

# THE IMPACT OF IMPLANT DESIGN ON HOSPITAL LENGTH OF STAY AND DISCHARGE DESTINATION EVIDENCE SUMMARY REPORT

## INTRODUCTION

Total knee arthroplasty (TKA) is a successful and cost effective procedure that provides pain relief and improved function for patients with osteoarthritis of the knee.<sup>1</sup> Despite the globally reported success of the procedure, studies have shown that up to 20% of patients are dissatisfied with the results of TKA.<sup>2</sup>

The ATTUNE® Knee System is designed to reduce pain and improve patient satisfaction following TKA. Extensive research and science has gone into the design to address recognised industry challenges and help improve functional outcomes for patients.

Since the commercial launch in 2013, the ATTUNE Knee System has shown statistically significant improvements in multiple Patient Reported Outcome Measures (PROMs) compared to certain leading knee brands.<sup>3</sup> Additional studies have demonstrated improvements in patellofemoral outcomes, including reduced anterior knee pain, compared to another leading knee brand.<sup>4-7</sup> Results from several registries including the UK and Australia have also shown survivorship performance in line with the class of TKA.<sup>8-9</sup>

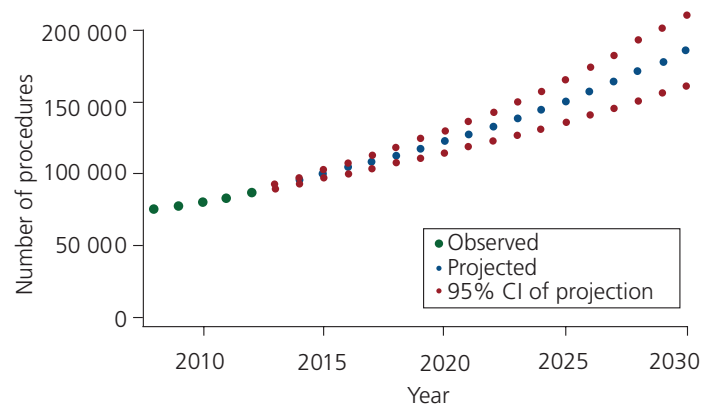


Figure 1. Graph showing the actual and projected total number of primary TKA with 95% confidence intervals (CI) in England and Wales. Cited from Patel et al. 2015.

Given the increasing incidence of osteoarthritis worldwide<sup>10</sup> and the predicted growth of TKA procedures (Figure 1)<sup>1</sup>, it is increasingly important for healthcare providers to demonstrate both improved clinical and economic outcomes to help minimise the total cost per procedure whilst maintaining quality of care.

Reducing length of stay (LOS) is recognised as a way to reduce the financial burden of elective orthopaedics.<sup>11</sup> Emerging evidence suggests the ATTUNE Knee may facilitate earlier hospital discharge versus some comparative devices.<sup>12-17</sup> which could reduce resource utilisation and the cost of care.<sup>10-12</sup> In addition to reducing costs, decreasing LOS may positively impact a hospital's operational capacity.<sup>18</sup>

The purpose of this report is to summarise a series of studies that were designed to evaluate whether patients treated with the ATTUNE Knee had a shorter LOS versus a comparative device. The studies were conducted in several countries with differing healthcare systems. All the studies in this report defined LOS as the primary endpoint. An additional study by Clement et al., (2016) conducted in Scotland also observed a statistically significant 1.2 days reduction in LOS versus another leading knee system but is not included in this report as LOS was not the primary outcome.<sup>16</sup>

## STATISTICAL REVIEW SUMMARY

There are several important aspects of this report that limit the comparability of results among the studies. Due to factors within each countries' healthcare systems, baseline mean LOS will vary, which limits direct comparison of the means and differences between studies. Statistical analyses also differ by study as they controlled for different factors because of the feasibility of data collection at each site, which further limits the comparability of the results. This review, however, is not intended to aggregate the data; it is to report each study in isolation and highlight the reductions in LOS seen in multiple healthcare settings following the adoption of the ATTUNE Knee.

