of nonessential cases were actually canceled across the United States, that would still result in the cancellation of 15,001 primary and 1435 revision hip and knee arthroplasty procedures per week while restrictions are in place.

Conclusion: This study highlights the profound impact COVID-19 is having on our current hip and knee arthroplasty volume. The large number of cases canceled because of COVID-19 translates into major financial losses for health care institutions and may have a profound impact on our patients.

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In an effort to help combat the SARS-CoV-2 (COVID-19) pandemic, minimize the burden on the health care system, and preserve essential health care resources needed to care for patients infected with COVID-19, the American College of Surgeons (ACS) and the Centers for Medicare & Medicaid Services (CMS), have recommended postponing or canceling elective procedures starting mid-March 2020. Most states have followed with similar guidelines [1]. Although definitions of “elective” or “nonessential” surgery vary across guidelines and state mandates, almost all primary hip

and knee arthroplasty procedures and most revision hip and knee arthroplasty procedures fall within the nonessential definition. The American Association of Hip and Knee Surgeons (AAHKS) and the American Academy of Orthopaedic Surgeons have both voiced support for these measures and have provided information for their members to navigate these recommendations.

These drastic efforts are important steps in the worldwide fight against the COVID-19 pandemic. However, this mandated reduction of nonessential surgical procedures will have a profound impact on the health care system [2]. Furthermore, given that hip and knee arthroplasty comprise a substantial share of the surgical volume in the United States, there is no doubt these policies are hard felt by hip and knee arthroplasty patients and the providers and institutions that care for them. The purpose of this study was to estimate 1) the number of primary hip and knee arthroplasty procedures canceled because of COVID-19 and 2) the number of revision hip and knee arthroplasty procedures canceled because of COVID-19 to better understand the effect of COVID-19 on hip and knee arthroplasty surgical volume in the United States.

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Methods

The availability of current national procedural data is quite limited in the United States. Therefore, a literature review was performed to identify recently published studies that projected hip and knee arthroplasty volume for 2020. Four studies that projected hip and knee arthroplasty procedure volume in the United States for 2020 were assessed [3–6]. These studies utilized various projection modeling algorithms and periods of data to create hip and knee arthroplasty volume projections. Overall, the projected number of primary total knee arthroplasty (TKA) procedures to be performed in 2020 ranged from approximately 775,000 to 1.4 million, and the projected number of primary total hip arthroplasty (THA) procedures to be performed in 2020 ranged from approximately 460,000 to 512,000 depending on the specific model utilized [3–6]. Only one study provided projections for revision hip and knee arthroplasty procedures during 2020, with Kurtz et al. [6] projecting approximately 128,000 revision TKA procedures and 66,000 revision THA procedures to be performed in 2020. To best estimate the projected primary THA and TKA volume for 2020, the volume projections across these four studies were averaged for the various procedures, including their multiple projection models. These calculations resulted in an estimated 1,078,359 primary TKA and 495,140 primary THA to be performed in 2020.

In general, the recommendations/mandates from various states, the CMS, and the ACS specified that surgeons only perform “essential” surgical procedures and to postpone or cancel “nonessential” surgery [1]. Although definitions for essential and nonessential surgical procedures are either not defined or vary across published guidelines [1], for the purposes of this study, the following arthroplasty procedures were assumed to fall under a general definition of “essential” and thus would likely proceed despite COVID-19 restrictions: THA for hip fracture, periprosthetic fracture-related revision TKA or THA, and infection-related revision TKA and THA. To estimate the number of these presumed essential hip and knee arthroplasty procedures for 2020, data from the American Joint Replacement Registry (AJRR) was assessed [7]. According to the AJRR 2019 Annual Report, THA for fracture accounted for 2.7% of all primary THA procedures occurring from 2012 to 2018 [7]. Over this same period, THA revisions were performed for infection in 13.3% of cases, periprosthetic fracture in 5.4% of cases, and fracture or fracture-related sequelae in 4.3% of cases [7]. Similarly, from 2012 to 2018, TKA revisions were performed for infection in 20.5% of cases and fracture or fracture-related sequelae 2.3% of cases [7]. These percentages were utilized to exclude “essential” cases from the 2020 volume projections to estimate the number of “nonessential” hip and knee arthroplasty procedures that were projected to occur throughout 2020.

