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► **To cite this version:**

Roger Erivan, Anna Tardieu, Guillaume Villatte, Matthieu Ollivier, Christophe Jacquet, et al.. Knee surgery trends and projections in France from 2008 to 2070. *Orthopaedics & Traumatology: Surgery & Research*, 2020, 106 (5), pp.893-902. 10.1016/j.otsr.2020.02.018 . hal-03138624

HAL Id: hal-03138624

<https://uca.hal.science/hal-03138624>

Submitted on 22 Aug 2022

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Original article

Knee surgery trends and projections in France from 2008 to 2070

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Abstract

Introduction: Knee surgery makes up a large share of the orthopedic surgery practice. Data on how this activity has changed over time is not available in France, thus we wanted to do a study to determine 1) how many knee surgeries were performed in France in 2018, 2) how this changed between 2012 and 2018, and 3) how it is projected to change by 2070. The hypothesis is that the number of knee surgeries will increase over the next 50 years.

Methods: This was an epidemiology study analyzing coding data for surgical procedures in France between 2012 and 2018. Two scenarios were defined to assess the change over time: the first only considered population growth and how the age distribution changes over time; the second extrapolated the trends observed over the past few years.

Results: In 2018, 321,179 procedures were coded as a main knee surgery procedure. The three most frequent were primary knee arthroplasty with 113,600 procedures (31.2% of procedures) then meniscus surgery (110,510 procedures or 30.3%) and then ligament surgery (57,053 procedures or 15.7%). The number of primary knee arthroplasty procedures increased by 32.2% between 2012 and 2018. Between 2018 and 2050, the different scenarios suggested an increase of 30.8% to 152.8%. The number of ligament surgery procedures increased by 17.3% between 2012 and 2018. Between 2018 and 2050, an increase of 1.2% to 49.2% is expected. The number of meniscus procedures decreased by 14.2% between 2012 and 2018. Between 2018 and 2050, scenario 1 projects a 5.6% increase and scenario 2 a 73.6% reduction.

Discussion: The number of knee surgery procedures per year has increased over the past few years in France and should continue to increase.

Level of evidence: IV, descriptive epidemiology study

Keywords: epidemiology; knee; knee arthroplasty; trends; prediction; national data

1. Introduction

The number of orthopedic surgery procedures has increased over the past decades throughout the world [1–3]. This can be attributed to multiple factors, including better outcomes due to improvements in the devices, techniques and peri-operative care [4]. Knee surgery consists of ligament and meniscus surgery in a younger population and also knee arthroplasty surgery in an older population. The French population is increasing in size and age [5]. Thus, it would be useful to know how many of these surgeries are being done and how this will change in the future. In Nordic countries, this analysis is done using registries [6–8]. In France, this analysis is done by looking at procedure coding and procedure-based pricing.

To our knowledge, this data has not been generated for knee surgery in France. This led us to carry out a study to determine 1) how many knee surgeries were performed in France in 2018, 2) how this changed between 2012 and 2018, and 3) how it is projected to change by 2070. We hypothesized that the number of knee surgeries will increase over the next 50 years.

2. Materials and Methods

Materials

This was a descriptive epidemiology study. The data were generated using the same methodology as a recent article on hip surgery procedures [9]. The coding information was consulted in May 2019 to capture data from 2018 in its entirety.

Methods

The data were placed in different categories: knee arthroplasty (unicompartmental or total), ligament surgery (reconstruction or repair), meniscus surgery (suture or resection), synovectomy, osteochondral fixation, surgery on the patella, osteotomy, lavage of knee joint, revision knee arthroplasty, mobilization under anesthesia, reduction of dislocation and arthrodesis. All the procedure codes included in each category are listed in Appendix 1.

For each category, two scenarios were defined based on the method outlined by DREES (French Directorate for Research, Studies, Assessment and Statistics of Ministry of Health) [10]:

- Scenario 1: This scenario has fixed characteristics. It exactly reproduces the parameters measured during the last year of PMSI (French hospital discharge database) data available (2018) and assumes they are identical over time. It only considers how the population grows and how the age distribution changes over time. In some ways, it acts as a reference. In this scenario, the model was adjusted for each procedure, with weighing based on the expected change in each age distribution according to INSEE data (French National Institute for Statistics and Economic Studies). For example, procedures done in younger patients increase less than procedures done in older patients because the population as a whole tends to be older in the coming years. Thus, for each procedure and for each decade going forward, we came up with a multiplication factor based on the age distribution for each procedure and the INSEE data. A few examples are shown in Table 1.
- Scenario 2: This scenario captures the projected changes. It reuses the trends observed in the 2012–2018 period while integrating the population changes from scenario 1. In this scenario, for each procedure, the changes in the number of procedures done was estimated

using a linear regression over the prior available years and the equation used for future projections.

The geographic descriptions were done with the raw data by taking an average of the number of procedures over the 2012–2018 period. For each region, the share of procedures done at each type of hospital (public, private for profit, private not-for-profit) was determined. The total number of procedures and number per resident were calculated for each region.

Statistical methods

Statistical calculations were done using Excel™ software (Microsoft, Redmond, USA) and XLSTAT™ software (Addinsoft, New York, USA). The overall projections for each procedure are the sum of the individual projections for each age bracket weighted by the INSEE data. Thus, independent models were created for each procedure as a function of its target population and the age brackets affected by a certain procedure. The results are presented as raw counts or mean \pm standard deviation with minimum and maximum values for the quantitative variables. The 95% confidence intervals were calculated. There was no missing data and all the data were included in the analysis.

3. Results

1) Year 2018

In 2018, the last year of data available in France, there were 364,436 procedures coded as primary knee surgery procedures. The three main procedures were primary knee arthroplasty with 113,600 procedures (31.2% of procedures) then meniscus surgery (110,510 procedures or 30.3%) and then ligament surgery (57,053 procedures or 15.7%) (Table 2).

2) Period 2012 to 2018

Overall, an average of 354,811 procedures \pm 11619 [339,263–366,718] were performed annually between 2012 and 2018, with the number increasing year over year (Figure 1). The mean growth rate was 1.21% \pm 1.55% [–0.6%; 3.8%] per year.

These procedures were done at a public hospital facility in 86,960 cases (24.5%), not-for-profit hospital in 23,000 case (6.5%) and for-profit hospital in 244,851 cases (69.0%). The procedures were performed in women in 44.1% of cases (156,616 procedures).

The geographic distribution of the average number of primary knee arthroplasty procedures in the years 2012 to 2018 are shown on Figure 2. The geographic distribution of meniscus surgery and ligament surgery in the same period in France is shown in Figure 3.

There were large regional differences for the knee arthroplasty surgery and for meniscus and ligament surgery. The frequency of primary knee arthroplasty ranged from 0 to 19.7 per 10,000 residents, with the frequency of revisions ranging from 0 to 3.6 per 10,000 residents. The frequency of ligament reconstruction ranged from 0.3 to 11.4 per 10,000 residents while that of meniscus procedures ranged from 0.2 to 24.4 per 10,000 residents. The distribution of primary or revision knee arthroplasty, meniscus or ligament surgery in public, not-for-profit and for-private hospitals was significantly different between regions ($p < 0.0001$).