## STUDY 1: COMPARATIVE ANALYSIS OF HOSPITAL LENGTH OF STAY AND DISCHARGE STATUS OF TWO CONTEMPORARY PRIMARY TOTAL KNEE SYSTEMS.<sup>12</sup>

**Sample size and comparator:** ATTUNE Knee n=1,178; Triathlon™ (Stryker) Knee n=5,707.

**Study period and design:** January 2013 to December 2014. Retrospective analysis of the Premier Perspective™ Database.

**Data Source:** Premier Perspective™ Database. Based on data from 38 US hospitals.

**Results summary:** The ATTUNE Knee patients had a 0.19 day shorter LOS (2.94 vs 3.13 days p<0.001) and a 39% lower adjusted odds of discharge to a skilled nursing facility compared to patients who received a Triathlon™ TKA. Sensitivity analyses suggest that the effect on LOS could not be explained by patient factors including age, insurance and marital status.

**Conclusion:** Patients who received the ATTUNE Knee had a slightly shorter LOS compared to patients who received the Triathlon™ Knee.

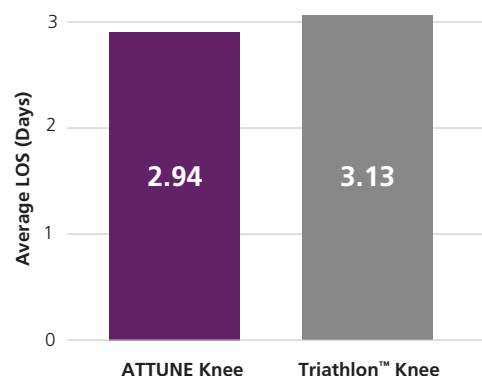


Figure 2. Adjusted Hospital Length of Stay, Mean Days (95% CI)

## STUDY 2: ECONOMIC EFFECTIVENESS OF THE ATTUNE® KNEE SYSTEM. ANALYSIS OF REAL WORLD HOSPITAL LENGTH OF STAY AND INCIDENCE OF EARLY COMPLICATIONS.<sup>13</sup>

**Sample size and comparator:** ATTUNE Knee n=238; SIGMA® Knee (DePuy Synthes) n=332; Columbus® (Aesculap) Knee n=149.

**Study period and design:** April 2014 to April 2015. Single centre retrospective cohort study.

**Data Source:** University Teaching Hospital, England, UK.

**Results summary:** Patients implanted with the ATTUNE Knee reported a 0.8 day (95% CI 0.1-1.5, p=0.0212) reduction in mean LOS compared to patients receiving the SIGMA Knee and a 1 day (95% CI 0.1-1.9, p=0.0197) reduction in mean LOS compared to patients receiving the Columbus® knee (shown in Figure 3). No statistically significant differences in patient or surgical characteristics were reported between the groups; with the exception of age between the ATTUNE Knee and the Columbus® Knee cohorts.

**Conclusion:** Patients treated with an ATTUNE Knee experienced shorter LOS compared to the patients implanted with either a SIGMA Knee or Columbus® Knee.

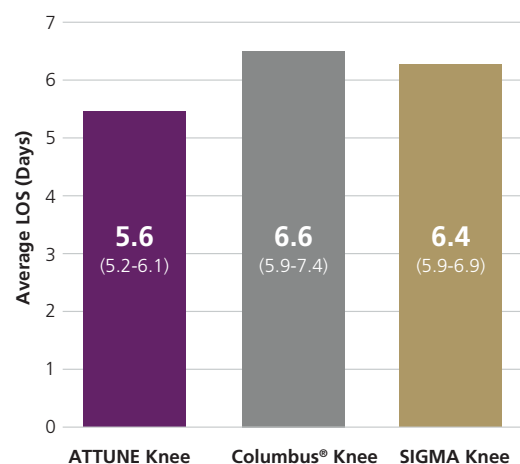


Figure 3. Adjusted Hospital Length of Stay, Mean Days (95% CI)

## STUDY 3: ECONOMIC EFFECTIVENESS OF THE ATTUNE® KNEE SYSTEM: ANALYSIS OF REAL WORLD HOSPITAL LENGTH OF STAY IN THE GERMAN HEALTHCARE SYSTEM.<sup>14</sup>

**Sample size and comparator:** ATTUNE Knee n=85; LCS™ Knee (DePuy Synthes) n=85.

**Study period and design:** July 2008 to October 2016. Single centre, single surgeon retrospective chart review.

**Data source:** Private German Hospital.

**Results:** The unadjusted mean LOS for patients implanted with the ATTUNE Knee was 2.1 days (95% CI 1.6-2.7, p < 0.001) shorter than patients implanted with the LCS Knee (shown in Figure 4). Due to the duration of data extraction and the possible impact of longitudinal change on LOS, a sensitivity analysis was performed to understand its impact on the reported LOS reduction. The adjusted LOS reduction in patients implanted with the ATTUNE Knee was 0.8 days (p<0.01) which is still statistically significant.