Utilizing the estimated nonessential 2020 volume projections, monthly and weekly estimates of nonessential hip and knee arthroplasty procedures that would have occurred had there not been any restrictions due to COVID-19 were calculated. These estimates were made by dividing the 2020 projections equally into

the respective periods. This strategy was felt to be valid after reviewing the AJRR data to calculate the number of primary and revision hip arthroplasty procedures performed per month over the years 2018 and 2019. This analysis revealed the monthly procedural volumes varied slightly month to month with a range of 6.2% to 9.9% of total procedures occurring per month in 2018 (median: 8.8%) and a range of 5.5% to 10.3% of total procedures occurring per month in 2019 (median: 9.1%). In 2018, 8.9% of all hip and knee arthroplasty procedures occurred in April and 9.2% occurred in May. In 2019, 10.0% of all hip and knee arthroplasty procedures occurred in April and 10.3% occurred in May. Therefore, the monthly and weekly projections used here likely underestimate the number of procedures canceled due to COVID-19 as most cancellations are likely to occur during the months of April and May.

Although it is hoped that all surgeons and hospital systems followed the recommendations from the CMS, the ACS, and their respective states [1]; at this time, it cannot be determined how these guidelines were followed across the nation. Therefore, estimates have been created utilizing four different cancellation scenarios (100%, 75%, 50%, and 25% of “nonessential” cases canceled) to project the number of primary and revision hip and knee arthroplasty cases that would be canceled per month and per week for each scenario.

Results

Estimated “Nonessential” Case Volume

After excluding THA for hip fracture, an estimated 481,771 primary THA and 1,078,359 primary TKA were projected to occur during 2020 in the United States. After excluding revision hip and knee arthroplasty procedures performed for infection and revision hip and knee arthroplasty procedures performed for fracture or fracture-related sequelae, 50,792 revision THA and 98,438 revision TKA were projected to be otherwise performed in the United States in 2020 (Table 1). This translates into a projected 130,001 primary and 12,436 revision hip or knee arthroplasty procedures that would occur in a given month during 2020. In addition, this equates to a projected 30,002 primary and 2870 revision hip or knee arthroplasty procedures that would occur in a given week during 2020 (Table 1).

Cancellation Scenarios

If national and state recommendations to cancel nonessential procedures during the COVID-19 pandemic are followed by all orthopedic providers in the United States (100% cancellation scenario), this would result in 30,002 primary and 2870 revision hip and knee arthroplasty procedures being canceled during each week while COVID-19 restrictions regarding nonessential surgical procedures are in place (Table 2). At the time of preparing this article, it is quite likely that such restrictions will remain in place for a least a month which would result in 40,148 primary THA, 89,863 primary

Table 1
Non-essential Hip and Knee Arthroplasty 2020 Surgical Volume Estimates.

Surgery Type	Projected 2020 Nonessential Procedures	Projected 2020 Nonessential Procedures, per Month	Projected 2020 Nonessential Procedures, Per Week
Primary THA	481,771	40,148	9265
Primary TKA	1,078,359	89,863	20,738
Revision THA	50,792	4233	977
Revision TKA	98,438	8203	1893
Total primary procedures	1,560,130	130,001	30,002
Total revision procedures	149,230	12,436	2870

TKA, total knee arthroplasty; THA, total hip arthroplasty.

Table 2
Nonessential Surgery Cancellation Scenarios, per Week Estimates.

Surgery Type	100% Cancellation	75% Cancellation	50% Cancellation	25% Cancellation
Primary THA	9265	6949	4632	2316
Primary TKA	20,738	15,553	10,369	5184
Revision THA	977	1420	947	473
Revision TKA	1893	733	488	244
Total primary procedures	30,002	22,502	15,001	7501
Total revision procedures	2870	2152	1435	717

TKA, total knee arthroplasty; THA, total hip arthroplasty.

TKA, 4233 revision THA, and 8203 revision TKA being canceled because of COVID-19 restrictions (Table 3).

The per week and per month estimates of nonessential primary and revision hip arthroplasty procedures that would be canceled for each cancellation scenario are found in Tables 2 and 3. For example, if only 50% of nonessential cases were actually canceled across the United States, that would still result in the cancellation of 15,001 primary and 1435 revision hip and knee arthroplasty procedures per week while COVID-19 restrictions are in place (Tables 2 and 3).

Discussion

The COVID-19 pandemic has resulted in unprecedented restrictions aimed at curbing the pandemic's impact, thereby affecting all aspects of society. The health care industry has been particularly affected. The ACS, the CMS, and most states have recommended or mandated that only essential surgical procedures be performed during the COVID-19 outbreak [1]. This study sought to estimate the number of nonessential hip and knee arthroplasty procedures that would be canceled per week and per month while these restrictions were in place. We estimated that approximately 30,000 primary and 3000 revision hip and knee arthroplasty procedures would be canceled each week while these important recommendations remain in place.