Primary knee arthroplasty procedures increased by 32.2% between 2012 and 2018 (Figure 4). On average, between 2012 and 2018, the procedures were done in women in 61.1% of cases (61,047 / 99,941). On average, 17 knee arthroplasty procedures were done per 10,000 residents in France in 2018.

Knee ligament surgical procedures increased 17.3% since 2012. The projections are shown in Figure 5. On average, between 2012 and 2018, the procedures were done in women in 28.8% of cases (15,273/52,950).

The number of meniscus-related procedures (repair or meniscectomy) has trended down since 2012, with a 14.2% decrease. This is shown in Figure 6. On average, between 2012 and 2018, the procedures were done in women in 34.0% of cases (41,035/120,773).

The number of synovectomy procedures increased by 23.6% since 2012, as shown in Figure 7. On average, between 2012 and 2018, the procedures were done in women in 44.6% of cases (10,472/23,479).

The number of patella-related surgeries increased by 26.4% between 2012 and 2018. On average, between 2012 and 2018, the procedures were done in women in 60.0% of cases (5,345/8,905).

There was an 11.1% reduction in the number of osteotomy procedures done around the knee between 2012 and 2018. On average, between 2012 and 2018, the procedures were done in women in 32.0% of cases (941/2,936).

There was a 13.5% decrease in the number of joint lavage procedures done between 2012 and 2018. On average, between 2012 and 2018, the procedures were done in women in 40.1% of cases (6328/15,795).

Revision of total knee arthroplasty increased by 38.2% as shown in Figure 8. On average, between 2012 and 2018, the procedures were done in women in 62.1% of cases (6281/10,107)

Knee mobilization and arthrotomy increased by 18.7% between 2012 and 2018. On average, between 2012 and 2018, the procedures were done in women in 49.7% of cases (6240/12,561).

Overall, the number of surgical procedures increased by 8.2% between 2012 and 2018. This is summarized in Figures 1 to 9. On average, between 2012 and 2018, the procedures were done in women in 44.0% of cases (151,218/343,701).

3) Future trends

The expected change over the coming years was determined using the two scenarios described previously.

Primary knee arthroplasty

Between 2018 and 2050, scenario 1 projects a 30.8% increase and scenario 2 a 152.8% increase ($p = 0.005$).

Ligaments

Between 2018 and 2050, scenario 1 projects a 1.2% increase and scenario 2 a 49.2% increase ($p < 0.0001$).

Meniscus

Between 2018 and 2050, scenario 1 projects a 5.6% increase and scenario 2 a 73.6% reduction ($p < 0.001$).

Synovectomy

Between 2018 and 2050, scenario 1 projects a 14.9% increase and scenario 2 a 178.6% increase ($p = 0.003$).

Patella surgery

Between 2018 and 2050, scenario 1 projects a 13.9% increase and scenario 2 a 116.1% increase ($p = 0.028$).

Osteotomy

Between 2018 and 2050, scenario 1 projects a 2.3% increase and scenario 2 a 61.3% reduction ($p = 0.055$).

Joint lavage

Between 2018 and 2050, scenario 1 projects a 15.2% increase and scenario 2 a 100% reduction ($p = 0.007$).

Revisions

Between 2018 and 2050, scenario 1 projects a 31.8% increase and scenario 2 a 180.2% increase ($p = 0.002$).

Mobilization and arthrotomy

Between 2018 and 2050, scenario 1 projects a 12.7% increase and scenario 2 an 89.4% increase ($p = 0.126$).

Overall activity

Between 2018 and 2050, scenario 1 projects a 15.3% increase and scenario 2 a 78.2% increase ($p = 0.001$).

4. Discussion

The working hypothesis was confirmed: the number of surgical procedures on the knee will increase during the upcoming years. This study provides firm data on the current knee surgery activity throughout France and its expected change.

These data are comparable to data from other countries and to prior studies with national data both for primary and revision total knee arthroplasty [3, 6,11]. The Ackerman team reported a mean of 18.5 TKA/10,000 in Australia in 2013, 10.9/10,000 in Denmark in 2013, 17.6/10,000 in Finland in

2013, 7.9/10000 in Norway in 2013, 12.5/10000 in Sweden in 2013 versus 17.0/10,000 in France in 2018 according to the analysis [12]. Joint arthroplasty and its complications make up most knee-related surgeries. The variability observed in the different scenarios that we looked at point to the difficulty in estimating this type of change; however, the most likely is a 40% increase overall in the next decades. This finding follows the same trend as the study done on hip surgery in France, but may be more marked for knee surgery [9].

The number of knee surgery procedures is expected to increase in the coming years and decades. While these data are only estimates, it is likely the true number of each procedure will be between scenario 1 and 2 in most instances. The regional distribution in France varied greatly, which can be explained by the local availability of care with certain hospitals specialized in a certain type of surgery, by the patient demographics and by medical demographics. The increased activity should be related to the national capacity to carry out these procedures; although a consistent increase is possible, the capacity remains limited [13]. When we look at each category, some of the differences and curves may appear false, e.g. the meniscus and lavage procedures in scenario 2 that trend towards 0. This occurred when the activity tended to decrease, since the scenario 2 used a trend curve with linear regression, it was not possible to predict to which point it would be reduced. The reduction phenomenon for meniscus procedure has previously been described by Jacquet et al [14]; it is due to a preference for performing meniscus suture repair when possible, instead of meniscectomy. Nevertheless, we cannot conclude that meniscectomy procedures will disappear completely. Similarly, while TKA is associated with less and less complications, we cannot state that complications will disappear completely over time [15–18]. Similarly, procedures that have the same name may be done on patients with different indications that may change over time [19].

The question of care opportunity was not considered here, although it is relevant. For example, it is reasonable to wonder whether mobilization and arthrotomy will only increase in the coming years since surgery and rehabilitation will only improve. The same can be said for surgical procedures in knees with moderate osteoarthritis [20]. It is likely that part of the expected increases is related to how the procedures are coded. Also, there is a disparity in the distribution of the procedures, with a tendency to fewer meniscectomy and more meniscal repair procedures. Another major factor is the improvement in surgical practices and introduction of new technologies (impossible to estimate currently) that could completely alter the recourse to surgery. A good example is the reduction in the number of TKA in rheumatoid arthritis patients due to better treatment of the disease.

The primary limitation of this study is a potential bias related to lack of coding. Nevertheless, since coding a procedure triggers its payment, it is very likely that the procedures were coded most of the time. While this study sought to be exhaustive, some procedures may have been missed, especially the less common ones. We only looked at the procedures that were coded as the main procedure. Some procedures may have been underestimated since the main procedure is not always the one that spurred the patient to be operated. This is particularly true for meniscus procedures that are often done at the same time as ligament surgery. Another limitation of this study is that the changes in population are not homogeneous, they vary depending on the geographic location. This factor was not taken into consideration as it would have added too much complexity to the analysis. As stated in the methods section, the average scenario was used with the INSEE data, thus this scenario is not

absolute and could lead to false estimates of the population's evaluation. And while a linear regression was used in scenario 2, another type of growth pattern (exponential or logarithmic) is also possible. Lastly, the estimate was done by taking into account current medical data. If a medical treatment that completely cures osteoarthritis was discovered tomorrow, our findings would be profoundly altered. Thus, our results should be seen within the present state of medical knowledge.