**Conclusion:** Comparing two cohorts with similar demographic factors the patients implanted with the ATTUNE Knee demonstrated a shorter LOS compared to patients treated with the LCS Knee.

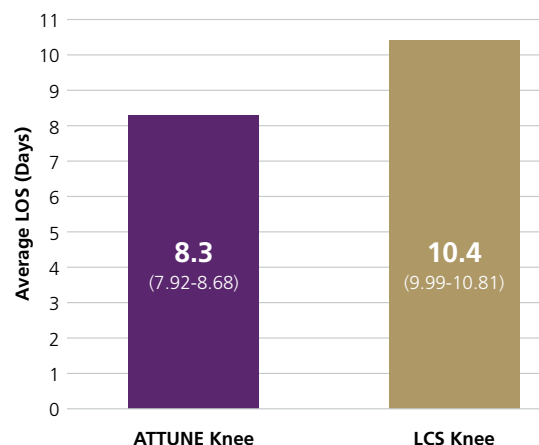


Figure 4. Unadjusted Hospital Length of Stay, Mean Days (95% CI)

## STUDY 4: ECONOMIC EFFECTIVENESS OF THE ATTUNE® KNEE SYSTEM: ANALYSIS OF REAL WORLD HOSPITAL LENGTH OF STAY IN AN ITALIAN HOSPITAL.<sup>15</sup>

**Sample size and comparator:** ATTUNE Knee n=100; SIGMA Knee n=100.

**Study period and design:** April 2013 to April 2015. Single centre, single surgeon retrospective chart review.

**Data source:** Private Italian Hospital.

**Results summary:** Patients treated with the ATTUNE Knee reported a 4 day (CI 3.5-4.5,  $p < 0.0001$ ) reduction in mean LOS compared to SIGMA Knee patients. ATTUNE Knee mean LOS was 9.7 days versus the SIGMA Knee mean of 13.7 (shown in Figure 5). There were no significant differences in reported patient characteristics between the groups.

**Conclusion:** Differences were noted in the LOS between the two groups with ATTUNE Knee patients demonstrating a reduced LOS compared to patients treated with SIGMA Knee.

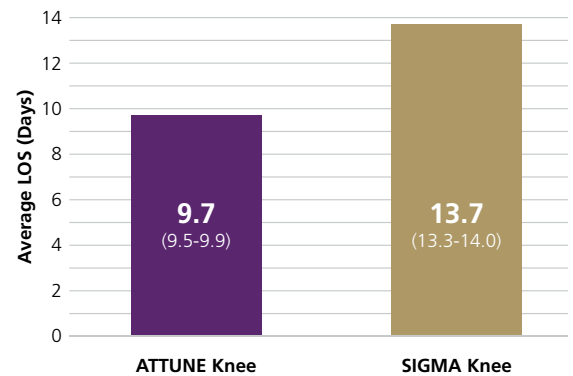


Figure 5. Adjusted Hospital Length of Stay, Mean Days (95% CI)

## STUDY 5: COMPARATIVE ANALYSIS INVESTIGATING THE IMPACT OF IMPLANT DESIGN ON HOSPITAL LENGTH OF STAY AND DISCHARGE DESTINATION IN A DUTCH HOSPITAL WITH AN ESTABLISHED ENHANCED RECOVERY PROGRAM.<sup>17</sup>

**Sample size and comparator:** ATTUNE Knee n=100; SIGMA Knee n=100.

**Study period and design:** January 2015 to October 2017. Single centre, single surgeon retrospective chart review.

**Data source:** Public Netherlands Hospital.

**Results summary:** The study found patients treated with the ATTUNE Knee reported reductions in adjusted mean LOS ( $p < 0.01$ ). The adjusted means in the ATTUNE Knee and SIGMA Knee groups were 2.76 days (95% CI 2.45-3.10) and 3.43 days (95% CI 3.08-3.81) respectively (shown in Figure 6). Patients discharged to a rehabilitation centre was also lower in the ATTUNE Knee group: 4.4% vs 11.4%. No statistical differences in patient demographics were found between the two treatment groups.