These results highlight the profound impact COVID-19 is having on hip and knee arthroplasty patients as well as the medical institutions that care for them. Not only will institutions be hurt by the lost revenue from these canceled procedures but rescheduling approximately 130,000 primary and 12,000 revision arthroplasty surgeries will bring increased burden to an already struggling health care system. However, a predicted surge of rescheduling canceled cases is based on the assumption that patients will want to reschedule their surgery, or new patients will want to be indicated for surgery, once restrictions from COVID-19 are lifted. It is unknown how a pandemic will impact a patient's willingness to proceed with hip or knee surgery in the near future. With the recent grim statistics regarding national unemployment, a sizable share of the population becoming recently unemployed or underemployed will undoubtedly influence the ability of patients relying on private insurance to undergo joint reconstruction procedures. As

an illustrative example, following the economic downturn during 2008 and 2009, 30% of AAHKS surgeons reported a surgical volume decrease [8]. The results of this survey are supported by the identification of a plateau in arthroplasty procedures performed in 2008 to 2009 by Kurtz et al. [6] that was thought to be attributed to the recessionary conditions during that time. These studies suggest that the current impact of COVID-19 on the US economy may have a similar impact on subsequent demand for hip and knee arthroplasty during the early period of reopening our health care system to nonessential surgery. However, it is important to note that the anticipated long-term trends for demand in total joint were not significantly impacted by the recession in the late 2000s [6].

There are limitations to these estimates. First, the estimates were based on projected 2020 hip and knee arthroplasty volume from other studies and are thus limited by the accuracy of those projections. However, we sought to minimize these limitations by averaging the 2020 primary hip and knee arthroplasty volume projections from four recently published data sets [3–6]. Furthermore, it is likely that recommendations to cancel nonessential surgery were implemented over different periods. However, given the timing of state and national recommendations [1] and the current status of the COVID-19 pandemic, it is likely that most medical centers in the United States will perform minimal primary hip and knee arthroplasty and very few essential revision procedures during the months of April and May of 2020 and thus we have provided both weekly and monthly projections to account for this and to provide as accurate projections as possible. Finally, the true number of canceled hip and knee arthroplasty procedures will also greatly depend on how long the COVID-19 pandemic lasts and when restrictions on nonessential surgical cases can be lifted. These will happen at various times across the country, as each city and state go through their own phase of the pandemic.

The results of a survey given to AAHKS members regarding the impact of COVID-19 on their practice of hip and knee arthroplasty surgery was recently released [9]. The survey results indicated that 92% of hospitals have stopped elective inpatient surgery because of COVID-19 and 74% of responding surgeons are effectively not working because of institutional or self-imposed deferral of elective surgery [9]. These survey results suggest that our estimates from the 100% and 75% cancellation scenarios may be the most accurate projections for the number of cases canceled

Table 3
Non-essential Surgery Cancellation Scenarios, per Month Estimates.

Surgery Type	100% Cancellation	75% Cancellation	50% Cancellation	25% Cancellation
Primary THA	40,148	30,111	20,074	10,037
Primary TKA	89,863	67,397	44,932	22,466
Revision THA	4233	3175	2116	1058
Revision TKA	8203	6152	4102	2051
Total primary procedures	130,001	97,508	65,005	32,503
Total revision procedures	12,436	9327	6218	3109

TKA, total knee arthroplasty; THA, total hip arthroplasty.

per week due to COVID-19. Furthermore, the AAHKS survey results indicated that essential surgery is still occurring throughout the United States, with 64% of those who responded indicating they are still performing surgery for periprosthetic joint infection and 88% performing surgery for periprosthetic fracture [9]. These results also support our assumptions that infection- and fracture-related revisions would continue to occur as essential surgical procedures.

The results of this study highlight the profound impact COVID-19 is having on our current hip and knee arthroplasty volume. The large number of estimated cases canceled because of COVID-19 translates into major financial losses for our health care institutions and may have profound effects on our patients who had to have their surgery postponed. Even when utilizing a relatively conservative cancellation scenario, estimates still translate close to 100,000 hip and knee arthroplasty procedures being canceled in a given month because of COVID-19. We hope that these estimates help policy makers, administrators, health care providers, and patients better understand the impact COVID-19 is having on the hip and knee arthroplasty community and our patients as we all work together to combat this pandemic.

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