5. Conclusion

The number of knee surgery procedures per year has increased over the past few years in France and should continue to increase. This increase mainly impacts ligament surgery and knee arthroplasty.

Conflict of interest: RE, AT, GV and SD have no conflict of interest to declare. SB is a consultant with Zimmer (outside this study). MO is a consultant with Arthrex, Stryker, Newclip (outside this study).

Funding: No funding was received for this study

Author contributions: RE contributed to the design of this study, data collection, writing the article and corrections AT, GV, CJ and MO contributed to the design of this study and writing the article SD contributed to overseeing the project and writing the article SB contributed to overseeing the project.

Tables and Figures

Appendix 1: Classification of procedures codes studies; UKA: Unicompartmental knee arthroplasty, TKA: Total knee arthroplasty, rTKA: Revision of total knee arthroplasty, ACL: anterior cruciate ligament, PCL: posterior cruciate ligament

Table 1: Examples of the multipliers for each procedure based on the distribution of the population changes for each age group impacted by this procedure.

Table 2: Number of knee surgery procedures in 2018; TKA: total knee arthroplasty, UKA: Unicompartmental knee arthroplasty, rTKA: Revision of total knee arthroplasty

Figure 1: Change in the number of knee surgery procedures annually between 2012 and 2018 fitted with linear regression

Figure 2: Distribution in France of primary knee arthroplasty procedures, 2012–2018 average, TKA: Total knee arthroplasty; UKA: Unicompartmental knee arthroplasty; Fq: frequency

Figure 3: Distribution in France of meniscus and knee ligament procedures, 2012–2018 average, Fq: frequency

Figure 4: Change in the number of primary knee arthroplasty procedures between 2012 and 2018 with trend out to 2070 according to scenarios 1 and 2.

Figure 5: Change in the number of ligament-related procedures between 2012 and 2018 with trend out to 2070 according to scenarios 1 and 2.

Figure 6: Change in the number of meniscus-related procedures between 2012 and 2018 with trend out to 2070 according to scenarios 1 and 2.

Figure 7: Change in the number of knee synovectomy procedures between 2012 and 2018 with trend out to 2070 according to scenarios 1 and 2.

Figure 8: Change in the number of revision knee arthroplasty procedures between 2012 and 2018 with trend out to 2070 according to scenarios 1 and 2.

Figure 9: Change in the total number of knee surgery procedures between 2012 and 2018 with trend out to 2070 according to scenarios 1 and 2.

Class	Sub-class	PMSI - CCAM Procedure code	
Meniscus	Suture repair	NFEA001 - SUTURE REPAIR OF 2 MENISCUS, KNEE ARTHROTOMY	
		NFEA002 - SUTURE REPAIR OF 1 MENISCUS, KNEE ARTHROTOMY	
		NFEC001 - SUTURE REPAIR OF 2 MENISCUS, KNEE ARTHROSCOPY	
		NFEC002 - SUTURE REPAIR OF 1 MENISCUS, KNEE ARTHROSCOPY	
	Meniscectomy	NFFA001 - MENISCECTOMY LATERAL + MEDIAL KNEE ARTHROTOMY	
		NFFA003 - MENISCECTOMY LATERAL OR MEDIAL KNEE ARTHROTOMY	
		NFFC003 - MENISCECTOMY LATERAL + MEDIAL KNEE ARTHROSCOPY	
		NFFC004 - MENISCECTOMY LATERAL OR MEDIAL, KNEE ARTHROSCOPY	
Ligament	Suture repair	NFCA001 - SUTURE REPAIR/REATTACHMENT ANTERIOR CRUCIATE LIGAMENT, KNEE ARTHROTOMY	
		NFCA002 - SUTURE REPAIR/REATTACHMENT JOINT CAPSULE, KNEE DIRECT	
		NFCA003 - SUTURE REPAIR/REATTACHMENT CRUCIATE LIGAMENTS, KNEE ARTHROTOMY	
		NFCA004 - SUTURE REPAIR/REATTACHMENT ACL + PERIARTICULAR CAPSULE/LIGAMENT, KNEE ARTHROTOMY	
		NFCA005 - SUTURE REPAIR/REATTACHMENT PCL + PERIARTICULAR CAPSULE/LIGAMENT, KNEE ARTHROTOMY	
		NFCA006 - SUTURE REPAIR/REATTACHMENT POSTERIOR CRUCIATE LIGAMENT, KNEE ARTHROTOMY	
		NFCC001 - SUTURE REPAIR/REATTACHMENT POSTERIOR CRUCIATE LIGAMENT, KNEE ARTHROSCOPY	
		NFCC002 - SUTURE REPAIR/REATTACHMENT ANTERIOR CRUCIATE LIGAMENT KNEE ARTHROSCOPY	
		Reconstruction	NFMA002 - EXTRA-ARTICULAR LATERAL KNEE LIGAMENT RECONSTRUCTION + FASCIA LATA DIRECT
			NFMA004 - ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION WITH GRAFT, KNEE ARTHROTOMY
			NFMA008 - REPEAT RECONSTRUCTION POSTERIOR CRUCIATE LIGAMENT WITH SYNTHETIC LIGAMENT, KNEE ARTHROTOMY
			NFMA010 - PCL RECONSTRUCTION WITH GRAFT WITHOUT SYNTHETIC REINFORCEMENT, KNEE, ARTHROTOMY
	NFMA011 - CRUCIATE LIGAMENTS RECONSTRUCTION, KNEE ARTHROTOMY		
	NFMC001 - CRUCIATE LIGAMENTS RECONSTRUCTION, KNEE ARTHROSCOPY		
	NFMC002 - PCL RECONSTRUCTION WITH GRAFT WITHOUT SYNTHETIC REINFORCEMENT, KNEE, ARTHROSCOPY		
	NFMC003 - ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION WITH GRAFT, KNEE ARTHROSCOPY		
	NFMC005 - REPEAT RECONSTRUCTION POSTERIOR CRUCIATE LIGAMENT WITH SYNTHETIC LIGAMENT, KNEE ARTHROSCOPY		
	Synovectomy	NFFA002 - SYNOVECTOMY KNEE, POSTERIOR + ANTERIOR ARTHROTOMY, NO CHANGE IN PATIENT POSITION	
		NFFA004 - ANTERIOR SYNOVECTOMY, KNEE ARTHROTOMY	
		NFFA005 - ANTERIOR SYNOVECTOMY, KNEE ARTHROSCOPY + POSTERIOR ARTHROTOMY, 1 POSITION	
NFFA006 - SYNOVECTOMY KNEE, POSTERIOR + ANTERIOR ARTHROTOMY, WITH CHANGE IN PATIENT POSITION			
NFFC001 - ANTERIOR SYNOVECTOMY, KNEE ARTHROSCOPY + POSTERIOR ARTHROSCOPY			
NFFC002 - ANTERIOR SYNOVECTOMY, KNEE ARTHROSCOPY			
Osteochondral fixation	NFDA009 - FIXATION OSTEOCHONDRAL FRAGMENT IN KNEE JOINT, ARTHROTOMY		
Patella	NFMA005 - MUSCLE CAPSULE TENDON RECONSTRUCTION FOR PATELLA RECENTERING, KNEE ARTHROTOMY		