**Conclusions:** ATTUNE Knee patients in this study demonstrated a 0.67 day adjusted mean LOS reduction compared to patients treated with the SIGMA Knee. These improvements were achieved in a hospital environment with an established enhanced recovery program.

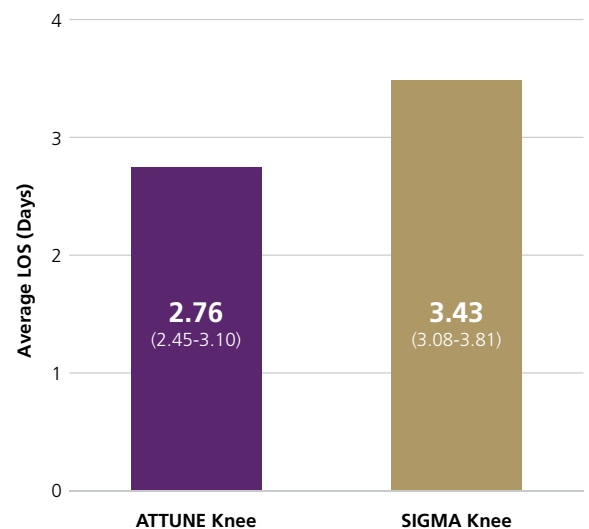


Figure 6: Adjusted Hospital Length of Stay, Mean Days (95% CI)

## SUMMARY

The results of these studies demonstrate that the ATTUNE Knee may positively impact patient LOS following TKA. All the observed LOS reductions highlighted in this report were statistically significant. Whilst it is important to acknowledge that there are many factors that can contribute to differences in LOS, the data summarised above suggests that implant design could be an important factor to consider. This evidence supports a potential association between implant design and earlier hospital discharge, which could translate into cost reductions and bed capacity gains.

The individual study summaries presented in this document report key results and conclusions relevant to this evidence summary report. Please see the referenced article or poster for full study details.

## REFERENCES

- Patel A, Pavlou G, Mújica-Mota RE, Toms AD The epidemiology of revision total knee and hip arthroplasty in England and Wales: a comparative analysis with projections for the United States. A study using the National Joint Registry dataset. Bone Joint J. 2015 Aug;97-B(8):1076-81.
- Bourne R, Chesworth BM, Davis AM, Mahomed NN, Charron K. Comparing patient outcomes after TKA and THA: is there a difference? Clin Orthop Relat Res 2010;468:542-6.
- Hamilton WG, Brenkel I, Clatworthy M, Dwyer K, Gibbon A, Kantor S, Lesko J, Himden S: Early Outcomes with a New Primary TKA System vs. Contemporary TKA: Interim Results of Two Worldwide, Multi-Center Prospective Studies. American Academy of Orthopaedic Surgeons (AAOS), San Diego, California, March 14-18, 2017, Poster # 106. Study comparators included the SIGMA Knee (89%), Triathlon™ (7%), NexGen® (3%), and Other (1%).
- Indelli PF, Pipino G, Johnson P, Graceffa A, Marcucci M. Posterior-stabilised total knee arthroplasty: a matched pair analysis of a classic and its evolutionary design. Arthroplasty Today 2016;2:193-8.
- Ranawat CS, White PB, West S, Ranawat AS. Clinical and Radiographic Results of ATTUNE and PFC SIGMA Knee Designs at 2 year Follow-up: A Prospective Matched-Pair Analysis. J Arthroplasty 2017; 78: 108-15.
- Toomey SD, Daccach JA, Shah JC, Himden SE, Lesko JP, Hamilton WG, Comparative Incidence of Patellofemoral Complications Between 2 Total Knee Arthroplasty Systems in a Multicenter, Prospective Clinical Study. J Arthroplasty 2017;32:5187-5192
- Martin JR, Jennings JM, Watters TS, Levy DL, McNabb DC, Dennis DA, Femoral Implant Design Modification Decreases the Incidence of Patellar Crepitus in Total Knee Arthroplasty. The Journal of Arthroplasty, 32(4): 1310-3.
- National Joint Registry for England, Wales, Northern Ireland and the Isle of Man, 14th Annual Report, 2017. Table 3.29 and 3.25(a). Available from www.njrreports.org.uk
- Australian Orthopaedic Association National Joint Replacement Registry Annual Report. (2017). Tables KT7, KT22, KT23 Retrieved from https://aoanjrr.sahmri.com/annual-reports-2017

Australian Orthopaedic Association National Joint Replacement Registry 2017 Annual Report  
Extracted from Table KT7 Cumulative Percent Revision of Cemented Primary Total Knee Replacement by Prosthesis Combination

Prosthesis Combination	N	1 Yr	3 Yr	5 Yr	10 Yr	15 Yr	18 Yr
Attune CR Attune	49	55(11.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
Attune PS Attune	16	20(12.5)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
Genesis II CR Genesis II	466	13(69.1)	2.4(1.2)	3.1(2.3)	4.3(3.4)	5.6(4.5)	6.0(5.7)
Genesis II CR Profile Modular	35	4(11.4)	3.4(11.4)	5.4(15.7)	8.0(23.1)	8.0(23.1)	8.0(23.1)
Genesis II Distal CR	547	7(1.3)	2.8(0.9)	3.7(1.2)	6.1(2.1)	10.9(3.6)	10.9(3.6)
Genesis II Distal PS	785	15(1.9)	3.8(0.4)	5.2(0.6)	7.5(0.9)	7.5(0.9)	7.5(0.9)
Genesis II PS	371	15(4.0)	2.8(0.9)	3.7(1.2)	5.0(1.5)	6.2(1.7)	6.2(1.7)
NexGen CR NexGen	119	3(2.5)	1.4(1.1)	1.5(1.2)	3.0(2.3)	3.1(2.4)	3.1(2.4)
NexGen CR Natural Knee II	8	3(37.5)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
NexGen CR Natural Knee II	315	10(3.2)	1.0(0.3)	1.1(0.3)	2.0(0.6)	2.0(0.6)	2.0(0.6)
NexGen CR Natural Knee II	39	7(17.9)	3.6(9.2)	5.0(12.8)	5.0(12.8)	5.0(12.8)	5.0(12.8)
NexGen CR Natural Knee II	239	5(2.1)	1.0(0.4)	1.0(0.4)	2.0(0.8)	2.0(0.8)	2.0(0.8)
NexGen CR Natural Knee II	856	20(2.3)	0.9(0.1)	1.0(0.1)	2.0(0.2)	2.0(0.2)	2.0(0.2)
PFC Sigma CR MBT	38	1(2.6)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
PFC Sigma CR PFC Sigma	318	1(0.3)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
PFC Sigma PS MBT	331	5(1.5)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
PFC Sigma PS PFC Sigma	374	7(1.9)	1.2(0.3)	1.5(0.4)	3.0(0.8)	4.7(1.2)	4.7(1.2)
Triathlon CR Triathlon	607	3(0.5)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
Triathlon PS Triathlon	219	6(2.7)	1.4(0.6)	1.4(0.6)	2.0(0.9)	2.0(0.9)	2.0(0.9)
Vanguard CR Vanguard	176	7(3.9)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
Vanguard PS Vanguard	16	3(18.8)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
Vanguard PS Vanguard	189	3(1.6)	1.0(0.5)	1.0(0.5)	1.0(0.5)	1.0(0.5)	1.0(0.5)

Table KT22 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement by Revision (Primary Diagnosis OA)

Revision	N	1 Yr	3 Yr	5 Yr	10 Yr	15 Yr	18 Yr
Cemented	4712	15(0.3)	0.8(0.0)	2.2(0.1)	2.9(0.1)	4.5(0.2)	6.0(0.3)
Cementless	4791	15(0.3)	1.0(0.1)	3.0(0.3)	4.2(0.4)	6.1(0.6)	8.0(0.8)
Hybrid	3864	18(0.5)	0.8(0.0)	2.3(0.2)	3.1(0.3)	4.6(0.4)	6.0(0.5)
<b>TOTAL</b>	<b>13367</b>	<b>37(0.3)</b>	<b>1.6(0.0)</b>	<b>5.5(0.3)</b>	<b>7.0(0.3)</b>	<b>10.6(0.5)</b>	<b>14.0(0.6)</b>

Note: Excluding cementless Genesis Distal and Profile Distal femoral prostheses

Table KT23 Cumulative Percent Revision of Posterior Stabilised Primary Total Knee Replacement by Revision (Primary Diagnosis OA)

Revision	N	1 Yr	3 Yr	5 Yr	10 Yr	15 Yr	18 Yr
Cemented	4714	14(0.3)	1.0(0.1)	2.9(0.3)	3.9(0.4)	5.9(0.6)	7.9(0.8)
Cementless	137	1(0.7)	1.9(1.2)	4.0(3.4)	5.9(5.6)	6.3(6.7)	8.0(7.6)
Hybrid	675	1(0.1)	1.8(0.4)	4.2(0.8)	5.0(1.0)	7.3(0.7)	10.9(0.9)
<b>TOTAL</b>	<b>5526</b>	<b>16(0.3)</b>	<b>2.7(0.3)</b>	<b>7.1(0.5)</b>	<b>9.0(0.8)</b>	<b>13.6(0.8)</b>	<b>18.8(1.2)</b>

- Wittenauer R, Smith L, Aden K. Background Paper 6.12 Osteoarthritis. World Health Organisation. 2013 Jan 28.
- Briggs TWR. A national review of adult elective orthopaedic services in England: Getting it right first time. Available at: <https://www.boa.ac.uk/wp-content/uploads/2015/03/GIRFT-National-Report-Mar15.pdf>
- Etter K, Lerner J, Kalsekar I, de Moor C, Yoo A, Swank M. Comparative Analysis of Hospital Length of Stay and Discharge Status of Two Contemporary Primary Total Knee Systems. The Journal of Knee Surgery. 2017 Aug 25. Premier Perspective™ Database analysis including 38 US hospitals, representing 1,178 primary, unilateral TKAs with the ATTUNE Knee and 5,707 primary, unilateral TKAs with Triathlon®. The analysis found that the patients implanted with the ATTUNE Knee had statistically shorter length of stay and were more frequently discharged home vs. a skilled nursing facility compared to the TKAs with Triathlon®.
- Mantel J, Corso KA, Wei D, Holy CE, Muehlendyck C, Jayakumar P, Higgins M, Westbrook A. Economic Effectiveness Of The ATTUNE® Knee System-Analysis Of Real World Hospital Length Of Stay And Incidence Of Early Complications. Value in Health. 2017 Oct 1;20(9):
- Brüggenjürgen B, Muehlendyck C, Gador L, Katzer A. Length of Hospitalisation After ATTUNE® Knee Joint Arthroplasty (TKA)-Results of A German Retrospective Database Analysis. Value in Health. 2017 Oct 1;20(9):A597.
- Pipino G, Paragò V, Corso KA, Wigham R, Holy CE, Do Rego B. Economic Outcomes Of The ATTUNE® Knee System: Analysis Of Real World Length Of Stay In An Italian Hospital. Value in Health. 2017 Oct 1;20(9):A595.
- Clement N, Brenkel I, Walmsley P. IMPROVED EARLY FUNCTIONAL OUTCOME WITH THE ATTUNE TOTAL KNEE REPLACEMENT: A PROPENSITY SCORE MATCHED TRIAL. 2017. Poster session presented at British Association for Surgery of the Knee, Southport, United Kingdom.
- Meermans G, Galvain T, Wigham R, Do Rego B, Schröder D. Comparative analysis investigating the impact of implant design on hospital length of stay and discharge destination in a Dutch hospital with an established enhanced recovery program. DSEM/JRC/0118/0984. Poster Accepted to ISPOR Annual Meeting May 19-23, 2018. Baltimore US. Presentation code PMD23.
- Nuffield trust. Understanding patient flow in hospitals 2016. Retrieved from: [http://www.abhi.org.uk/media/1215/understanding\\_patient\\_flow\\_in\\_hospitals-nuffield-trust.pdf](http://www.abhi.org.uk/media/1215/understanding_patient_flow_in_hospitals-nuffield-trust.pdf)



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