		<p>NFPA002 - TRANSECTION LATERAL PATELLAR RETINACULUM, ARTHROTOMY</p> <p>NFPA004 - TRANSECTION LATERAL PATELLAR RETINACULUM + OSTEOTOMY PATELLAR SURFACE, FEMUR, ARTHROTOMY</p> <p>NFPC001 - TRANSECTION LATERAL PATELLAR RETINACULUM, ARTHROSCOPY</p> <p>NCPA001 - RECENTERING PATELLA TIBIAL TUBEROSITY OSTEOTOMY / MOBILIZATION PATELLAR TENDON, ARTHROTOMY</p> <p>NCPA002 - RECENTERING PATELLA TIBIAL TUBEROSITY OSTEOTOMY + MUSCLE CAPSULE TENDON RECONSTRUCTION, ARTHROTOMY</p> <p>NCPA003 - PATELLAR RECENTERING OSTEOTOMY BY ARTHROTOMY</p>
Joint arthroplasty	UKA TKA	<p>NFKA006 - UNICOMPARTMENTAL KNEE ARTHROPLASTY</p> <p>NFKA007 - TOTAL KNEE REPLACEMENT FOR 1 DEFORMITY < 10° IN FRONTAL PLANE</p> <p>NFKA008 - TOTAL KNEE REPLACEMENT FOR 1 DEFORMITY > 10° IN FRONTAL PLANE</p> <p>NFKA009 - KNEE ARTHROPLASTY WITH FIXED/ROTATING HINGE</p> <p>NFMA006 - CUSTOM/MASSIVE IMPLANT FOR KNEE ARTHROPLASTY DUE TO SEGMENTAL BONE DEFECT</p>
Joint lavage		<p>NFJA001 - JOINT LAVAGE, KNEE ARTHROTOMY</p> <p>NFJA002 - JOINT ASPIRATION, KNEE ARTHROTOMY</p> <p>NFJC001 - JOINT LAVAGE, KNEE ARTHROSCOPY</p> <p>NFJC002 - JOINT ASPIRATION, KNEE ARTHROSCOPY</p>
rTKA		<p>NFKA001 - CHANGE OF 1 TOTAL KNEE IMPLANT WITHOUT BONE RECONSTRUCTION</p> <p>NFKA002 - CHANGE OF 1 TOTAL KNEE IMPLANT WITH BONE RECONSTRUCTION</p> <p>NFKA003 - CHANGE OF 1 UNICOMPARTMENTAL KNEE IMPLANT</p> <p>NFKA004 - CHANGE OF KNEE ARTHROPLASTY INSERT</p> <p>NFKA005 - CHANGE OF 1 UNICOMPARTMENTAL KNEE IMPLANT FOR 1 TOTAL KNEE IMPLANT</p> <p>NFLA001 - REPLACEMENT OF 1 KNEE JOINT IMPLANT + BONE RECONSTRUCTION</p> <p>NFLA002 - REPLACEMENT OF 1 KNEE JOINT IMPLANT WITHOUT BONE RECONSTRUCTION</p>
	Implant removal	<p>NFGA001 - REMOVAL 1 KNEE IMPLANT + ARTHRODESIS</p> <p>NFGA002 - REMOVAL 1 KNEE IMPLANT</p>
Knee mobilization		<p>NFPA001 - KNEE RELEASE, ARTHROTOMY</p> <p>NFPA003 - KNEE RELEASE, ARTHROSCOPY/ARTHROTOMY + ADDITIONAL QUADRICEPS RELEASE</p> <p>NFPC002 - KNEE RELEASE, ARTHROSCOPY</p> <p>NFRP001 - THERAPEUTIC KNEE JOINT MOBILIZATION + GENERAL/REGIONAL ANESTHESIA</p>
Reduction		<p>NFEP001 - REDUCTION 1 PATELLAR DISLOCATION</p> <p>NFEP002 - REDUCTION 1 DISLOCATION / 1 FRACTURE-DISLOCATION TIBIOFEMORAL JOINT</p>
Arthrodesis		<p>NFDA002 - TIBIOFEMORAL ARTHRODESIS, ARTHROTOMY</p> <p>NFDA003 - PROXIMAL TIBIOFIBULAR ARTHRODESIS, ARTHROTOMY</p> <p>NFMA013 - BONE RECONSTRUCTION AT KNEE FOR SEGMENTAL DEFECT + ARTHRODESIS + FIXATION</p>
Osteotomy		<p>NBPA001 - SIMPLE BILATERAL OSTEOTOMY FEMUR + TIBIA</p> <p>NBPA004 - SIMPLE UNILATERAL OSTEOTOMY FEMUR + TIBIA</p> <p>NBPA009 - DEROTATION OSTEOTOMY DISTAL FEMUR / PROXIMAL TIBIA</p> <p>NBPA010 - COMPLEX OSTEOTOMY DISTAL FEMUR</p> <p>NBPA017 - SIMPLE OSTEOTOMY DISTAL FEMUR</p> <p>NCPA005 - SIMPLE OSTEOTOMY PROXIMAL TIBIA + ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION</p> <p>NCPA014 - COMPLEX OSTEOTOMY PROXIMAL TIBIA</p> <p>NCPA015 - SIMPLE OSTEOTOMY PROXIMAL TIBIA</p>

Appendix 1:

Table 1:

PROCEDURE - No. of procedures, main one only	2020	2025	2030	2035	2040	2050	2060	2070
NFMC001 - CRUCIATE LIGAMENTS RECONSTRUCTION, KNEE ARTHROSCOPY	1.002	0.999	0.992	0.993	1.003	1.011	1.008	1.016
NFEC002 - SUTURE REPAIR OF 1 MENISCUS, KNEE ARTHROSCOPY	1.002	0.999	0.992	0.993	1.003	1.010	1.008	1.015
NFGA002 - REMOVAL 1 KNEE IMPLANT	1.027	1.102	1.185	1.245	1.274	1.324	1.373	1.409
NFJA001 - JOINT LAVAGE, KNEE ARTHROTOMY	1.021	1.077	1.138	1.183	1.208	1.257	1.306	1.342
NFKA006 - UNICOMPARTMENTAL KNEE ARTHROPLASTY	1.021	1.080	1.144	1.190	1.216	1.252	1.286	1.313
NFKA007 - TOTAL KNEE REPLACEMENT FOR 1 DEFORMITY < 10° IN FRONTAL PLANE	1.026	1.099	1.179	1.236	1.265	1.306	1.344	1.374

Table 2:

Class	Sub-class	Number in 2018
Meniscus	Total	110510
	Suture repair	10703
	Meniscectomy	99807
Ligament	Total	57053
	Suture repair	3501
	Reconstruction	53552
Synovectomy		25244
Osteochondral fixation		249
Patella		9721
Primary knee replacement	Total	113600
	UKA	12743
	TKA	100857
Osteotomy		3072
Joint lavage		14475
rTKA	Total	11900
	Implant removal	893
Knee mobilization		13201
Reduction		671
Arthrodesis		179
TOTAL		364436

References

- [1] Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of Primary and Revision Hip and Knee Arthroplasty in the United States from 2005 to 2030. *JBJS* 2007;89:780.
- [2] Putman S, Girier N, Girard J, Pasquier G, Migaud H, Chazard E. Épidémiologie des prothèses de hanche en France : analyse de la base nationale du PMSI de 2008 à 2014. *Rev Chir Orthopédique Traumatol* 2017;103:S90.
- [3] Maradit Kremers H, Larson DR, Crowson CS, Kremers WK, Washington RE, Steiner CA, et al. Prevalence of Total Hip and Knee Replacement in the United States. *J Bone Joint Surg Am* 2015;97:1386–97.
- [4] Courpied JP, Caton J, Bouee S, Charpak Y, Thomine JM. [Osteoarticular disease in adults in France. A survey of 2000 persons]. *Rev Chir Orthop Reparatrice Appar Mot* 2001;87:424–36.
- [5] Nathalie Blanpain GB. Projections de population à l'horizon 2070 - Insee Première - 1619 n.d.
- [6] Malchau H, Herberts P, Eisler T, Garellick G, Söderman P. The Swedish Total Hip Replacement Register. *J Bone Joint Surg Am* 2002;84-A Suppl 2:2–20.
- [7] Rolfson O, Bohm E, Franklin P, Lyman S, Denissen G, Dawson J, et al. Patient-reported outcome measures in arthroplasty registries. *Acta Orthop* 2016;87:9–23.
- [8] Nemes S, Rolfson O, W-Dahl A, Garellick G, Sundberg M, Kärrholm J, et al. Historical view and future demand for knee arthroplasty in Sweden. *Acta Orthop* 2015;86:426–31.
- [9] Erivan R, Villatte G, Dartus J, Reina N, Descamps S, Boisgard S. Progression and projection for hip surgery in France, 2008-2070: Epidemiologic study with trend and projection analysis. *Orthop Traumatol Surg Res OTSR* 2019.
- [10] France. Dossiers solidarité et santé. Paris: Direction de la recherche, des études, de l'évaluation et des statistiques; 2007.
- [11] Bozic KJ, Kurtz SM, Lau E, Ong K, Vail TP, Berry DJ. The Epidemiology of Revision Total Hip Arthroplasty in the United States. *JBJS* 2009;91:128.
- [12] Ackerman IN, Bohensky MA, de Steiger R, Brand CA, Eskelinen A, Fenstad AM, et al. Substantial rise in the lifetime risk of primary total knee replacement surgery for osteoarthritis from 2003 to 2013: an international, population-level analysis. *Osteoarthritis Cartilage* 2017;25:455–61.
- [13] Erivan R, Chaput T, Villatte G, Ollivier M, Descamps S, Boisgard S. Ten-year epidemiological study in an orthopaedic and trauma surgery centre: Are there risks involved in increasing scheduled arthroplasty volume without increasing resources? *Orthop Traumatol Surg Res OTSR* 2018.
- [14] Jacquet C, Pujol N, Pauly V, Beaufils P, Ollivier M. Analysis of the trends in arthroscopic meniscectomy and meniscus repair procedures in France from 2005 to 2017. *Orthop Traumatol Surg Res OTSR* 2019.
- [15] Lévy Y, Azar M, Tran L, Boileau P, Bronsard N, Trojani C. Early morbidity and mortality after single-stage bilateral total knee replacement. *Orthop Traumatol Surg Res OTSR* 2018;104:1199–203.
- [16] Cassard X, Garnault V, Corin B, Claverie D, Murgier J. Outpatient total knee arthroplasty: Readmission and complication rates on day 30 in 61 patients. *Orthop Traumatol Surg Res OTSR* 2018;104:967–70.
- [17] Ode Q, Gaillard R, Batailler C, Herry Y, Neyret P, Servien E, et al. Fewer complications after UKA than TKA in patients over 85 years of age: A case-control study. *Orthop Traumatol Surg Res OTSR* 2018;104:955–9.
- [18] Putman S, Argenson J-N, Bonnevalle P, Ehlinger M, Vie P, Leclercq S, et al. Ten-year survival and complications of total knee arthroplasty for osteoarthritis secondary to trauma or surgery: A French multicentre study of 263 patients. *Orthop Traumatol Surg Res OTSR* 2018;104:161–4.
- [19] Pietrzak J, Common H, Migaud H, Pasquier G, Girard J, Putman S. Have the frequency of and reasons for revision total knee arthroplasty changed since 2000? Comparison of two cohorts from the same hospital: 255 cases (2013-2016) and 68 cases (1991-1998). *Orthop Traumatol Surg Res OTSR* 2019;105:639–45.

[20] Palmer JS, Monk AP, Hopewell S, Bayliss LE, Jackson W, Beard DJ, et al. Surgical interventions for symptomatic mild to moderate knee osteoarthritis. *Cochrane Database Syst Rev* 2019;7:CD012128.

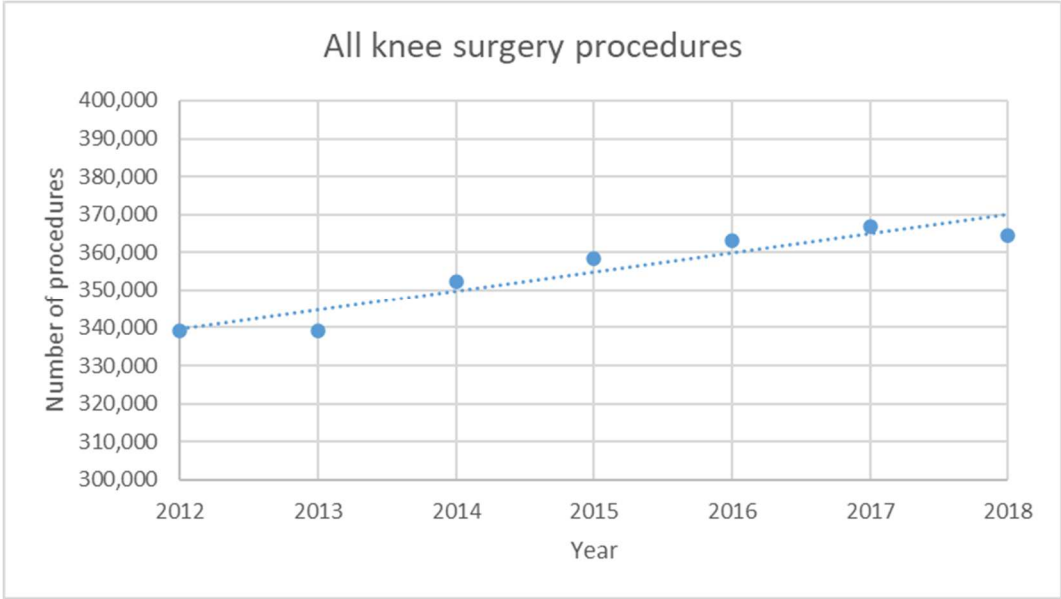


Figure 1:

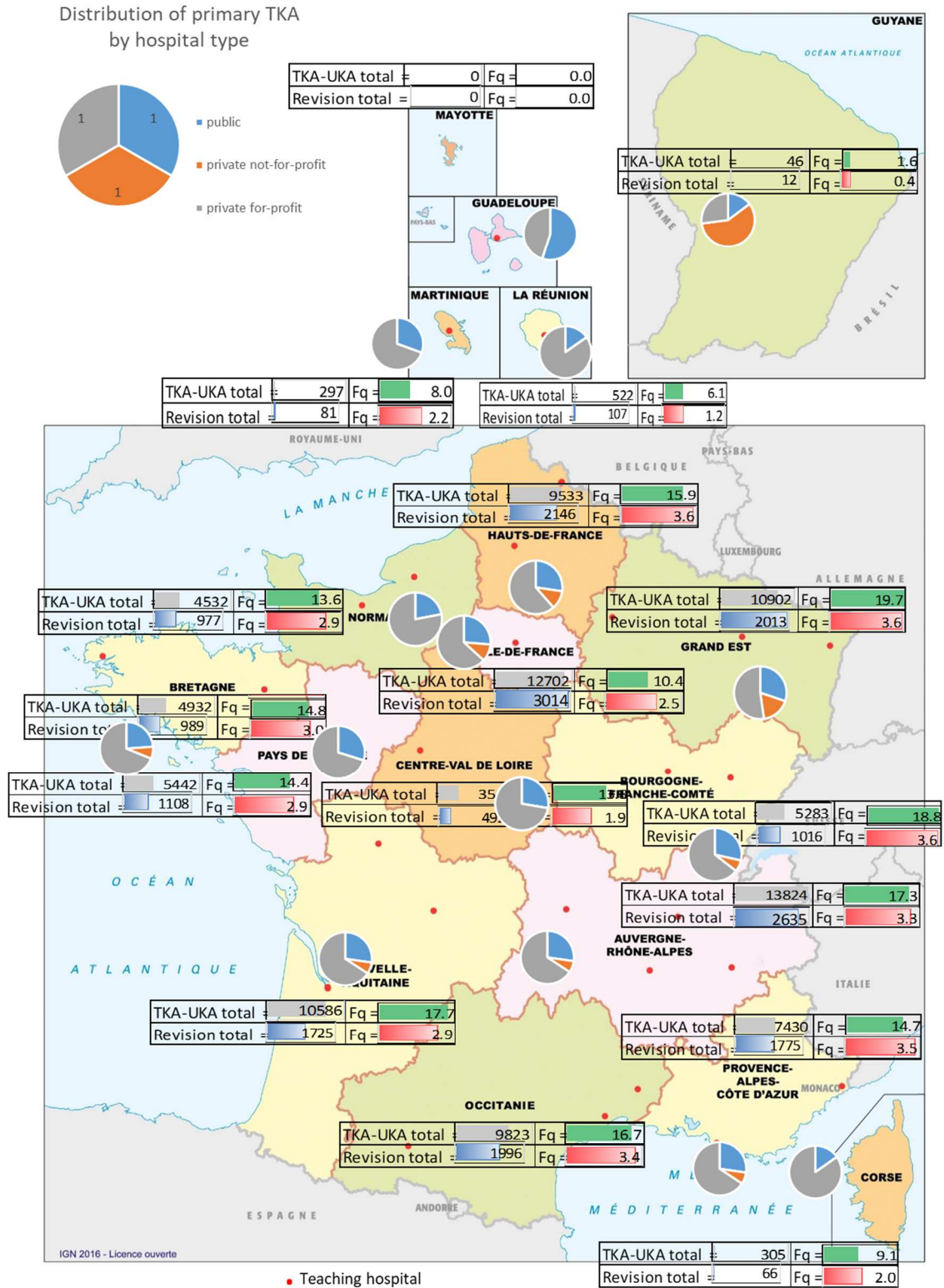


Figure 2:

Fq = mean annual number between 2012 and 2018 per 10,000 residents

Total = mean number between 2012 and 2018

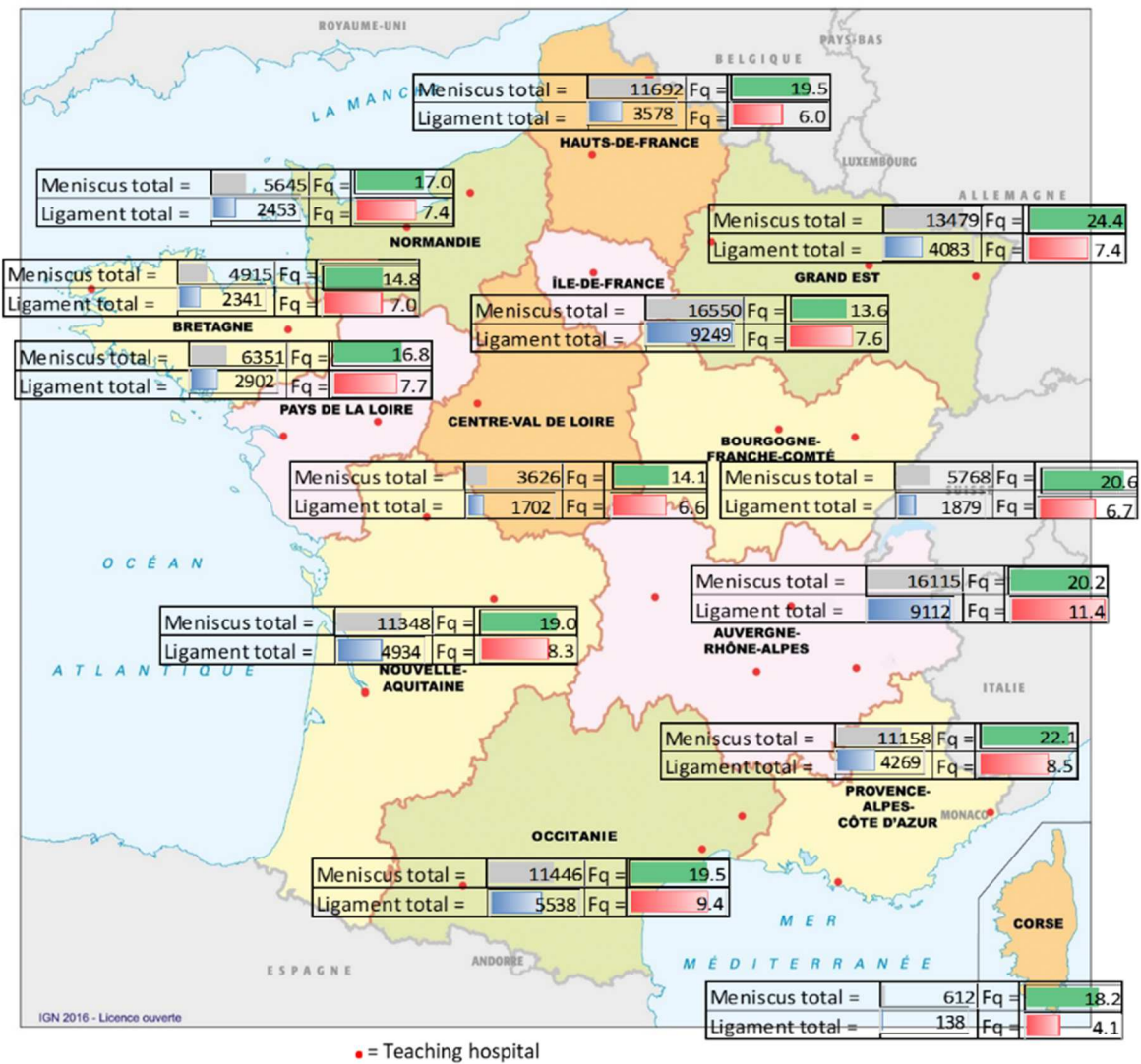
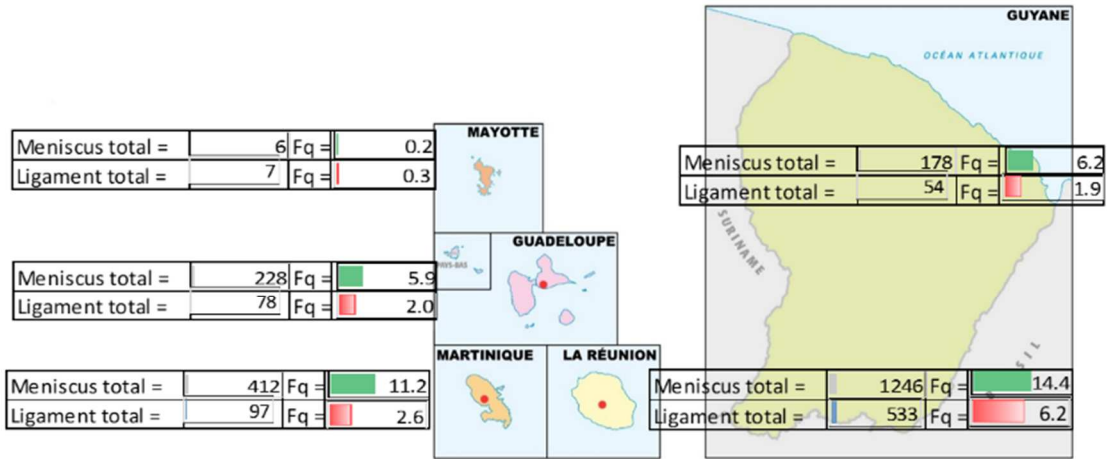


Figure 3:

Fq = mean annual number between 2012 and 2018 per 10,000 residents

Total = mean number between 2012 and 2018

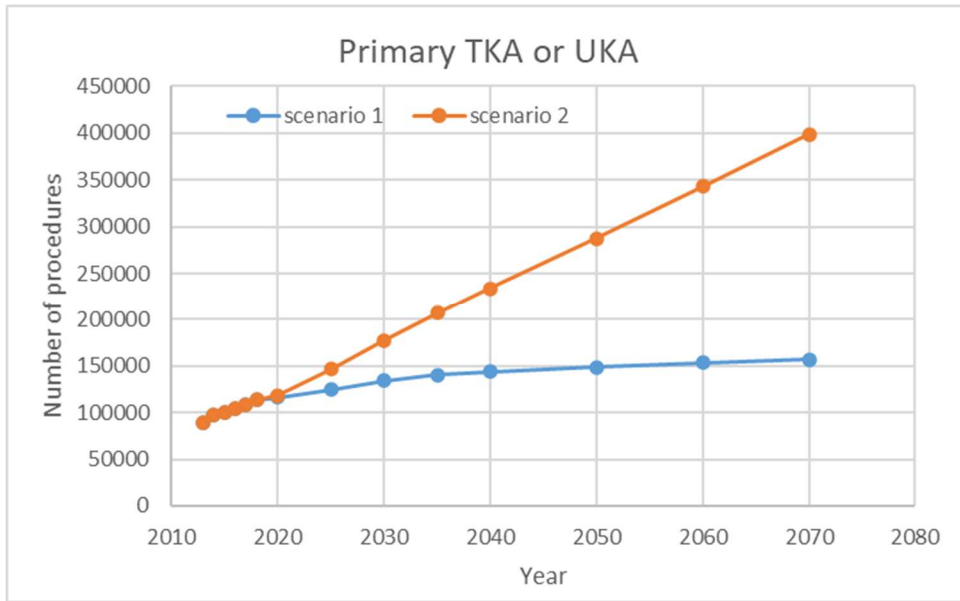


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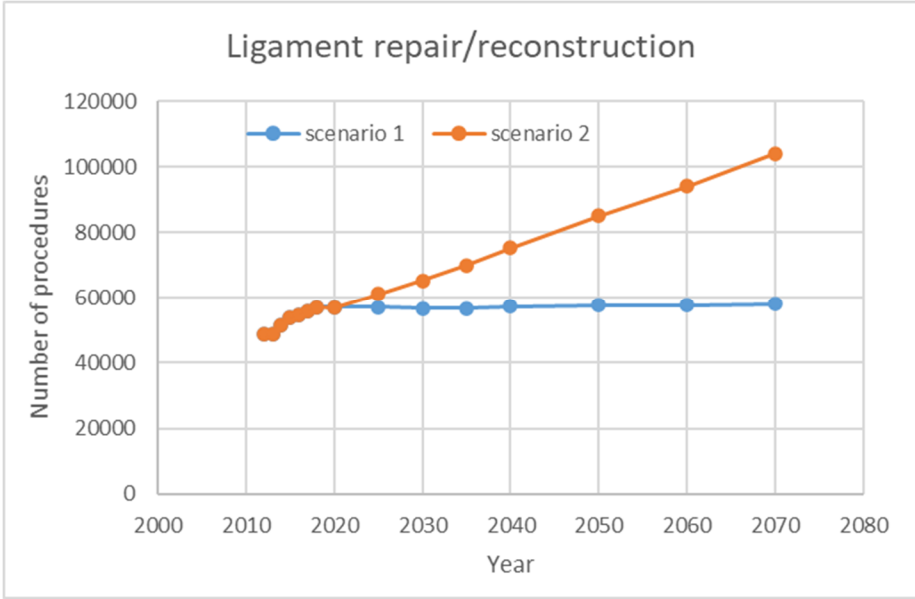


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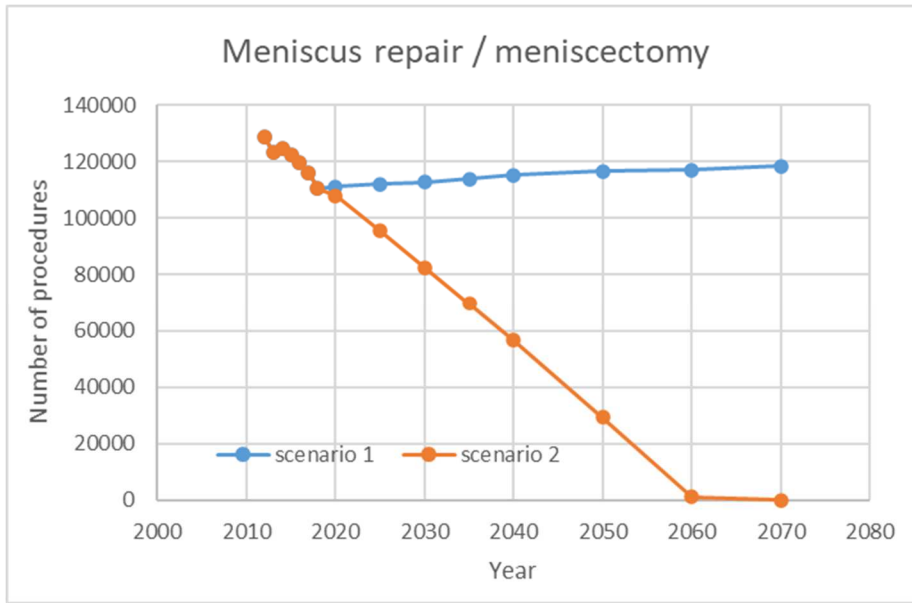


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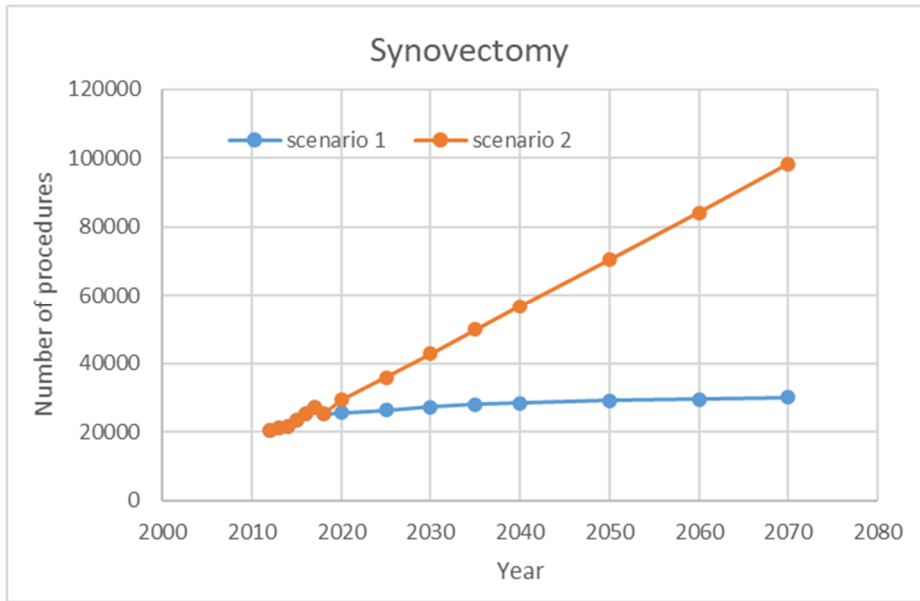


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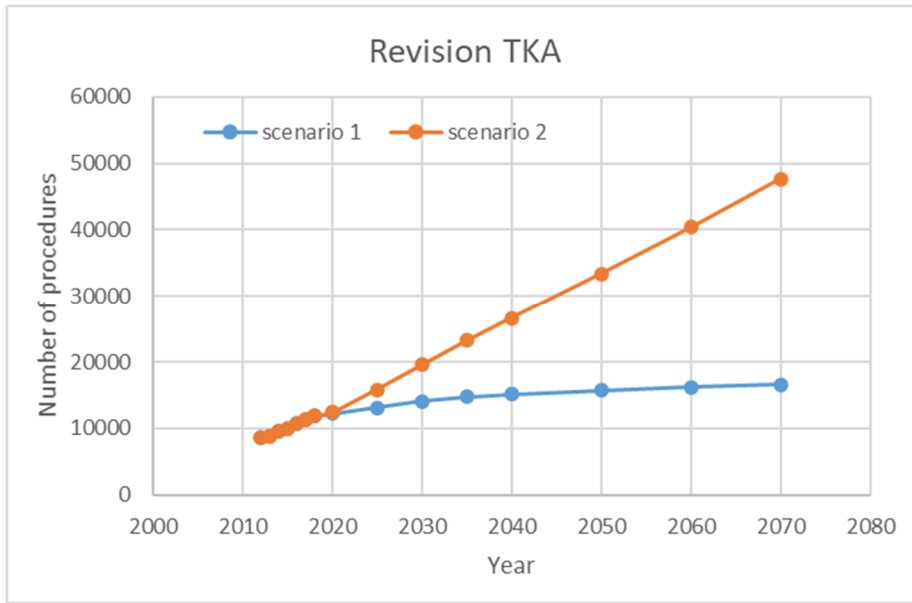


Figure 8:

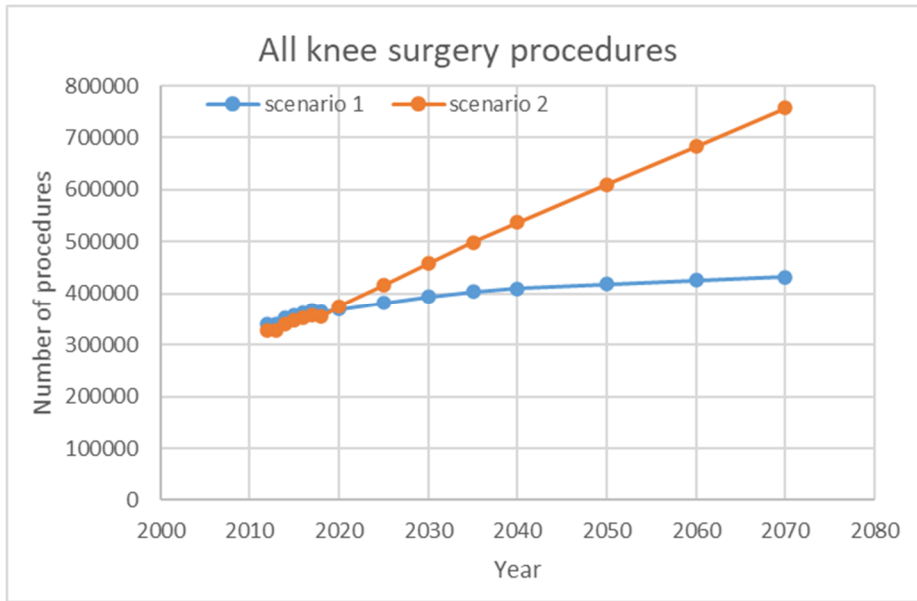


Figure 9: