MASTER THESIS

A study about "Benchmarking Quality of Robotic assisted radical prostatectomy surgery outcomes"- Among two centres in Europe

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Summary of the study

Background: Over the years there is an increase in demand for quality care in cancer treatment from both the patients and the providers. Prostate cancer is one of the common types of cancer in men. Among the treatment modalities for prostate cancer, Robotic assisted radical prostatectomy (RARP) is the common treatment modality; however, there are too less evidence or studies to demonstrate the good practices in performing RARP to achieve the best possible patient outcome. Hence, benchmarking the surgical and functional patient outcome of robotic assisted radical prostatectomy is essential. Therefore, Rijnstate, Arnhem, Netherlands ("Rijnstate") and Onze-Lieve-Vrouwziekenhuis Aalst, Belgium ("OLV Aalst") were engaged in a partnership to perform benchmarking to analyse the quality of robotic assisted radical prostatectomy surgeries and to explore ways to increase quality in terms of patient outcomes and to learn from each other.

Objective: The main objective of the study is to measure the surgical and patient related outcome of the robotic assisted radical prostatectomy and compare them with the benchmarking partner to learn from the good practices and to improve the quality of service provided. This study provides a collaborative environment to learn and share knowledge among the hospitals in aim of improving the overall surgical and patient related outcomes of robotic assisted radical prostatectomy.

Methodology: The research is carried out based on the 13 benchmarking steps of Van Lent et al in the aim of learning from the good practices to improve the surgical and patient related outcomes. Step 1 to 8 is theory-based approach whereas the steps 9 to 13 are empirical-based on evidence. In the theory-based approach, literature reviews are performed to develop performance indicators and the framework for benchmarking whereas for the empirical based evidence, retrospective data of patients who underwent Robotic assisted radical prostatectomy during the year 2018-2019 in both the centres are gathered and the analysis of the indicators with the data obtained are performed to compare between both the centres.

Results: Based on the analysis of the indicators, Rijnstate, Arnhem Netherlands performs statistically better in the following indicators: ASA Score, p-TNM classification, Blood loss rate and blood transfusion rate, Hospital days, Surgical duration, Re-admission rate, continence rate and OLV Aalst, Belgium performs well in the following indicators: Surgical margins, Catheter time, Lymph node dissection, Re-intervention rate and erection recovery rate. Both the centres had 0% mortality rate during the year 2018-2019. Among the compared performance indicators, some of the indicators such as catheter time, surgical duration, Blood loss rate had remarkable difference and hence few recommendations are given on these indicators. Rijnstate has longer catheter days of 10.9 days and OLV Aalst has 3.2 days therefore, Rijnstate is recommended to reduce the catheter days step by step to 7days and 5 days respectively. OLV Aalst had increased blood loss rate and surgical duration than Rijnstate and therefore, recommended to do a process mapping to identify the deviations in the process of the surgery and to identify factors influencing blood loss rate by finding association of blood loss with the patient related characteristics such as age, BMI, prostate volume, pre-existing medical conditions.

Conclusion: There is a growing interest in international benchmarking to systematically assess the quality of care provided. This is mainly done through developing standard quality indicators that can be used internationally. However, cross-national data comparison is a real challenge. Benchmarking is a process of identifying the gap in the performance of the organization and making plans to continuously improve to be "best of the best" and also benchmarking tries to identify what the organization is already best at and helps to focus on that process/performance to gain a competitive advantage. The basic objectives of the international benchmarking are to assess performance, create sustained pressure for improvement, expose areas where improvement is needed, identifying superior processes, focus on links between the processes and the results and to test whether improvement has been successful. In this study, patient outcomes are measured to analyse the quality of robotic assisted radical prostatectomy surgery. Therefore, this study created a healthy learning environment to expose the areas of improvement without naming and shaming through outcome measurements and by identifying how the outcome vary between both the centres and process variations in ultimately improving the patient related outcomes. Though both the centres provide the same service, there is difference in outcome which could be due to various social and economic factors which the organization has no control over it. Henceforth, comparing the results between the centres is not sufficient, the results have to be linked to the processes that can explain the factors influencing the outcome. However, benchmarking is not only copying from each other, the interaction between the benchmarking centres during each phase of the study is an important source for improvement.

Additionally, access to data is a key component in identifying the differences in outcome between the centres located cross-nationally. Hence, comparing quality across countries helps to assess the causes underlying the differences in the outcome of the service provided (intervention) and determines what appropriate actions need be taken to improve the health outcomes. This study provides a model for international benchmarking using the quality indicators defined for the robotic assisted radical prostatectomy outcome measurement which can be used as a reference when multiple centres are involved in the future.

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LIST OF ABBREVIATIONS

RARP	Robotic assisted radical prostatectomy
RALP	Robotic assisted laparoscopic prostatectomy
EPD	Electronic patient database/dossier
PROMS	Patient reported outcome measures
IOM	Institute of Medicine
OLV	Onze-Lieve-Vrouwziekenhuis
VBHC	Value based healthcare
PSA	Prostate specific antigen
MRI	Magnetic resonance imaging
ASA Score	American society of Anaesthesiologists
p-TNM	Pathologic Tumor, Lymph node, Metastasis
SM	Surgical margin
UTI	Urinary tract infection
PC	Packed cells
TWOC	Trial without catheter

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Anitha Ravichandran

1 Introduction

Prostate cancer is one of the most common types of cancer in men. According to data published by the Netherlands global cancer observatory 14,580 new cases have been recorded in the year 2020 which is 11% of all Dutch incident cancer cases (both sexes, all ages) and 20.3% of male Dutch incident cases (all ages). The 5-year prevalence rate is about 61,096 cases. The mortality rate is about 6.1% which is a serious concern(1). In Belgium 8,163 new cases have been recorded in 2020 which is 9.8% of all Belgian incident cancer cases (both sexes, all ages) and 18.4% of male Belgian incident cases (all ages). The 5-year prevalence rate is about 33,050 cases. The mortality rate is about 5.6% which is to be considered(2). Hence prostate cancer ranks second in the entire cancer types worldwide.

1.1 Prostate Cancer

The prostate is a gland in the male reproductive system that surrounds the urethra and presents below the urinary bladder. Prostate cancer is commonly seen in men above the age of 50(3). It is a slow growing cancer type with initial symptoms such as pain or difficulty in urinating, blood in urine and pain in the pelvic region. Some of the common risk factors identified for the prostate cancer are age, family history but the exact cause of cancer is still unclear(3). Prostate cancer is generally diagnosed by Prostate specific antigen (PSA) testing. Prostate specific antigen is a general protein released by both normal and malignant prostate cells. Men with symptoms are screened for PSA levels and the presence of cancer is detected when the prostate specific antigen level is higher than the normal range in the blood stream. If there are increased PSA levels, a Magnetic resonance imaging (MRI) scan is performed to check for abnormalities of the prostate gland(3) which is further used for surgical planning.

1.2 Treatment

Early-stage prostate cancer is slow growing and hence active surveillance or watchful waiting is recommended because the treatment at times may cause a more severe burden than the disease itself(4). When there is decease in prognosis by diagnostic criteria treatment is started immediately. There are various choices of treatment available for prostate cancer such as surgery, radiation therapy, focal therapies, systemic treatments such as hormonal therapy, targeted therapy, chemotherapy, immunotherapy (3). Most common is the surgical modality with various approaches such as open radical prostatectomy, laparoscopic radical prostatectomy, and robotic assisted radical prostatectomy.

Among these surgical interventions, the most common and advanced treatment modality is Robotic assisted radical prostatectomy (RARP).

1.3 Robotic assisted radical prostatectomy using Da-Vinci Robotic system

In the recent times, among the surgical choices for treating prostate cancer, RARP is the most effective surgical procedure. It is a minimal invasive procedure which is performed using Da Vinci robots. The Da Vinci system was developed by Intuitive Surgical, Sunnyvale, California. The system has a surgeon's console from where the surgeons operate by manipulating the hand wristed instruments and the robotic system replicates the hand movements of the surgeon in real-time and filters all the tremors. A patient side cart, and vision system which has two high resolution fibre optic cameras which provides a three-dimensional view of the surgical site to enhance the vision of the surgeon(5). The system can neither be programmed nor can it make any independent decisions. These features of the robotic system makes it more advantageous than the other surgical choices of prostate cancer. It is considered as less tiring than the laparoscopic instruments and it has paved way for many urologists who are experienced in open radical prostatectomy to shift easily to this invention.

1.4 Outcomes of Robotic assisted radical prostatectomy

Robotic assisted radical prostatectomy is considered to have less common intra-operative complications, such as bleeding, damage to nearby organs, infection(6), like in other alternative procedure such as open radical prostatectomy and it is said to have better patient outcomes such as lower incontinence rate, higher recovery of erection function, less biochemical recurrence, less pain, with minimum post-operative complication and fast recovery rate with short length of stay in the hospital(6). Robotic assisted radical prostatectomies are more precise than the other procedures and the nerves that control the bladder and sexual functions are spared in this procedure(5).

1.5 Motivation for this research

Quality of care is one of the key issues in healthcare that must be continuously evaluated, to constantly determine the factors associated with the satisfaction of the patients with the service provided and to determine how service improvement can be made(7). As defined by Institute of Medicine

study committee, quality of care is the degree to which health services for individuals and population increase the likelihood of desired health outcomes and are consistent with current professional knowledge(8). Over the years there is an increase in demand for quality care from both the patients and the providers. Robotic assisted radical prostatectomy is the widely practiced surgical treatment modality for prostate cancer by Rijnstate, Arnhem, the Netherlands and Onze-Lieve-Vrouwziekenhuis Aalst, Belgium and they are well known of these demands of quality care and therefore looking for ways to improve the quality of service provided.

The benchmarking centres were chosen based on the expertise in the field of robotic surgery. Rijnstate is one of the large peripheral centre in the Netherlands and OLV Aalst Hospital is the big academic hospital fully dedicated in performing robotic surgeries in which Rijnstate contributes to almost 10% of all operations with robot in the Netherlands, in which 120 surgeries are robotic prostatectomies every year(9). Onze-Lieve-Vrouwziekenhuis Aalst is recognized by ERUS-European Robotic Urologic society as a training centre for robotic surgery and performs around 360 robotic prostatectomies every year(10). Hence, these two centres engaged in a benchmarking partnership with the goal of improving patient outcome and creating a quality label for robotic assisted radical prostatectomy surgeries.

Based on the initial overview of the research undertaken, robotic assisted radical prostatectomy has better patient outcomes than any other surgical procedures such as laparoscopic prostatectomy and open radical prostatectomy. Nevertheless, this benchmarking research is carried out with the aim of improving the patient outcome and learning from the good practices among the benchmarking centres and improving the quality of care provided with robotic assisted radical prostatectomy.

This benchmarking study is focused on measuring and comparing the outcome of the robotic prostatectomy surgery to evaluate its performance on quality because benchmarking is considered as a tool for continuous improvement. According to Joint commission resources, “Benchmarking is a systematic, data driven process for continuous improvement that involves a comparison of performance to identify, introduce and sustain good practices and this is achieved by collecting, measuring, and evaluating data to establish a target performance level, a benchmark”(11). The goal of benchmarking in healthcare is to improve the process and patient outcomes to attain excellence. Hence this definition of benchmarking fits best to the aim of the study. Therefore, it is used in this research.

The robotic assisted radical prostatectomy is chosen as a benchmarking candidate because of the assumption that the procedure is significant with a stable process, and with less variation. Furthermore, there is reasonable amount of data available pertaining to robotic prostatectomy in both the centres. Henceforth, this quality research of benchmarking the quality of robotic prostatectomies outcome was started based on the increased demand for quality and the commitment on quality improvement of both the centres.

The following background section provides basic insights about the quality of care and its importance and how it is measured, the purpose of measuring and some of the tools used in measuring them and the concept and principles of value-based healthcare. This background information serves as a base for this study.

2 Background

2.1 Quality of care

According to WHO (World health organization), quality of care is the degree to which health services for individuals and population increase the likelihood of desired health outcomes(8). As countries commit to achieving health for all, it is imperative to consider the quality of care and health services.

As every patient deserves the healthcare best suited for him/her, the movement of Outcome based healthcare 2018-2022 has been established by the Dutch ministry of healthcare, welfare, and sports. The intended goal of this initiative is that the outcomes must be measured for half of the disease burden by 2022. In the aim of improving patient quality of life and increasing the job satisfaction for healthcare providers this movement was started(12).

2.2 Measuring quality of care

Quality measurement is important for various stakeholders of healthcare. Most of the quality measurement focuses on the development and assessment of indicators(13). Quality indicators are the quantitative measure which help to track progress and performance and act as a guide in the improvement process and decision making. Calhoun (2002) stated that in social sciences, indicators are the quantitative measures that provide

information about a variable that cannot be measured directly. Hence, the quality of care cannot be measured directly as it encompasses multiple aspects. Indicators are the tool for its measurement.

2.3 Purpose of measuring quality

Quality measurement helps in creating a basis for quality assurance and improvement strategies such as Accreditation and certification, pay for quality, auditing, and feedback(13). There are two purposes for measuring quality. One is to use the measurements in quality assurance system (summative mechanism) for external verification and accountability. The second is to use them as a formative mechanism for Quality improvement. There are few differences existing between quality assurance and improvement. Quality assurance focuses on external assessment strategies, while the low/insufficient quality providers will lose their licence and will be prohibited from practicing(13). It contributes to public reporting initiatives, whereas quality improvement is change oriented, which continuously stimulates the healthcare providers to improve their performance(13). The purpose of this benchmarking study is quality improvement.

2.4 Tools for measuring quality

As mentioned, quality indicator serves as an excellent tool of measuring healthcare quality. There are many choices of classifying quality indicators such as rate-based, count-based, generic indicators, disease specific indicators, patient-based and event-based indicators. However, the most used classification is Avedis Donabedian classification (1966)(13). He classified the indicators as structure, process, and outcome. Structural indicators are used to assess the infrastructure, qualification of the medical professionals, and the adequacy of facilities. Process indicators are used to assess the actions indicating high quality of services. Process indicators can be built based on scientific evidence or with the clinical guidelines or some golden standard. Finally, Outcome indicators are the concrete patient related measurements which focus on the actual goals of the service provision. Outcome indicators are more meaningful for both patients, the policy makers(13) and the healthcare professionals. Benchmarking indicators are defined as a measurement tool used to monitor and evaluate the importance of governance, management, clinical and support functions (14).

2.5 Value-based healthcare principles

Value based healthcare is a concept given by Michael Porter in 2006 through his book, “Redefining Healthcare: Creating value-based competition on results(15). Value based care simply implies improving quality and outcomes for patients. Porter’s model (Fig.1) has six dimensions of value-based healthcare such as; organize into integrated practice units, measure outcomes and costs for every patient, move to bundled payments for care cycles, integrate care delivery across separate facilities, and expand excellent services across geography.

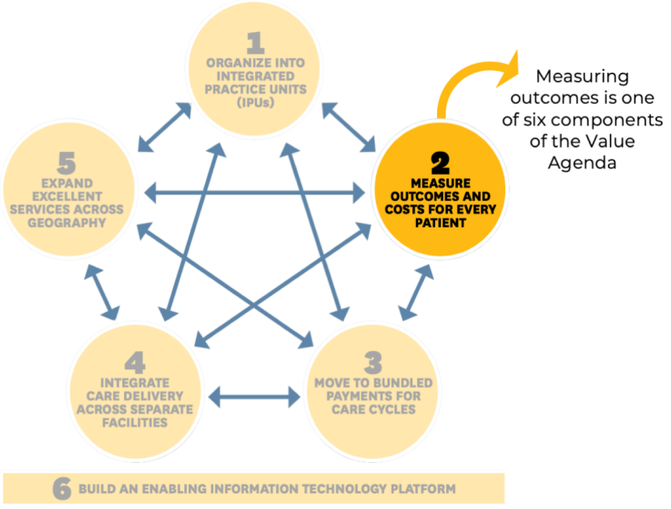


Fig 1. Michael E. Porter’s value-based healthcare model

The value-based healthcare model prioritizes patient-centred care. It focuses on maximizing the value of care for patients and reducing the healthcare cost. This study is based on the principle of measuring the outcome for every patient to improve the quality of care provided.

2.6 Benchmarking process model

Benchmarking process models found in literature originated mainly from manufacturing industries, and therefore some of them are not suitable to use in healthcare benchmarking. Some of the common benchmarking process models used in healthcare are model of Spendolini (1992), model of Finnigan (1996), model of van Hoorn (2007), model of Van Lent (2010). Every process model has its own strong and weak points. The model of Spendolini is commonly used for industrial benchmarking. The process of Van Hoorn et al is used in healthcare which states the importance of creating support for the project and the need to assess the comparability of organization and the involvement of stakeholders in the development of indicators. This model does not focus on the aspects of forming a benchmarking team, framework selection to structure the indicators and identifying the stakeholders involved. Whereas the Van lent et al model describes how healthcare benchmarking is carried out in detail involving all aspects of measuring the outcome and focuses on improvement plans. Hence the best suited benchmarking process model for this study is Van Lent et al model of 13 steps.

3 Research question

Since there are multiple objectives for this study, the research questions are framed based on the initial background search and the motivation of this research. For this research to be carried out performance indicators to measure the outcome of RARP and a healthcare benchmarking process model is needed which can be used on a continuous basis for improvement and collection of performance information, measuring and comparing them with both the centers and involving in actual learning from each other. Hence, the research question is developed as follows,

"How are the performance indicators for measuring the quality of robotic assisted radical prostatectomy selected, measured and compared between the benchmarking centers and what improvement suggestions are recommended based on the results?"

To be clearer and simpler, the research question is divided into following sub questions and ultimately these sub questions together answer the main question:

1. Which performance indicators can be used for benchmarking the quality of RARP?
2. How do the benchmarking centres perform on these performance indicators?
3. What are the variation in these performance indicators?
4. How can the benchmarking centres improve their performance based on the results?

4 Study design/ Methodology

The research process is carried out based on the benchmarking steps of Van Lent et al in the aim of learning from the good practices to improve the patient related outcomes. The benchmarking process has 13 steps which answers the main research question. Step 1 to 8 is theory-based approach whereas the steps 9 to 13 are empirical-based on evidence.

The steps 1 to 8 describes how the benchmarking candidate is chosen and who are the stakeholders involved and the characteristics of the benchmarking partners and the performance indicators required to measure and compare between the benchmarking centres. This is mainly based on literature review and gives answer to the first research sub-question, which performance indicators can be used for benchmarking the quality of RARP?

Steps 9 to 13 will be carried out based on the evidence, and the data gathered which serves as empirical evidence. These steps answers the sub-questions 2-4, How do the benchmarking centres perform on these performance indicators? , What are the variation in these performance indicators? , How can the benchmarking centres improve their performance based on the results?

The nature of benchmarking carried out is functional performance benchmarking, intended to measure the performance (i.e.) the outcome characteristics which can be quantified. The proposed study will use quantitative methods to measure the outcome of the robotic prostatectomy surgeries.

Since the study involves measuring and comparing patient outcome data, undertaking such a project requires ethical committee approval unless the project falls under the definition of quality research. The research proposal has been reviewed by the science and legal department of Rijnstate and this benchmarking research is considered as a quality improvement project. Therefore, this project does not require any ethical approval from the project centre as the study does not involve any human specimens during the research period and only aggregate data will be shared and does not include any patient level data. The following link gives a detailed overview of the specifications,

"Quality research under the Wkggz (Wet kwaliteit, klachten en geschillen zorg(Wkkgz) | Kwaliteit van de zorg | Rijksoverheid.nl), specifically article 7.2.a" (16), OLV Aalst, Belgium has its own ethics committee approval to take part in this benchmarking research.

The research design depicts the sequence of actions to be taken in each phase of the research. The research design is as follows, Fig.2

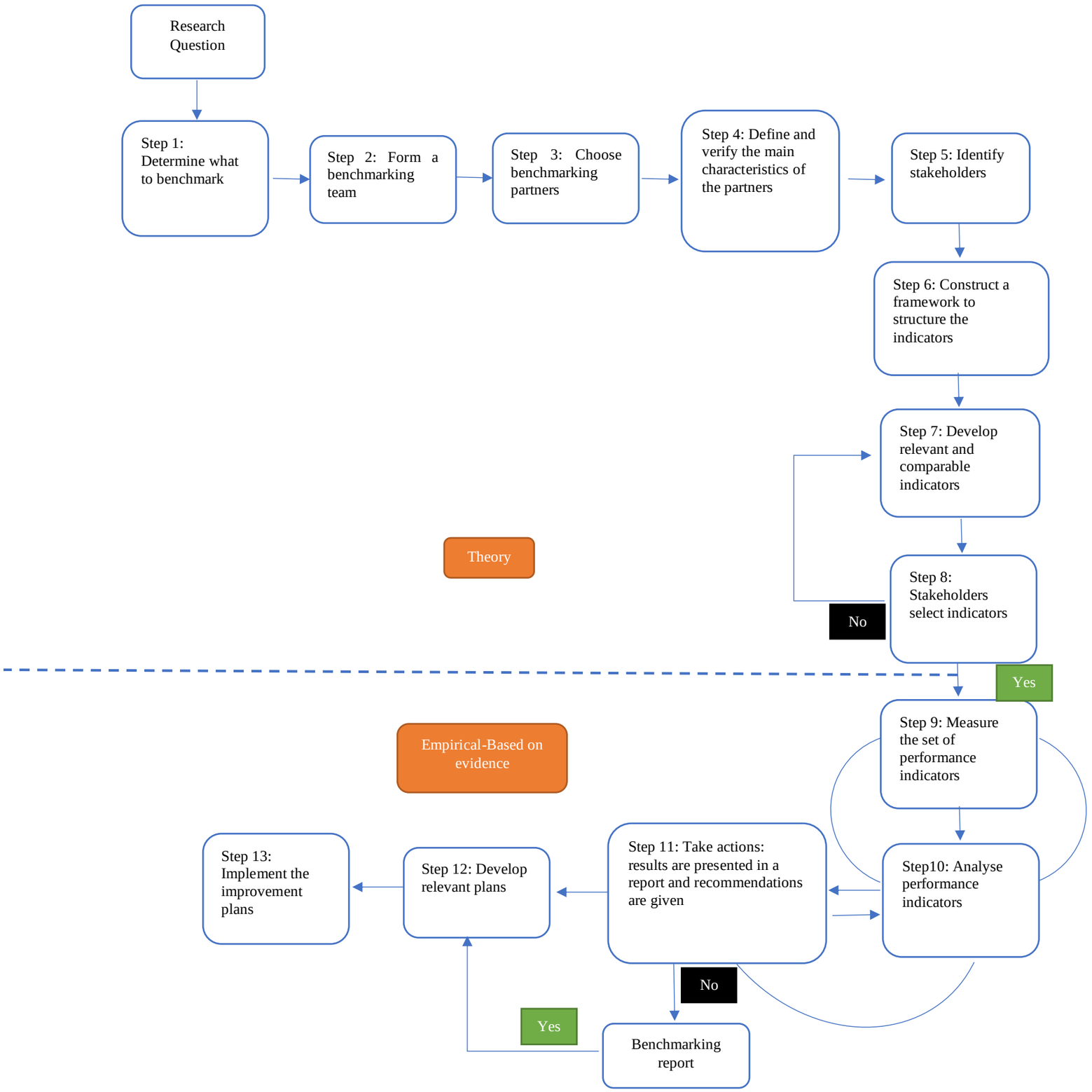


Fig.2 Research design

The following section describes the methodology of this study in the aim of finding an answer to the research questions. The methods are described step by step based on the benchmarking process of van lent et al.

Step 1: Determine what to benchmark

In the search of good practices, every organization need to look after the key aspects that can lead the organization in achieving superior performance. Hence, as a first step it is essential to determine what to benchmark. For this study, the benchmarking candidate chosen is the Robotic assisted radical prostatectomy. RARP has profoundly become the popular surgical intervention for treating localised prostate cancer among the Urologists. It is considered as the well-tolerated, safe and efficacious intervention in the management of prostate cancer. In the aim of developing a quality label and improving patient related outcomes the widely practiced intervention in treating prostate cancer- RARP is chosen and also the choice is based on the assumption that the procedure of robotic assisted radical prostatectomy is standard with a stable process which has less variations and furthermore there is reasonable amount of data available pertaining to robotic prostatectomy in the benchmarking centres.

Step 2: Form a benchmarking team

Developing a benchmarking team is an essential part to conduct the study that aligns to the actual goal of the study. Based on literature, benchmarking team should consist of 3 to 7 members. Apart from the executive board, the project coordinator, data collector, data analyst and the support staffs should be present. For this study, A team consisting of Urologist's, Robotics project leader and quality staffs of the benchmarking centres, and student Intern is formed.

Step 3: Choose benchmarking partners

One of the keys to successful benchmarking is choosing a right partner. But this process of selecting a benchmarking partner is complex. According to Spendolini benchmarking partners can be divided into four main categories from the lowest hierarchical level to highest one such as equal or lower than the current performance, improvement compared to current performance, best practices, best in class(17). For this study two academic hospitals within Europe performing equally good were chosen. The benchmarking partners are, Rijnstate-Arnhem & Onze-Lieve-Vrouwziekenhuis Aalst, Belgium. These two centres were chosen based on the expertise in the field of robotic surgery. Both the centres are fully dedicated in performing robotic surgeries and performs a large number of robotic prostatectomy surgeries every year.

Step 4: Define and verify the main characteristics of the partners

Rijnstate is one of the largest peripheral centres in the Netherlands and OLV Aalst Hospital is a big academic hospital in Belgium performing large number of robotic surgeries in which Rijnstate performs about 700 robotic surgeries every year in which 150 surgeries are robotic prostatectomies and this contributes to almost 10% of all operations with robot in the Netherlands. Onze-Lieve-Vrouwziekenhuis Aalst is recognized by ERUS-European Robotic Urologic society as a training centre for robotic surgery and performs about 360 robotic prostatectomies on an average ever year. Hence, these two centres are engaged in a benchmarking partnership with the goal of improving patient outcome and creating a quality label for robotic surgeries.

Step 5: Identify stakeholders

There are multiple definitions for the term stakeholders found in the literature. One of most common definition used is from Freeman, "A stakeholder in an organization is any group or individual who can affect or is affected by the achievement of the organizations objectives". By redefining this definition, it can be used in this study. It is "A stakeholder for the benchmarking quality of robotic assisted radical prostatectomy is a group or individual who is interested in and can affect the or affected by the objectives of the study". The stakeholders involved in the study are the Patients (Indirect stakeholders- Only the retrospective data of who underwent RARP is used), Urologists of both the centres (Direct stakeholders), Quality staff and the robotic project leader.

Step 6: Construct the framework to structure the indicators

Any framework chosen for the benchmarking study should be able to cover all aspects of quality. One such framework found from the literature is the Institute of Medicine- IOM framework of quality domains such as efficiency, effectiveness, safety, patient centred, timely and equitable care. These quality domains covers all the aspects of quality, related to patient outcome.

All the 12 indicators defined in this study is structured through this framework, as it covers all aspects of quality.

Step 7: Develop relevant and comparable indicators

To benchmark RARP surgical, functional, and oncological outcome between the centres, performance indicators measuring those outcomes must be identified. The effectiveness of robotic assisted radical prostatectomy is measured through patient outcomes in various studies. The performance indicators (i.e.) outcome indicators used for measuring the quality of the robotic assisted radical prostatectomy are selected from the literature and some of the indicators suggested by the Urologists.

Many studies in the literature focus on measuring the patient clinical, surgical, and functional outcome of RARP to analyse the quality of the surgery. In this study, PubMed and Google scholar, Science direct were used as databases. The following search terms were used:- Benchmarking, patient outcomes, Robotic surgical procedures, Robotic assisted radical prostatectomy, outcome assessment, prostatectomy. Articles published in the international journals during the period 1990-2021 with full text in English were retrieved. Based on the search terms a search string is built and used in PubMed, 169 relevant articles were found in the initial search based on the title, which is further analysed, with the abstract review 19 articles were shortlisted and they are used as a reference for this study. The 150 articles were excluded from the review due to the reason that it does not extensively cover all the performance indicators used for benchmarking, for example comparison of only two outcome measurements (continence rate and potency rate) are performed.

Literature search	
All articles published in international journals in English.	
Time frame: 1990-2021	
Search strategy: Keywords in the title and abstract and full text.	
Boolean search strings	
Search 1: "robotic assisted radical prostatectom*" AND "outcome*"	**Search 2:** "outcome assessment" AND "prostatectomy" AND "robotic surgical procedures"
Search 3: "benchmarking" AND "framework" AND "healthcare"	**Search 4:** "robot assisted radical prostatectomy"
PubMed first search: Articles retrieved: 61, n=10 selected based on abstract review. PubMed second search: Articles retrieved: 29, n=3 selected based on abstract review. PubMed third search: Articles retrieved: 62, n=1 selected based on abstract review. PubMed fourth search: Articles retrieved: 17, n=5 selected based on abstract review. Total articles retrieved: 169, Articles excluded: 150, Articles selected: 19	

The common outcome measured in these literatures for RARP are *operative time* (18-24) which is measured from the time of incision till closure with sutures, *blood loss and transfusion rate* (18-28) are measured in ml, *hospital days* (18, 19, 21, 22, 24, 26-28), *catheter duration* (18, 22, 24, 26), complication rate based on *Clavien Dindo classification* (18, 19, 21, 22, 24, 26, 28-31), *Urinary continence* (18-21, 23, 25, 28-33), *erection dysfunction or potency rate* (18-21, 23, 25, 26, 28-30, 33), *positive surgical margin* (18-21, 23-27, 29, 30, 32), *biochemical recurrence* (18, 19, 21, 23, 25, 26, 28-30, 32, 33), *lymph node involvement* (31, 32), *comorbidities* (33), *ASA physical status score* (31). The other factors contributing to the quality of robotic assisted radical prostatectomy are robot *setting time and docking time* (34), *post-operative pain* (35), *surgeons experience and hospital volume* (36). Total of 16 outcome measurements were selected from the literature. Some of the indicators suggested by the urologist are p-TNM classification, ASA physical status score, lymph node dissection.

Step 8: Stakeholders select indicators

A list of indicators from the literature is presented to the stakeholders (i.e., Urologists) and based on the research objectives some of the indicators such as hospital volume, surgeons experience are excluded which might be helpful in the learning curve. Hence, based on the reference of literature studies and urologist's opinion a final set of 12 outcome indicators were selected for this benchmarking study. A detailed description of the selected indicators and the criteria for measuring them and the arguments supporting the selection is given below in ***section 5*** of this report.

Step 9: Measure the set of performance indicators

To this study, Samples chosen are the patients who underwent robotic assisted radical prostatectomy surgery during the year 2018-2019, the retrospective data of those patients are extracted from the hospital electronic patient database (patient outcome data and patient reported outcome measures data). The reason for choosing the specific period 2018-2019 is due to the fact that recent data should be considered for the study. Initially, the aim is to include 2018-2020 data but due to the Covid-19 crisis, the number of surgeries during the year 2020 is reduced and there is no sufficient data available for 2020 and hence only the year 2018-2019 is chosen. The quantitative data is scanned for its consistency (some patient data are not recorded as they unsubscribe from post-surgical follow-up questionnaire (PROMS questionnaire) those patients are excluded from the analysis. The sample size of Rijnstate is 226 and OLV, Aalst is 727 for the specified year. The performance indicators are measured based on the data collected.

Step 10: Analyse performance indicators

Due to restriction in accessing patient level data of the benchmarking centres only descriptive statistical analysis was performed. Data analysis is performed using Microsoft excel software. The performance indicators are measured from the patient outcome data extracted. The analysis includes finding the average, median, mode, range and percentage based on the specific criteria determined by both the centres (Table 2-appendix) and the results are compared between centres. Indicators presented with difference in results are further analysed for the cause of variation. If the outcome variations are due to the process of the intervention, then data regarding those processes can be collected and evaluated through process mapping(37) which will be carried in the future due to time constraints. The results with comparison between the centres is presented in ***section 6*** of the report.

Step 11: Take actions: results are presented in a report and recommendations are given

The summary of major finding of the study with the discussion on the results are described in the ***section 7 & 8*** of this report. The initial results are presented before the Urologist and the benchmarking team of both the centres. The suggestions by the Urologist on further analysis is discussed in the ***section 10*** future research scope.

Step 12: Develop relevant plans & Step 13: Implement the improvement plans

Improvement plans on the suggestions given for both the centres will be developed with the approval of the top management. However, the step 12 & 13 is not within the scope of this study and hence these improvement plans will be plotted out and implemented in the future.

5 Indicator's list

In this section, the list of indicators used in the study and the definition with the measurement criteria is described. The definition of the indicators and the criteria for measuring them are presented with the consensus of both the centres. The selection method of these indicators is described in the earlier section of methodology.

Indicator 1: ASA physical status score

Percentage of patients who belong to ASA physical score category of 1 to 6 to record the comorbidities present prior to surgery.

Definition: ASA- American Society of Anaesthesiologist's physical status score classifies patients from 1 to 6, 1 being normal healthy patient and 6 being brain dead.
Numerator: Number of patients under each ASA category 1,2,3,4,5,6
Denominator: Total number of patients underwent RARP surgery.
Inclusion/Exclusion criteria: • All patients who are diagnosed with prostate cancer and underwent surgery in 2018-2019 were included. • Patients due to personal reasons withdrawn from treatment plan after diagnosis are excluded.
Importance: It is an important tool used for predicting short and long-term outcome in patients undergoing surgical procedures. There is an increased correlation between ASA scores with operating time, hospital length of stay, intra and post-operative complications and mortality rates following a surgical procedure(38). Hence this parameter is measured to evaluate the quality of surgery.

Indicator 2: p-TNM classification

Percentage of patients categorized in each p-TNM staging based on UICC 8th edition classification.

Definition: p-TNM classification of UICC 8th edition.
Numerator: Number of patients in each level of p-Tumor, p-Lymph node, p-Metastasis.
Denominator: Total number of patients for whom pathological biopsy is done.
Inclusion/exclusion criteria: • All the patients underwent RARP during the year 2018-2019 and for whom pathological biopsy is performed were included. • Patients with negative biopsy results are excluded.
Importance: Cancer staging evaluation occurs in two stages. Before and after surgery, clinical and pathologic stages respectively. Clinical staging is based on the clinical test prior to treatment and pathologic staging is determined following the biopsy through the examination of removed Tumor tissue. The pathologic staging is more accurate in providing direct insight about the nature and extend of the Tumor. p-TNM classification assist in the estimation of the prognosis.

Indicator 3: Surgical margins

Percentage of patients in R0- Negative margins and R1 & R2- Positive margins

Definition: The resection margin is defined as the non-tumorous margin that is surgically removed. It is represented as R0- Clean, R1- microscopic residual Tumor <3mm,1 location + R2- macroscopic residual Tumor >3mm,more locations.
Numerator: Number of patients with R0,R1+ R2 margins.
Denominator: Total number of patients that underwent RARP surgery.
Inclusion/Exclusion criteria: • All patients that underwent surgery during the year 2018-2019 were included. • Missing data are presented. Tumor margins that were un-assessable are presented in the results.
Importance: Positive margin defines that the Tumor is not completely removed from the site and residues are left behind which may cause biochemical recurrence or metastasis. Effectiveness of surgery is measured using this indicator.

Indicator 4: Blood loss and transfusion rate

Percentage of patients encountered blood loss during surgery measured through aspirator and received blood transfusion during the surgery and hospital stay (in ml).

4a. Blood loss rate

Definition: Blood loss during surgery are categorised in 5 classes. 0-250ml (>=0 and <=250 ml) 251-500 ml (>=251 and <=500 ml) 501-750ml (>=501ml and <=750ml) 751-1000ml (>=751ml and <=1000ml) >= 1001 ml
Numerator: Number of patients in each category of blood loss (range 0-250ml,251-500ml,501-750ml,751-1000ml, >1001ml).
Denominator: Total number of patients underwent RARP surgery.
Inclusion/Exclusion criteria: • All patients who underwent RARP Surgery during the year 2018-2019 were included. • Missing data is presented.
Importance: Traditionally open radical prostatectomy has been associated with higher estimated blood loss and transfusion rates. Whereas, in Robotic assisted prostatectomy surgeries significantly low blood loss and transfusion rate is recorded. Blood loss has serious impact on the surgical duration and the post-operative complication and recovery of patient.

4b. Blood transfusion rate

Definition: Blood transfusion during surgery and hospital stay.
Numerator: Number of patients received transfusion during the surgery and during the entire stay in hospital.
Denominator: Total number of patients underwent RARP surgery.
Inclusion/Exclusion criteria: • All patients who underwent RARP Surgery during the year 2018-2019 were included. • Non-surgery related blood transfusions are excluded.

Indicator 5: Surgical duration

Average surgical duration of RARP including and excluding lymph-node dissection in mins.

Definition: Surgical duration from the time of first incision till closing suture with and without lymph node dissection.
Numerator: Sum of all duration of patients from the time of first incision till closing suture including and excluding lymph-node dissection
Denominator: Total number of observations of RARP surgery
Inclusion/Exclusion criteria: • All patients who underwent RARP Surgery during the year 2018-2019 were included. • Surgeries converted to open are excluded.
Importance: Determining surgical duration is essential as it contributes to the overall patient outcome. This is measured since, longer the surgical duration, longer the patient to be anaesthetised. Surgical duration variation is multifactorial, it cannot be compared directly.

Indicator 6: Lymph-node dissection

Percentage of patients including and excluding lymph nodes dissection.

Definition: Lymph node dissection helps to determine the spread of Tumor cells through lymphatic system to other parts of the body
Numerator: Number of patients with and without lymph node dissection
Denominator: Total number of patients underwent RARP surgery
Inclusion/Exclusion criteria: • All patients who underwent RARP Surgery during the year 2018-2019 were included.
Importance: Pelvic lymph node dissection is the most accurate staging procedure for the detection of nodal involvement in men diagnosed with prostate cancer. In about 60-70% of cases lymph node dissection is done to further investigate on the spread of Tumor cells through the lymphatic system. Lymph node dissection has correlation with the biochemical recurrence and operating time which determines how long the patient should be in anaesthesia.

Indicator 7: Hospital days

Average length of stay in the hospital- entire stay (Values in days with decimals)

7a. Hospital days- Length of stay in hospital from the day of admission till hour to discharge day.

Definition: Length of stay in hospital from the day of admission + hour to discharge day
Numerator: Sum of all days and hours during entire stay.
Denominator: Total number of patients admitted for RARP surgery.
Inclusion/Exclusion criteria: • All patients who underwent RARP Surgery during the year 2018-2019 were included. • Patients who developed complications unrelated to urology and stayed for a longer duration were excluded.
Importance: It is an important component to measure patient well-being after surgery. The shorter the Length of stay (LOS) lower the degree of morbidity and faster recovery.

7b. Hospital days- post-op stay in hospital

Average length of stay in the hospital- post-op stay (Values in days with decimals)

Definition: Post-op stay in hospital from the first incision to discharge time.
Numerator: Sum of all days and hours post-op.
Denominator: Total number of patients admitted for RARP surgery.
Inclusion/Exclusion criteria: • All patients who underwent RARP Surgery during the year 2018-2019 were included. • Patients who developed complications unrelated to urology and stayed for a longer duration were excluded.
Importance: It is an important component to measure patient well-being after surgery. The shorter the Length of stay (LOS) lower the degree of morbidity and faster recovery.

Indicator 8: Catheter time

Average catheter time of own patients underwent RARP surgery

Definition: Catheter time is the time from surgery till the time of trial without catheter (TWOC)
Numerator: Sum of all duration of catheter time from surgery till TWOC
Denominator: Total number of patients underwent RARP surgery
Inclusion/Exclusion criteria: • All patients underwent RARP surgery during the year 2018-2019 were included. • Patients sent to other hospitals and home with catheter are excluded. • Patients who removed their catheters from other hospitals and clinics are excluded.
Importance: Prolonged catheter duration is a risk factor for catheter associated urinary tract infection (UTI) which might increase the post-surgical complications and thereby increase the length of stay. Increased duration also causes discomfort in patients.

Indicator 9: Continence rate

Percentage of patients who are continent (0 & 1 PADS) and incontinent (>1 PADS) at pre-operative, 6 weeks, 3months, 12months and 24months follow-up period.

Definition: Incontinence is the involuntary leakage of urine due to loss of control of bladder muscles which is measured by the number of pads used per day by the patient in the T0-pre-op/T1-6weeks/T2-3months/T3-12months/T4-24months follow-up period
Numerator: Number of patients used 0 & 1 and >1 pads/day during pre-op,6weeks,3months,12months,24months follow-up period.
Denominator: Total number of patients underwent RARP and for whom follow-up is done.
Inclusion/Exclusion criteria: • All patients who underwent RARP Surgery during the year 2018-2019 were included. • Missing data is excluded. • Patients who unsubscribed themselves from the follow-up questionnaire were excluded. • Patients died during the follow-up period were excluded.
Importance: Incontinence after robotic prostatectomy surgery is common among patients which occurs due to sphincter muscle damage during the surgery. It is a temporary effect of surgery which sometimes causes stress in patients. Followed by surgery, pelvic floor exercise also known as Kegel exercises is recommended.

Indicator 10: Erection function recovery rate

Percentage of patients for those erection is stiff enough for sexual activity without medication at pre-operative, 6weeeks, 3 months,12months,24months follow-up period.

Definition: Erection dysfunction is the inability to have stiff erection enough for sexual activity, measured at T0-pre-op,T1-6weeks,T2-3months,T3-12months,T4-24months follow-up period.
Numerator: Number of patients with stiff erection enough for sexual activity without medication at pre-op, 6weeks, 3months, 12months, 24months follow-up period.
Denominator: Total number of patients operated.
Inclusion/Exclusion criteria: • All patients who underwent RARP Surgery during the year 2018-2019 were included. • Patients who are not active in sexual activity pre-operatively were excluded. • Patients died during the follow-up period were excluded. • Missing data is excluded.
Importance: Due to injury to the neurovascular bundles, erectile dysfunction is caused. Younger age, preoperative potency, comorbidities are the key factors affecting the recovery of erectile function.

Indicator 11: Measurable PSA level

Percentage of patients whose PSA level is >0.1 (Measurable PSA level of >0.1 at 3months and 12 months post-surgery).

11a. Measurable PSA level at 3months

Definition: Biochemical recurrence is the relapse or PSA failure measured at 3 months post-operatively. PSA >0.1 ng/dL indicates recurrence
Numerator: Number of patients detected with PSA level >0.1 at 3months post-surgery.
Denominator: Total number of patients underwent RARP surgery and for whom follow-up testing for PSA levels post-surgery is done.
Inclusion/Exclusion criteria: • Patients who underwent RARP surgery and under the follow-up programme during the year 2018-2019 were included. • Patients received post-operative adjuvant therapies are excluded. • Patients withdrawn from the follow-up session and died during the follow-up period were excluded. • Missing data is excluded.
Importance: Biochemical recurrence is stated as biochemical failure which cannot be determined by a single variable. The main variables associated with biochemical recurrence is Gleason score, positive resection margin, lymph node involvement and extra-prostatic extension(39).

11b. Measurable PSA level at 12 months

Definition: Biochemical recurrence is the relapse or PSA failure measured at 12months post-operatively. PSA >0.1 ng/dL indicates recurrence
Numerator: Number of patients detected with PSA level >0.1 at 12months post-surgery.
Denominator: Total number of patients underwent RARP surgery and for whom follow-up testing for PSA levels post-surgery is done.
Inclusion/Exclusion criteria: • Patients who underwent RARP surgery and under the follow-up programme during the year 2018-2019 were included. • Patients received post-operative adjuvant therapies are excluded. • Patients withdrawn from the follow-up session and died during the follow-up period were excluded. • Missing data is excluded.
Importance: Biochemical recurrence is stated as biochemical failure which cannot be determined by a single variable. The main variables associated with biochemical recurrence is Gleason score, positive resection margin, lymph node involvement and extra-prostatic extension(39).

Indicator 12: 90days complications rate

Percentage of patients who had complications related to urologic conditions during the stay or in 90 days post-op.

12a. Complication rate- Death during stay and <90days post-op

Definition: Complications related to urologic condition such as death during stay or <90 days post-op.
Numerator: Number of patients died due to urologic condition during stay and in <90days post-op.
Denominator: Total number of patients being operated.
Inclusion/Exclusion criteria: • All patients who underwent RARP Surgery during the year 2018-2019 were included. • Patients died due to complications other than urologic conditions are excluded. • Patients died >90days post-op are excluded.
Importance: Acute surgical complication such as bleeding, thromboembolism has an impact of outcome of the surgery and life-threatening stage where intensive treatment is required is recorded in 90 days complications rate which helps in measuring the quality of the surgery performed.

12b. Complication rate- re-hospitalization <90 days post-op

Definition: Complications related to urologic condition such as re-hospitalization for urology in <90 days post-surgically.
Numerator: Number of patients re-admitted due to urologic condition in <90days post-op.
Denominator: Total number of patients being operated.
Inclusion/Exclusion criteria: • All patients who underwent RARP Surgery during the year 2018-2019 were included. • Patients with complications other than urologic conditions are excluded. • Patients with minor complications are excluded. • Patients re-admitted after 90 days are excluded.
Importance: Acute surgical complication such as bleeding, thromboembolism has an impact of outcome of the surgery and life-threatening stage where intensive treatment is required is recorded in 90 days complications rate which helps in measuring the quality of the surgery performed.

12c. Complication rate- re-intervention <90 days post-op

Definition: Complications related to urologic condition such as re-intervention for urology in <90days post-surgically.
Numerator: Number of patients required re-intervention due to urologic condition in <90days post-op.
Denominator: Total number of patients being operated.
Inclusion/Exclusion criteria: • All patients who underwent RARP Surgery during the year 2018-2019 were included. • Patients with complications other than urologic conditions are excluded. • Patients with minor complications are excluded. • Re-intervention after 90 days are excluded.
Importance: Acute surgical complication such as bleeding, thromboembolism has an impact of outcome of the surgery and life-threatening stage where intensive treatment is required is recorded in 90 days complications rate which helps in measuring the quality of the surgery performed.

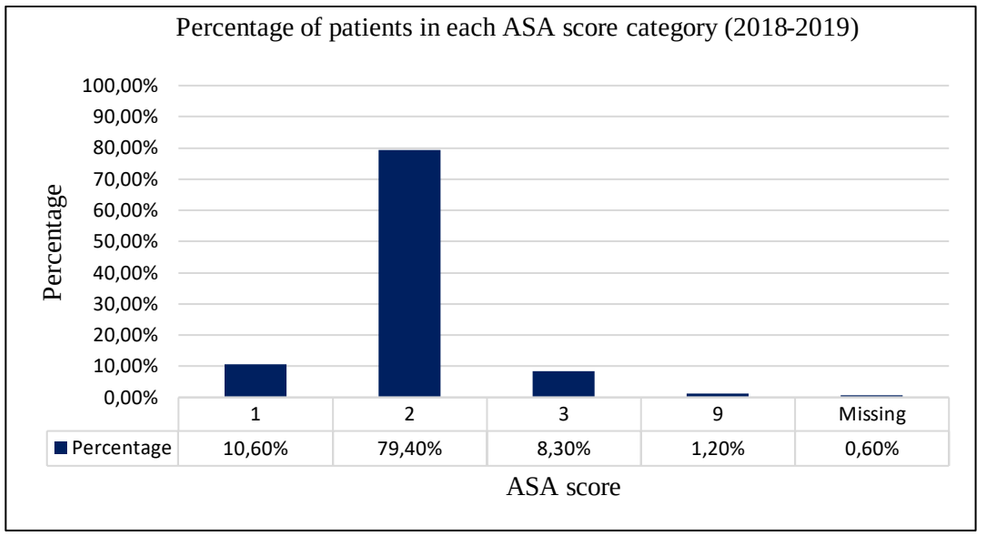
6 Results ***Rijnstate*** ***OLV Aalst***

This section is presented with the results of both the centres on how they perform on the indicators defined in the earlier section. The indicators are measured and compared based on the criteria set by both the centres.

Indicators 1- ASA physical status score

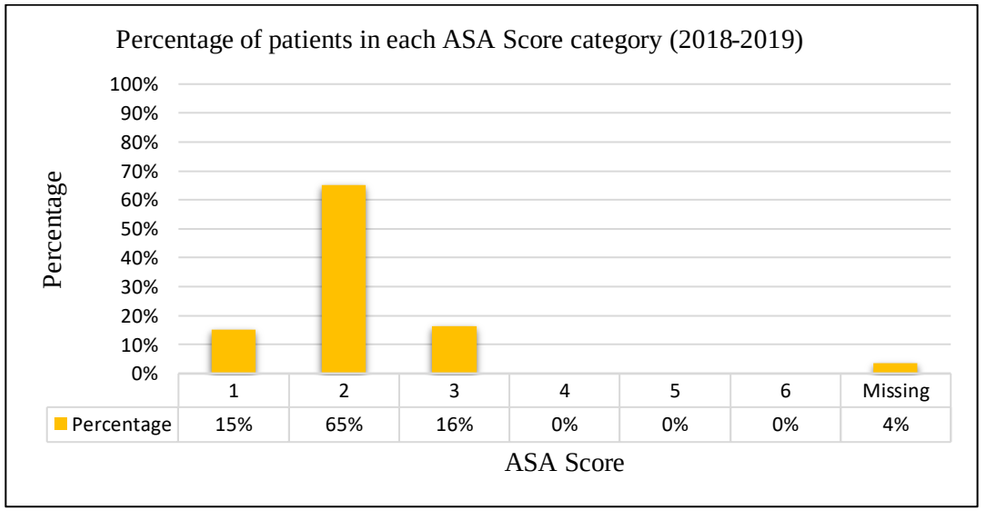
Percentage of patients who belong to ASA physical score category of 1 to 6 to record the comorbidities present prior to surgery.

OLV Aalst



ASA Score		
Category	***2018-2019***	
	No.of.patients	***Percentage***
1	*77*	*10,6%*
2	*577*	*79,4%*
3	*60*	*8,3%*
9	*9*	*1,2%*
Missing	*4*	*0,6%*
Total	***727***	***100,0%***

Rijnstate



ASA Score		
Category	***2018-2019***	
	No.of.patients	***Percentage***
1	*34*	*15%*
2	*147*	*65%*
3	*37*	*16%*
4,5,6	*0*	*0%*
Missing	*8*	*4%*
Total	***226***	***100%***

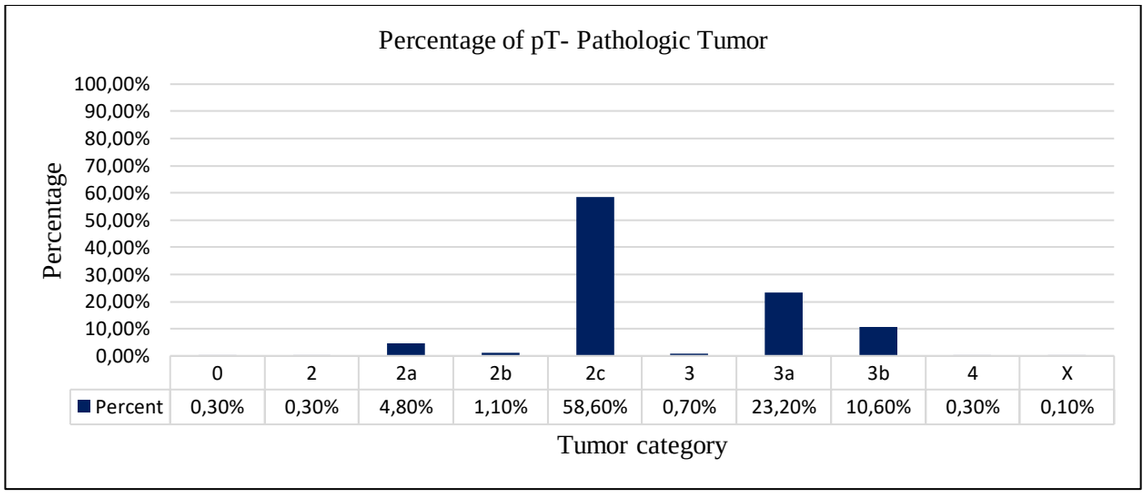
Comparison of results: Both centres selected patients with ASA score of 2 the highest (i.e.) a patient with a condition, for which medication may have to be taken. However, the condition does not affect daily life, but OLV Aalst is much higher with 79.4% than Rijnstate that is 65%. OLV Aalst have selected patients with ASA score of 3 (i.e.) a patient with a serious condition for which medication is being taken. The condition has a slight limitation on daily activities, for about 8.3% which is less in comparison with Rijnstate which is 16%.

Indicator 2- p-TNM classification

Percentage of patients categorized in each p-TNM staging based on UICC 8th edition classification.

OLV Aalst

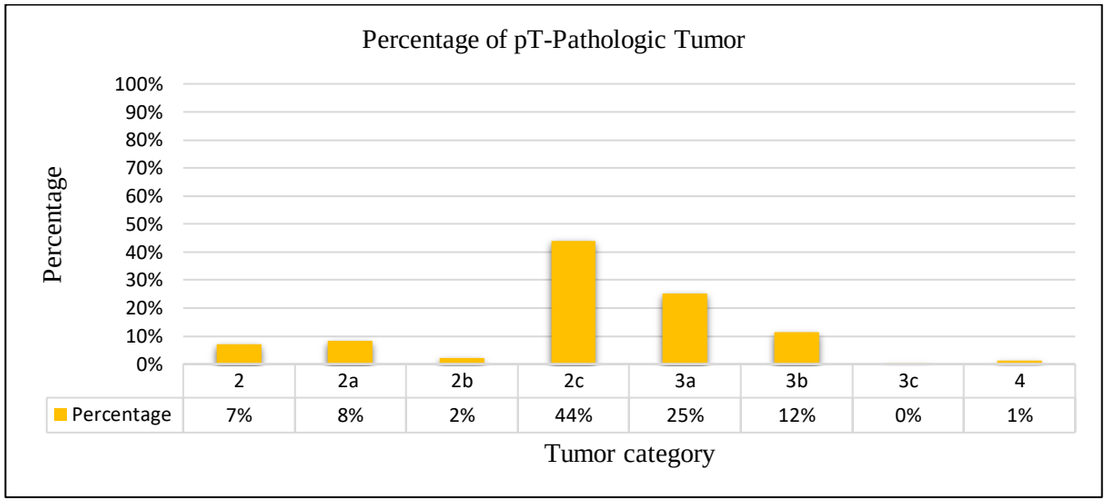
p-TNM Classification 2018-2019						
Tumor			***Lymph node***		***Metastasis***	
Category	***No.of.patients***	***Percentage***	***Category***	***Percentage***	***Category***	***percentage***
0	*2*	*0,3%*	*0*	*26.4%*	*0*	*0%*
2	*2*	*0,3%*	*1*	*9.6%*	*1*	*0%*
2a	*35*	*4,8%*	*X- Undetermined*	*64%*	*X- Undetermined*	*100,0%*
2b	*8*	*1,1%*				
2c	*426*	*58,6%*				
*3**	*5*	*0,7%*				
3a	*169*	*23,2%*				
3b	*77*	*10,6%*				
4	*2*	*0,3%*				
X	*1*	*0,1%*				
Totaal	*727*	***100,0%***		***100%***		***100%***



Comparison of results: Patient group with Tumor category of 2a (i.e.) the cancer is in only half of one side of the prostate gland is 4.8%, 2c (i.e.) the cancer is in both sides but is still inside the prostate gland, is the highest with 58.6% followed by which 3a (i.e.) the cancer has grown through the capsule (covering) of the prostate gland is 23.2%, 3b (i.e.) the cancer has spread into the tubes that carry semen (seminal vesicles) is 10.6%.

Rijnstate

p-TNM Classification (2018 &2019)						
Tumor			***Node***		***Metastasis***	
Category	***No.of.patients***	***Percent***	***Category***	***Percent***	***Category***	***Percent***
2	*16*	*7%*	*0*	*41%*	*0*	*5%*
2a	*19*	*8%*	*1*	*10%*	*1*	*1%*
2b	*5*	*2%*	*X-Undetermined*	*49%*	*X- Undetermined*	*94%*
2c	*99*	*44%*				
*3**	*1*	*0%*				
3a	*57*	*25%*				
3b	*26*	*12%*				
4	*3*	*1%*				
Total	***226***	***100%***	***Total***	***100%***	***Total***	***100%***



Comparison of results: Patient group with Tumor category of 2a (i.e.) the cancer is in only half of one side of the prostate gland is 8%, 2c (i.e.) the cancer is in both sides but is still inside the prostate gland, is the highest with 44% followed by which 3a (i.e.) the cancer has grown through the capsule (covering) of the prostate gland is 25%, 3b (i.e.) the cancer has spread into the tubes that carry semen (seminal vesicles) is 12%.

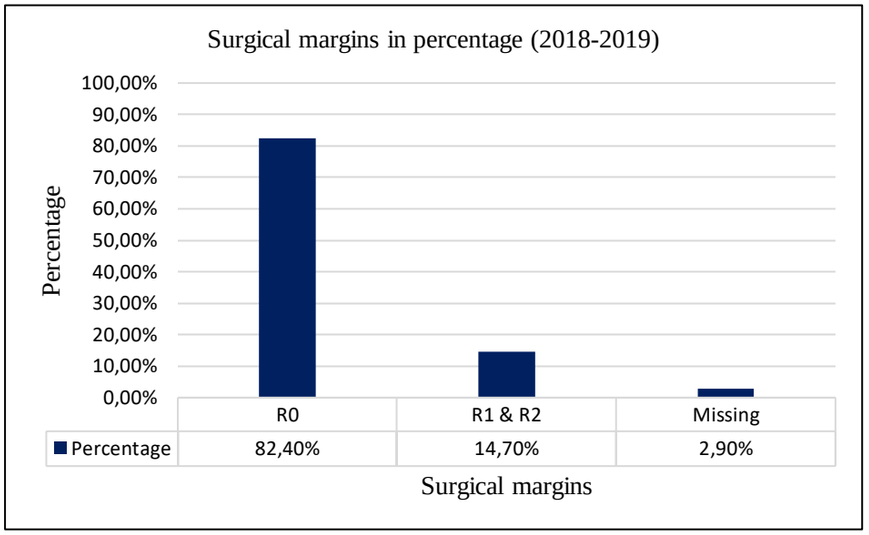
Among both centres, OLV Aalst has low percentage in 2a, 3a, 3b Tumor category than Rijnstate and has higher percentage of patients in 2c Tumor category whereas in Rijnstate it is less.

Indicator 3- Surgical margins

Percentage of patients in R0- Negative margins and R1& R2- Positive margins

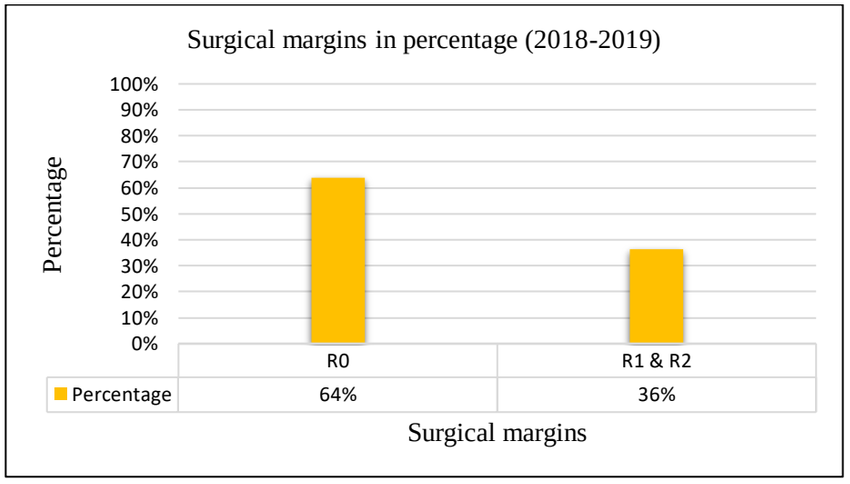
R0- *Clean/Negative margins,* ***R1-*** *microscopic residual Tumor <3mm,1 location +* ***R2-*** *macroscopic residual Tumor >3mm,more locations/ Positive margins.*

OLV Aalst



Surgical margins- 2018 &2019				
	2018	***2019***	***2018-2019***	
Category	***Percentage***	***Percentage***	***No.of.patients***	***Percentage***
R0	*81.3%*	*83.6%*	*599*	*82.4%*
R1 & R2	*15.8%*	*13.6%*	*107*	*14.7%*
Missing	*3%*	*2.8%*	*21*	*2.9%*
Total	***100%***	***100%***	***727***	***100%***

Rijnstate



Surgical Margins- 2018 & 2019				
	2018	***2019***	***2018-2019***	
Category	***Percentage***	***Percentage***	***No.of.patients***	***Percentage***
R0	*64%*	*63%*	*144*	*64%*
R1 & R2	*36%*	*37%*	*82*	*36%*
Total	***100%***	***100%***	***226***	***100%***

Comparison of results: Based on the above results, OLV Aalst has less positive surgical margins (R1 & R2) which is 14.7% whereas, Rijnstate has 36% of positive surgical margins in the year 2018-2019 together.

Pathologic Tumor with surgical margins cross tabulation

From the results of p-TNM classification of both the centres, there is difference in percentage of patients in each Tumor category. The Tumor category of 3a and 3b is more is one centre. From the literature it is known that extensive category such as pT3, pT3a, pT3b, pT4 results in high positive margins(40, 41). Hence, Cross tabulation of the pathologic Tumor with surgical margins is drawn to present which Tumor category has resulted in high percentage of positive margins

OLV Aalst

p-TNM classification	***Surgical Margins***			
pT- Category	***R0***	***R1 & R2***	***RX***	***Total***
0	*0%*	*0%*	*0%*	*0.3%*
2	*0%*	*0%*	*0%*	*0.3%*
2a	*5%*	*0%*	*0%*	*4.8%*
2b	*1%*	*0%*	*0%*	*1.1%*
2c	*51%*	*6%*	*1%*	*58.6%*
3	*1%*	*0%*	*0%*	*0.7%*
3a	*17%*	*5%*	*1%*	*23.2%*
3b	*7%*	*3%*	*1%*	*10.6%*
4	*0%*	*0%*	*0%*	*0.3%*
x	*0%*	*0%*	*0%*	*0.1%*
Total	***82%***	***15%***	***3%***	***100%***

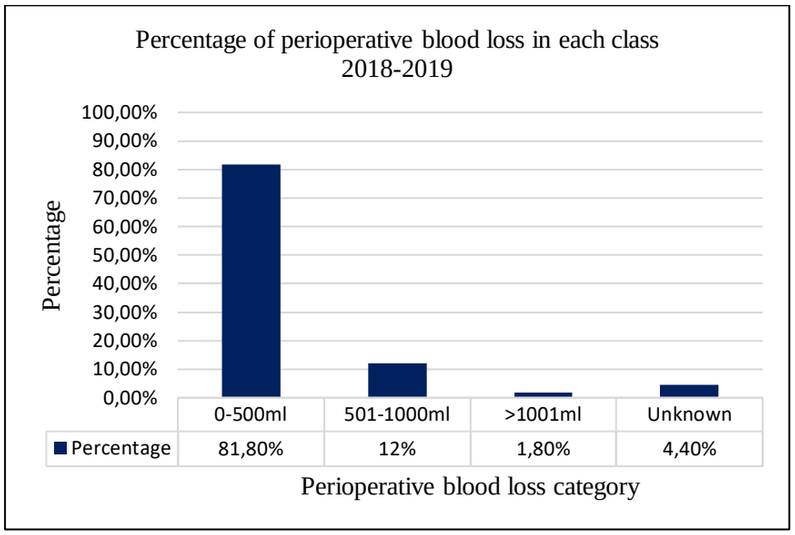
Rijnstate

p-TNM Classification	***Surgical margins***		
pT- Category	***R0***	***R1 & R2***	***Total***
2	*6%*	*1%*	*7%*
2a	*8%*	*0%*	*8%*
2b	*2%*	*0%*	*2%*
2c	*31%*	*13%*	*44%*
3a	*12%*	*14%*	*25%*
3b	*5%*	*7%*	*12%*
3c	*0%*	*0%*	*0%*
4	*0%*	*1%*	*1%*
Missing	*0%*	*0%*	*0%*
Total	***64%***	***36%***	***100%***

Comparison of results: In OLV Aalst, From the percentage of patients who had positive margins R1 & R2, 5% belong to pT3a, 6% is from pT2c and 3% is pT3b whereas, In Rijnstate from the percentage of patients who had positive margins R1 & R2, 14% belong to pT3a, 13% is from pT2c and 7% is pT3b.

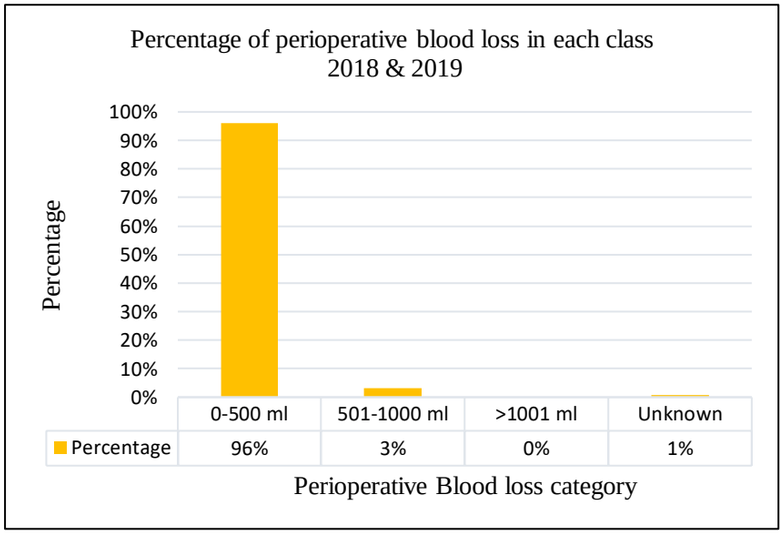
Indicator 4- Blood loss and transfusion rate

4a. Percentage of patients encountered blood loss during surgery, measured from aspirator (in ml)
0-500ml,501-1000ml, >1001ml
OLV Aalst



Perioperative Blood loss rate-2018&2019				
Category	***2018***	***2019***	***2018-2019***	
	Percentage	***Percentage***	***No.of.patients***	***Percentage***
0-500 ml	*85,6%*	*78%*	*595*	*81,8%*
501-1000 ml	*10,6%*	*13,4%*	*87*	*12%*
>1001 ml	*0,5%*	*3,1%*	*13*	*1,8%*
Unknown	*3,3%*	*5,6%*	*32*	*4,4%*
Total	***100%***	***100%***	***727***	***100%***

Rijnstate



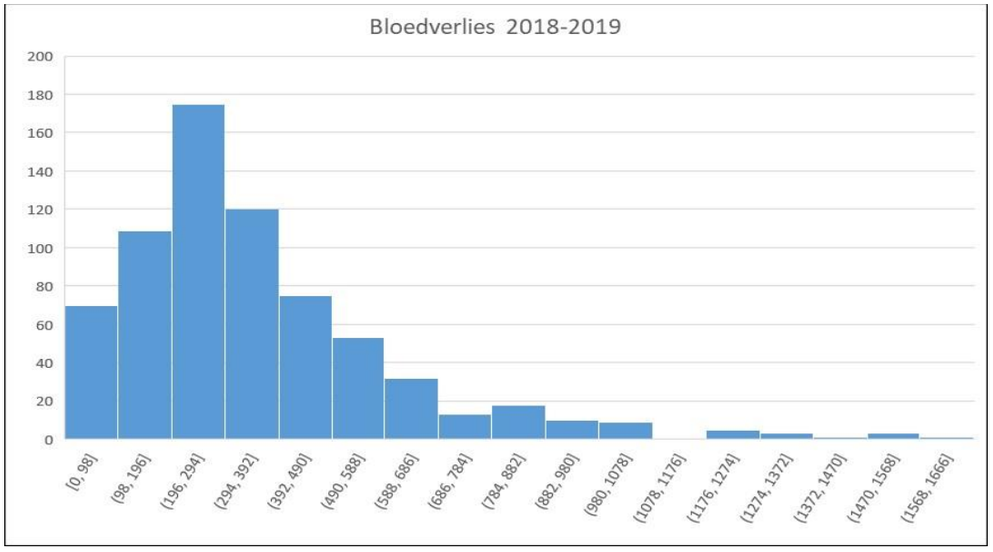
Perioperative Blood loss rate-2018&2019				
Category	***2018***	***2019***	***2018-2019***	
	Percentage	***Percentage***	***No.of.patients***	***Percentage***
0-500 ml	*97%*	*95%*	*217*	*96%*
501-1000 ml	*3%*	*3%*	*7*	*3%*
>1001 ml	*0%*	*0%*	*0*	*0%*
Unknown	*0%*	*2%*	*2*	*1%*
Total	***100%***	***100%***	***226***	***100%***

Comparison of results: Based on the results, OLV Aalst recorded high perioperative blood loss than Rijnstate. The perioperative blood loss with the category 0-500ml is 81.8%, 501-1000ml is 12% and >1001ml is 1.8% in OLV Aalst whereas in Rijnstate 0-500ml is 96%, 501-1000ml is 3%, >1001ml is 0%.

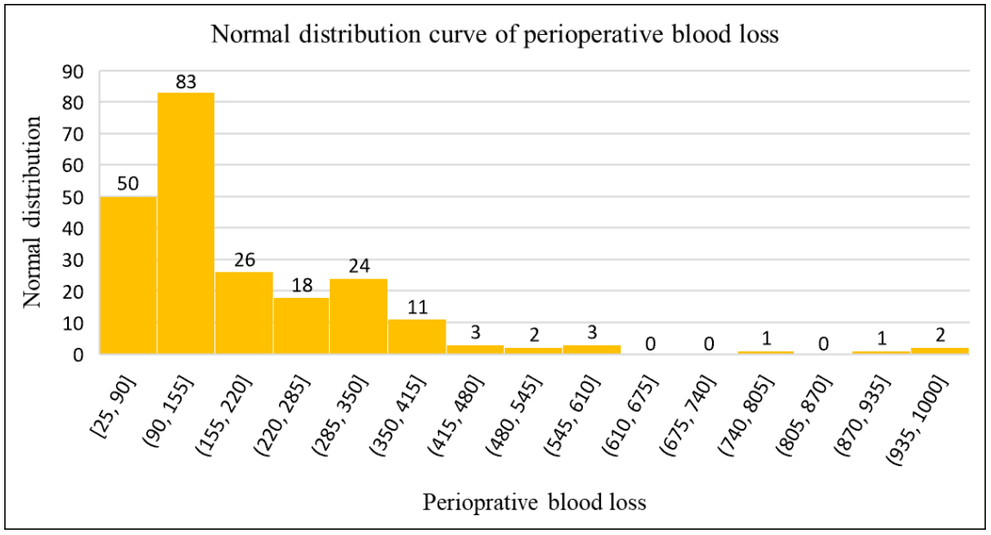
Normal distribution curve of Perioperative blood loss

Normal distribution curve for blood loss is drawn to show how often the values will produce a particular result. The normal distribution is a probability distribution that is symmetric about the mean, showing that data near the mean are more frequent in occurrence than the data far from the mean.

OLV Aalst



Rijnstate

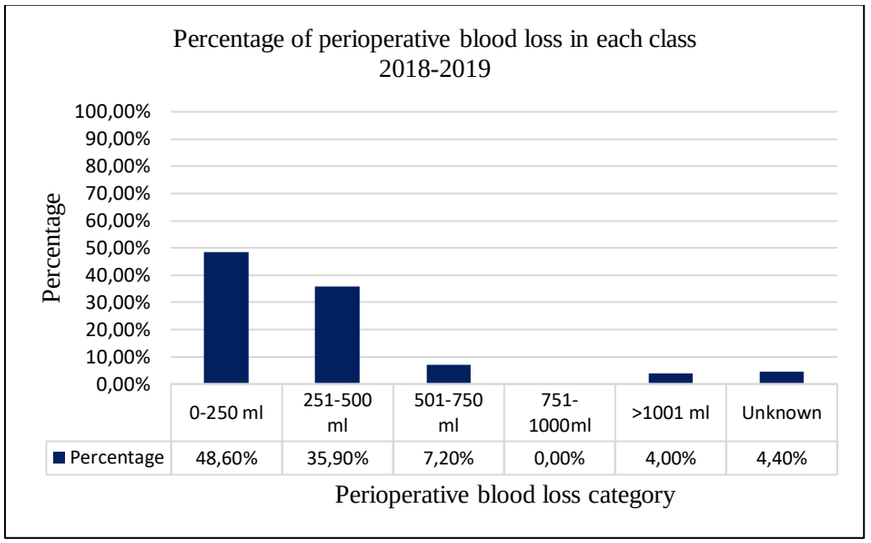


Comparison of results: The values which are within the curve are the more frequent ones to occur and most of the values lies around the mean value, whereas the value which are away from the curve such as 600ml-1000ml and >1000ml has a less probability in occurrence.

0-250ml,251-500ml, 501-750ml, 751-1000ml, >1001ml

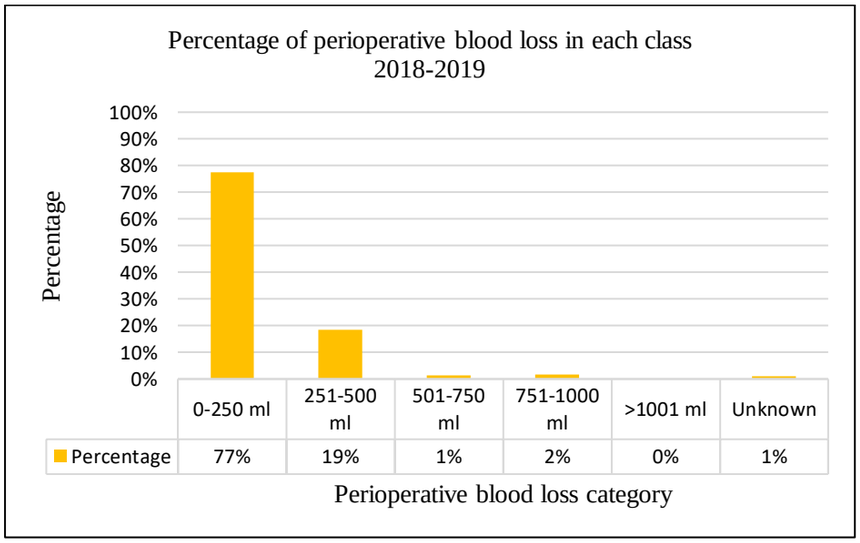
As highest percentage of patients are in 0-500ml category of perioperative blood loss, the category 0-500ml is sub-categorized to identify the clinical significance

OLV Aalst



Perioperative Blood loss rate-2018&2019				
Category	***2018***	***2019***	***2018-2019***	
	Percentage	***Percentage***	***No.of.patients***	***Percentage***
0-250 ml	*53,5%*	*43,5%*	*353*	*48,6%*
251-500 ml	*32,6%*	*39,3%*	*261*	*35,9%*
501-750 ml	*7,1%*	*7,2%*	*52*	*7,2%*
751-1000ml	*0%*	*0%*	*0%*	*0%*
>1001 ml	*3,5%*	*4,5%*	*29*	*4,0%*
Unknown	*3,3%*	*5,6%*	*32*	*4,4%*
Total	***100%***	***100%***	***727***	***100%***

Rijnstate

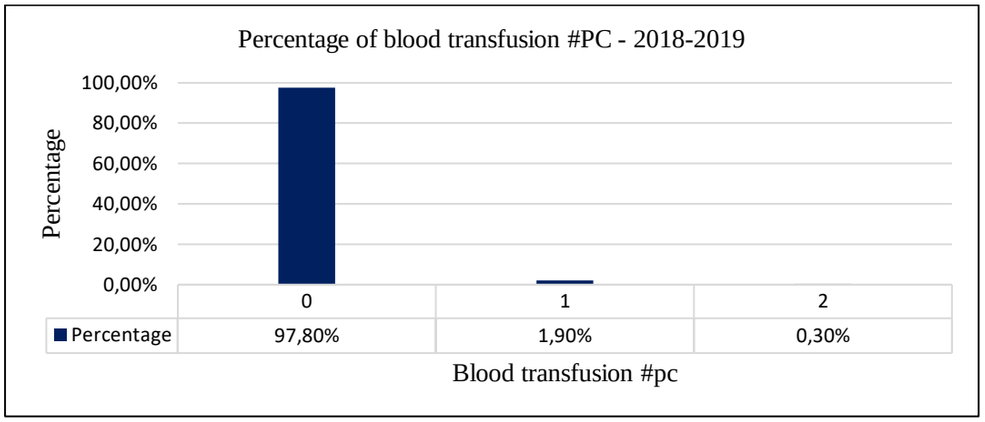


Perioperative Blood loss rate-2018&2019				
Category	***2018***	***2019***	***2018-2019***	
	Percentage	***Percentage***	***No.of.patients***	***Percentage***
0-250 ml	*78%*	*76%*	*175*	*77%*
251-500 ml	*18%*	*19%*	*42*	*19%*
501-750 ml	*2%*	*1%*	*3*	*1%*
751-1000ml	*2%*	*2%*	*4*	*2%*
>1001 ml	*0%*	*0%*	*0*	*0%*
Unknown	*0%*	*2%*	*2*	*1%*
Total	***100%***	***100%***	***226***	***100%***

Comparison of results:. From the sub-categorization it is interpreted that OLV, Aalst has high blood loss 0-250ml is 48.6%, 251-500ml is 35.9%, 501-750ml is 7.2%, 751-1000ml is 0% and >1001ml is 4% whereas in Rijnstate has less perioperative blood loss which is 0-250ml is 77%, 251-500ml is 19%, 501-750ml is 1%, 751-1000ml is 2% and >1001ml is 0%.

4b. Blood transfusion rate during the surgery and hospital stay (Yes/No).

OLV Aalst



Blood transfusion #PC			
Number	***2018***	***2019***	***2018-2019***
0	*97%*	*98,60%*	*97,80%*
1	*2,40%*	*1,40%*	*1,90%*
2	*0,50%*	*0%*	*0,30%*
Total	***100%***	***100%***	***100%***

Rijnstate

Blood transfusion rate			
Category	***2018***	***2019***	***2018-2019***
Yes	*0%*	*0%*	*0%*
No	*100%*	*100%*	*100%*
Total	***100%***	***100%***	***100%***

Comparison of results:

- OLV Aalst has recorded 2,2% of blood transfusion in which 1.90% had 1 number of package (PC) transfused and 0.3% had 2 #PC. In Rijnstate, no blood transfusions recorded- During surgery and during post-operative stay- 2018 & 2019, assuming that the variation in transfusion rate could be due to the difference in blood transfusion protocol between both the centres based on the location, further analysis is done. We first identified the blood transfusion protocol existing in both centres.
- The first point identified is that, in both the centres, the Hb values are recorded in different units. In OLV Aalst it is recorded in g/dl whereas, in Rijnstate it is recorded as mmol/l which differs with a factor of 1.61
- ***Blood transfusion Protocol in Netherlands:*** Blood transfusion is considered only when the Hb value is **<5mmol/l**, in combination with cardio-vascular problems are given earlier.
- ***Blood transfusion Protocol in Belgium:*** Blood transfusion for patients is considered when the Hb value is **<8g/dl**. Therefore, based on the protocol OLV Aalst has considered patients with Hb values <8 for transfusion and thus resulted in 2.2% of transfusion rate during the year 2018-2019.
- In order to compare with OLV Aalst on how many patients would have received blood transfusion, Rijnstate has checked for Hb values of patients whose blood loss >500ml (this category is chosen because there are high chances of transfusion in case of increased blood loss) in the laboratory records, were only one patient is =5mmol/l (5mmol/l= 8g/dl, calculated through haemoglobin unit calculator, http://www.scymed.com/en/smnxpf/pfxdq210_c.htm)

Hb values range	*No.of.patients*	
	Before surgery	*After surgery*
<5	*0*	*0*
5-6	*1*	*1*
6-7	*0*	*3*
7-8	*0*	*2*
8-9	*3*	*3*
9-10	*5*	*0*

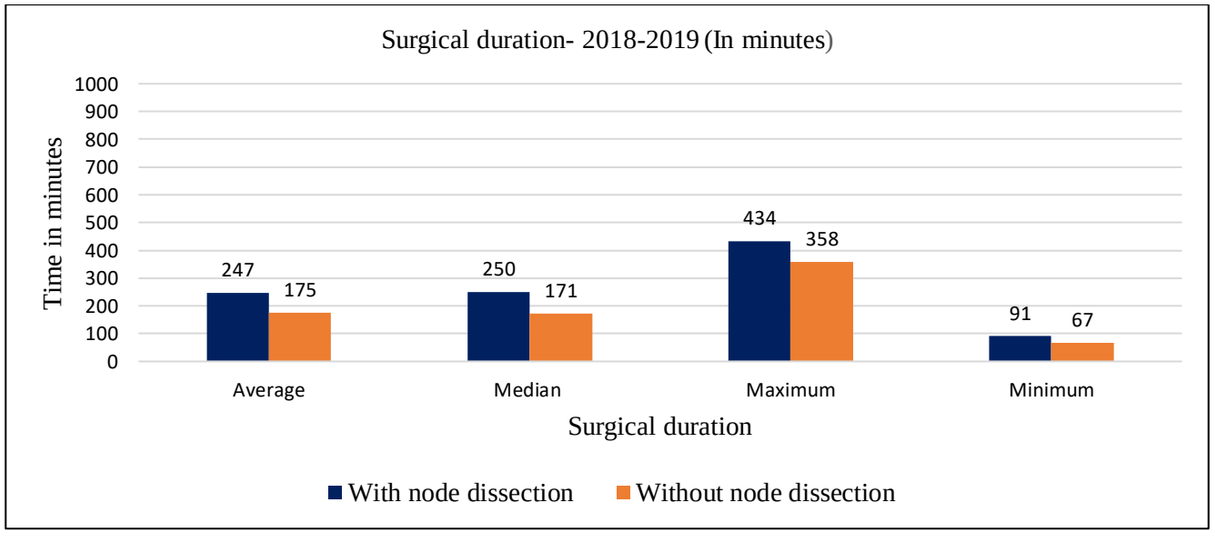
Indicator 5- Surgical duration

Average surgical duration of RARP including and excluding lymph-node dissection in minutes.

Calculated from the time of first incision till closing suture, with and without lymph node dissection.

OLV Aalst

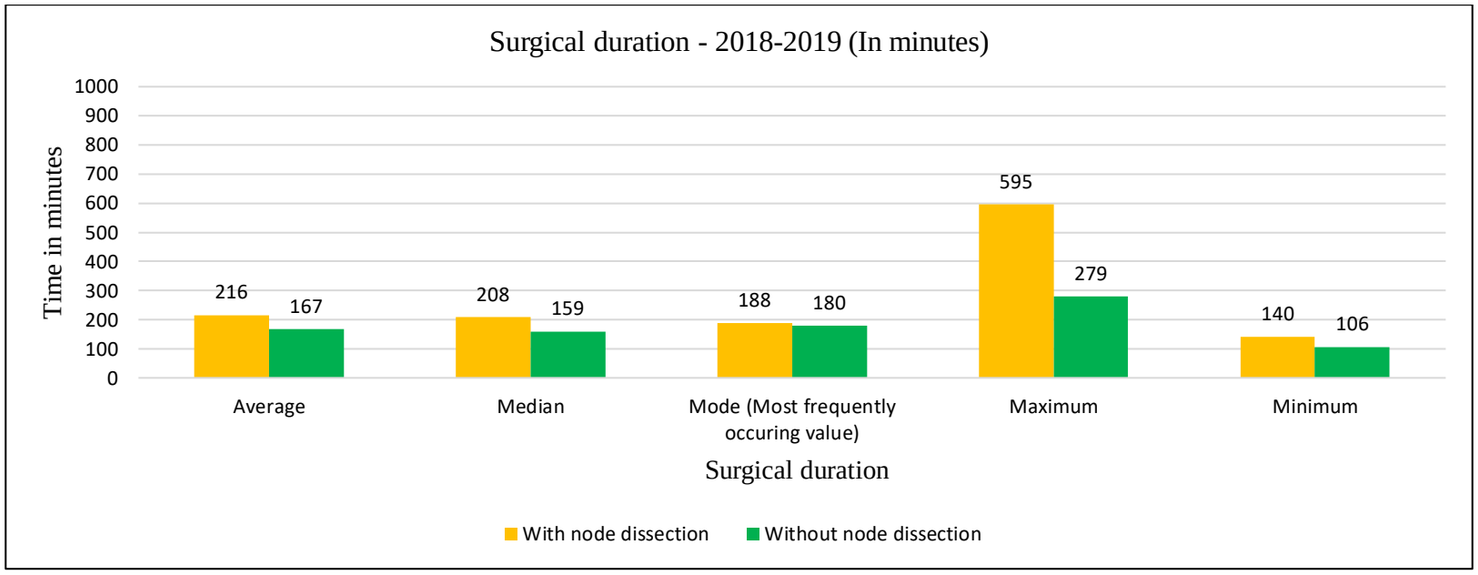
Surgical Duration (In minutes)						
	2018		***2019***		***2018-2019***	
Descriptive statistics	*With node dissection*	*Without node dissection*	*With node dissection*	*Without node dissection*	*With node dissection*	*Without node dissection*
Average	*256*	*173*	*238*	*177*	*247*	*175*
Median	*254*	*167*	*245*	*174*	*250*	*171*
Maximum	*434*	*311*	*432*	*358*	*434*	*358*
Minimum	*93*	*67*	*91*	*76*	*91*	*67*
Range	*341*	*244*	*341*	*282*	*343*	*291*



Rijnstate

Surgical Duration (In Minutes)						
	2018		***2019***		***2018-2019***	
Descriptive statistics	*With node dissection*	*Without node dissection*	*With node dissection*	*Without node dissection*	*With node dissection*	*Without node dissection*
Average	*213*	*173*	*220*	*160*	*216*	*167*
Median	*209*	*162*	*208*	*154*	*208*	*159*
Mode (Most frequently occurring value)	*230*	*193*	*190*	*117*	*188*	*180*
Maximum	*300*	*279*	*595*	*238*	*595*	*279*
Minimum	*140*	*114*	*147*	*106*	*140*	*106*
Range (Maximum-Minimum)	*160*	*165*	*448*	*132*	*455*	*173*
Confidence interval (CI)	*0.006731*	*0.007077*	*0.01397*	*0.006421*	*0.007522*	*0.00485*
Upper limit (Average+ CI)	*222*	*183*	*241*	*169*	*227*	*174*
Lower limit (Average-CI)	*203*	*163*	*200*	*151*	*206*	*160*

Confidence interval: Calculated with 95% significance level.



Comparison of results: In OLV, Aalst the average surgical duration with lymph node dissection is 247 minutes and without lymph node dissection is 175 minutes. In Rijnstate the average surgical duration with lymph node dissection is 216 minutes and the average duration without lymph node dissection is 167 minutes. Rijnstate has less surgical duration with and without lymph node dissection compared on an average.

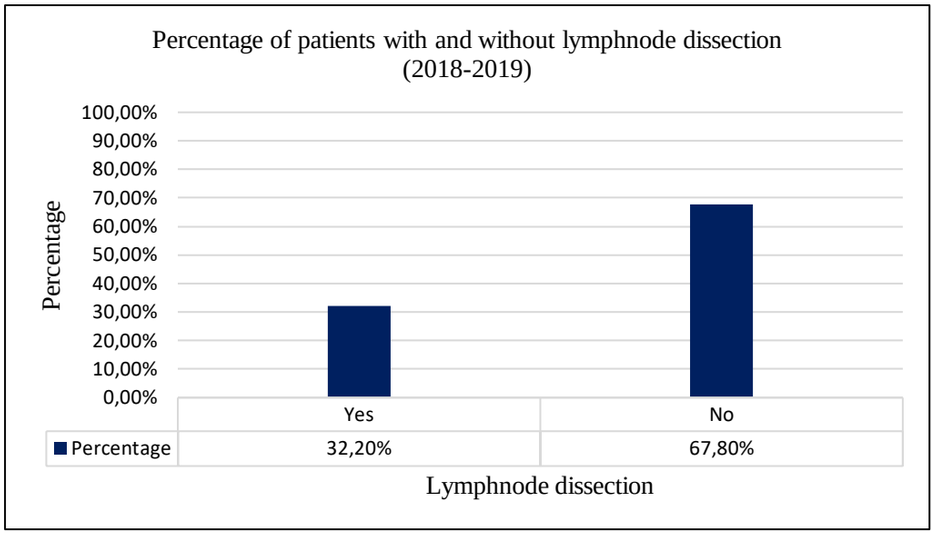
In OLV, Aalst the maximum duration is 434 minutes with node dissection and 358 minutes without node dissection. In Rijnstate, the maximum surgical duration in the year 2018-2019 is 595 minutes with node dissection and 279 minutes without node dissection.

In OLV, Aalst the minimum duration is 91 minutes with node dissection and 67 minutes without node dissection. In Rijnstate, the minimum surgical duration in the year 2018-2019 is 140 minutes with node dissection and 106 minutes without node dissection.

Indicator 6- Lymph-node dissection

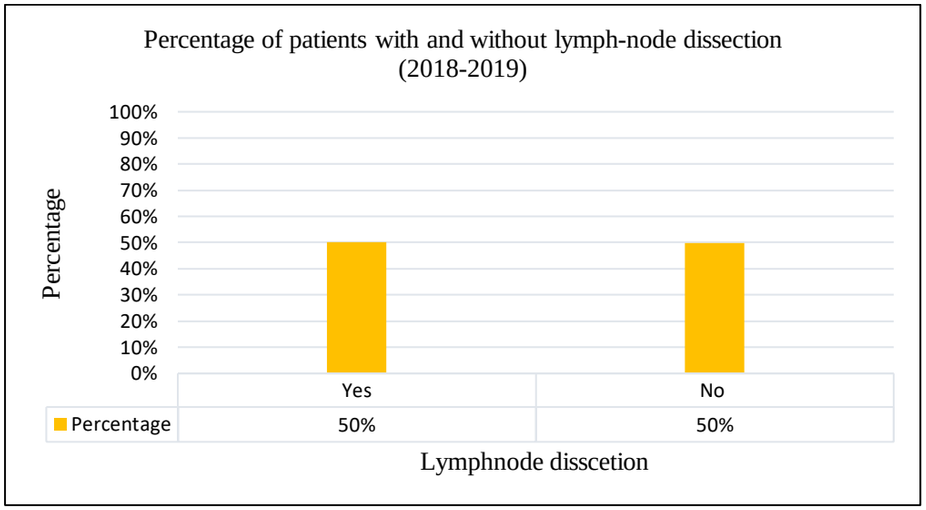
Percentage of patients including and excluding lymph nodes dissection.

OLV Aalst



	Lymph-node dissection			
	2018	***2019***	***2018-2019***	
Category	***Percentage***	***Percentage***	***No.of.patients***	***Percentage***
Yes	*34,20%*	*30,10%*	*234*	*32,20%*
No	*65,80%*	*69,90%*	*493*	*67,80%*
Total	***100%***	***100%***	***727***	***100%***

Rijnstate



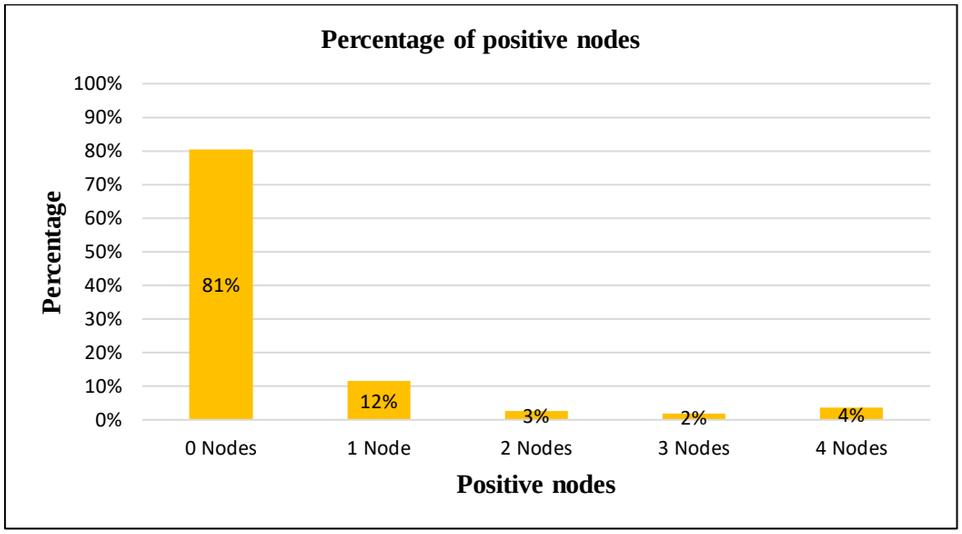
Lymph-node dissection				
Category	***2018***	***2019***	***2018-2019***	
	Percentage	***Percentage***	***No.of.patients***	***Percentage***
Yes	*48%*	*52%*	*113*	*50%*
No	*52%*	*48%*	*112*	*50%*
Total	***100%***	***100%***	***225***	***100%***

Comparison of results: Based on the analysis, OLV, Aalst has performed 32.2% of lymph node dissection along with RALP which is less in comparison with Rijnstate which is 50% lymph node dissection.

Since Rijnstate has performed 50% of lymph node dissection which is high in comparison with OLV Aalst, in continuation with the percentage of patients with and without lymph node dissection, analysis of number of lymph nodes dissected on an average with the percentage of positive and negative lymph nodes in the nodes dissected is calculated. This is done to know if the number of node dissection performed in both the centres are optimum, excess, or low.

In OLV Aalst the number of lymph nodes dissected is not recorded and hence only Rijnstate data is presented.

The average number of lymph nodes dissected in Rijnstate is 12. This is calculated from the data of patients who had lymph-node dissection.



Positive nodes	Percentage
0 Node	81%
1 Node	12%
2 Nodes	3%
3 Nodes	2%
4 Nodes	4%
Total	**100%**

From the lymph nodes dissected by Rijnstate 81% of the nodes are not positive, 1 node positive is 12%, 2 nodes is 3%, 3 nodes is 2%, 4 nodes positive is 4%.

Indicator 7- Hospital days

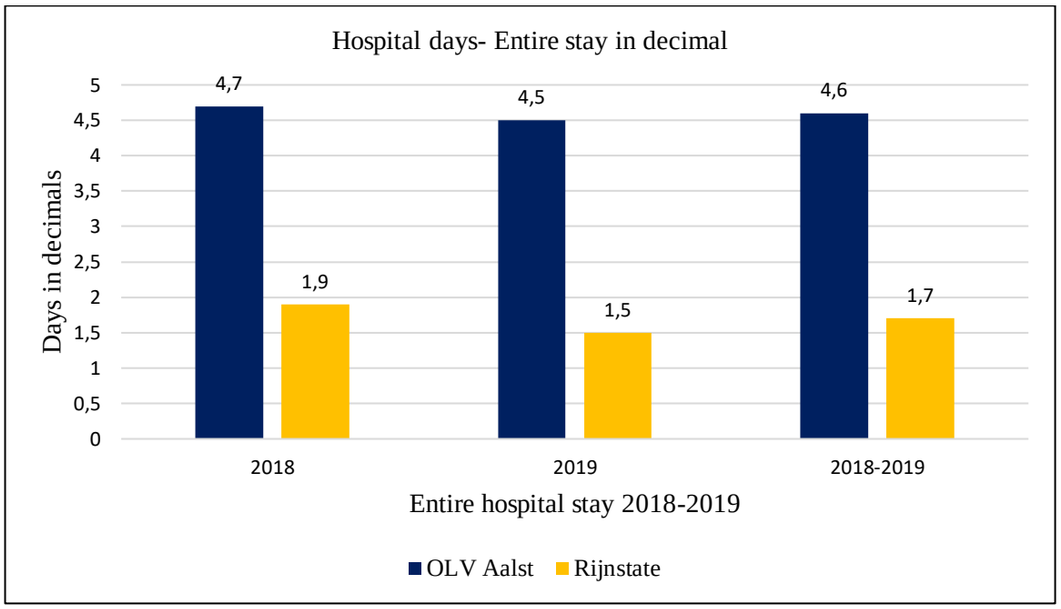
7a. Average length of stay in the hospital- Entire stay (Values in days with decimals), From the day + hour of admission till discharge day

OLV Aalst

Hospital stay- Entire stay			
	2018	***2019***	***2018-2019***
Average entire stay in decimals	*4,7*	*4,5*	*4,6*
Average in Days/Hours/ Minutes	*4d 17h 45m*	*4d 10h 48m*	*4d 14h 24m*

Rijnstate

Hospital stay- Entire stay			
	2018	***2019***	***2018-2019***
Average entire stay in decimals	*1,9*	*1,5*	*1,7*
Average in Days/Hours/Minutes	*1d 21h 21m*	*1d 12h 51m*	*1d 17h 20m*



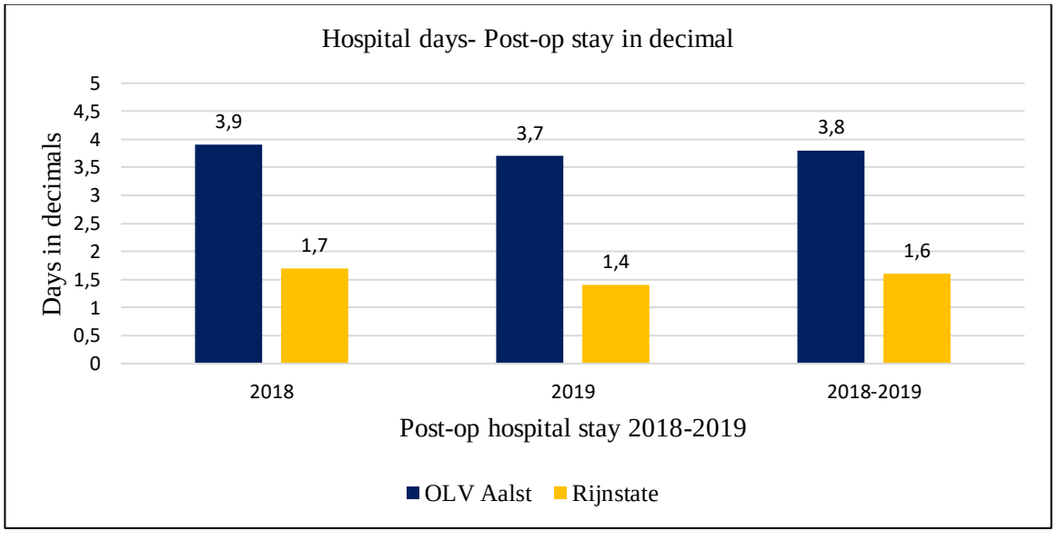
7b. Post-op stay in the hospital(Values in days with decimals), From the first incision till discharge time

OLV Aalst

Hospital stay- Post-op			
	2018	***2019***	***2018-2019***
Average entire stay in decimals	*3,9*	*3,7*	*3,8*
Average in Days/ Hours/ Minutes	*3d 22h 4m*	*3d 16h 4m*	*3d 19h 12m*

Rijnstate

Hospital stay-Post-op			
	2018	***2019***	***2018-2019***
Average post-op stay in decimals	*1,7*	*1,4*	*1,6*
Average in Days/Hours/Minutes	*1d 18h 8m*	*1d 10h 3m*	*1d 14h 18m*



Comparison of results: From the analysis, OLV, Aalst has hospital days- entire stay of 4.6 days on an average and post-op days of 3.8 days which is high in comparison with Rijnstate which has less hospital days- entire stay with an average of 1.7 days and post-op stay on an average of 1.6 days..

Indicator 8- Catheter time

Average catheter time of own patients underwent RARP surgery, From surgery end time till the time of trial without catheter (TWOC)

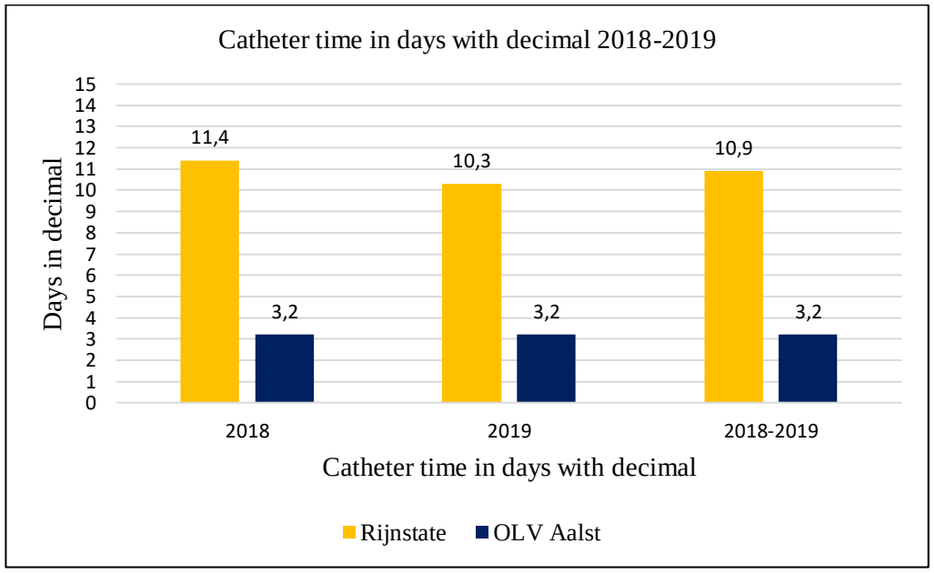
OLV Aalst

Catheter time			
	2018	***2019***	***2018-2019***
Average catheter time in decimals	*3,2*	*3,2*	*3,2*
Average catheter time in Days/Hours/Minutes	*3d 4h 19m*	*3d 4h 33m*	*3d 4h 33m*

Catheter time			
Number of days	***2018***	***2019***	***2018-2019***
2 Days	*67,1%*	*65,2%*	*66,2%*
>=3 Days	*32,9%*	*34,8%*	*33,8%*
Total	*100%*	*100%*	*100%*

Rijnstate

Catheter Time			
	2018	***2019***	***2018-2019***
Average catheter time in decimals	*11,4*	*10,3*	*10,9*
Average catheter time in Days/Hours/Minutes	*11d 10h 40m*	*10d 7h 19m*	*10d 20h 59m*



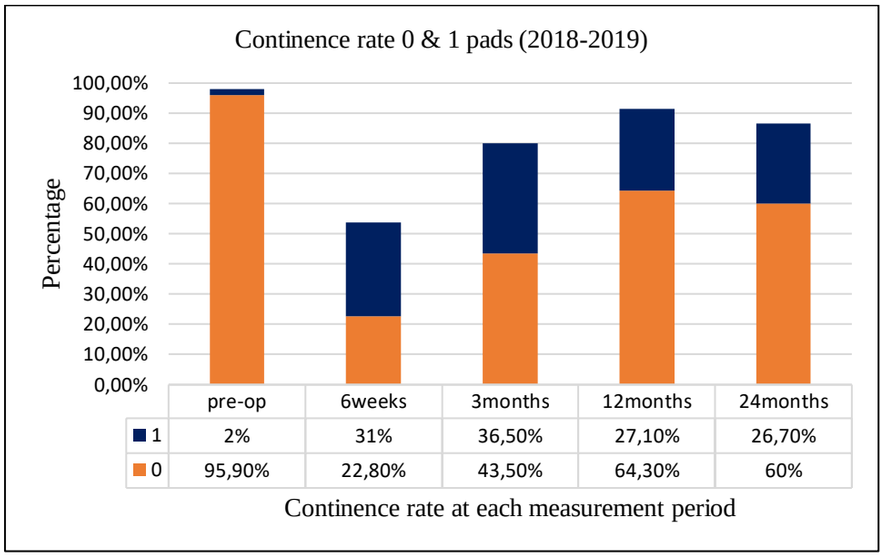
Comparison of results: Based on the results, OLV, Aalst has less catheter days which is 3.2 days for the year 2018-2019 whereas Rijnstate has high catheter days of 10.9 days on an average.

Indicator 9- Continence rate

Percentage of patients who are continent (0 & 1 PADS) and incontinent (>1 PAD) at pre-operative, 6weeks, 3months, 12months, 24months follow-up period.

Data retrieved from PROMS database

OLV Aalst

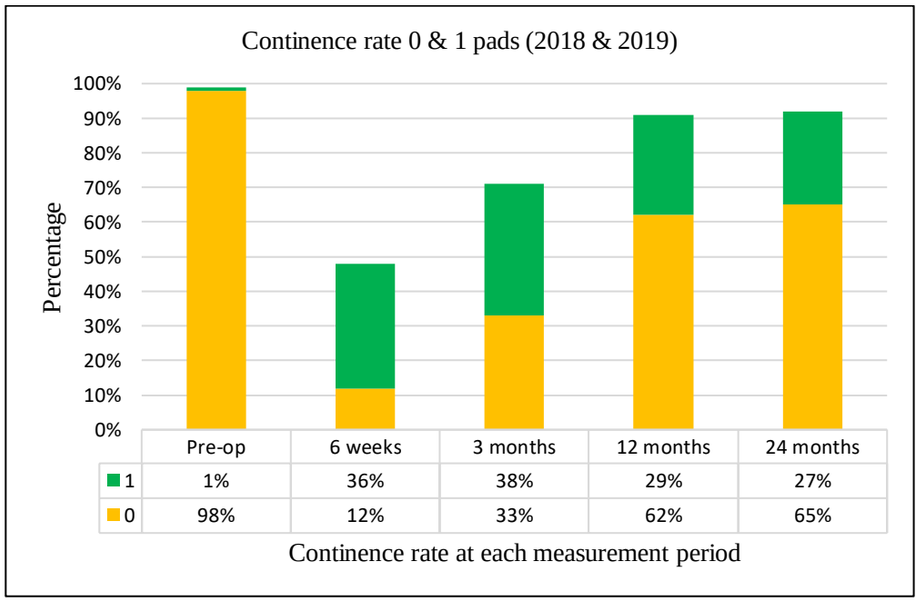


Continence rate- 2018&2019					
Category	***Pre-op***	***6weeks***	***3 months***	***12 months***	***24 months***
0	*188*	*39*	*74*	*90*	*63*
1	*4*	*53*	*62*	*38*	*28*
2	*2*	*35*	*17*	*7*	*7*
>=3	*2*	*44*	*17*	*5*	*7*
Total	***196***	***171***	***170***	***140***	***105***

Continence rate- 2018&2019					
Category	***Pre-op***	***6 weeks***	***3 months***	***12 months***	***24 months***
0	*95.9%*	*22.8%*	*43.5%*	*64.3%*	*60%*
1	*2%*	*31%*	*36.5%*	*27.1%*	*26.7%*
2	*1%*	*20.5%*	*10%*	*5%*	*6.7%*
>=3	*1%*	*25.7%*	*10%*	*3.6%*	*6.7%*
Total	***100%***	***100%***	***100%***	***100%***	***100%***

Response rate: 27% at pre-op, 24% at 6weeks, 23% at 3months, 19% at 12months, 14% at 24months.

Rijnstate



Continence rate- 2018&2019					
Category	***Pre-op***	***6 weeks***	***3 months***	***12 months***	***24 months***
0	*154*	*19*	*54*	*106*	*75*
1	*2*	*59*	*63*	*50*	*31*
2	*1*	*43*	*29*	*9*	*5*
>=3	*0*	*43*	*18*	*6*	*4*
Total	***157***	***164***	***164***	***171***	***115***

Continence rate- 2018&2019					
Category	***Pre-op***	***6 weeks***	***3 months***	***12 months***	***24 months***
0	*98%*	*12%*	*33%*	*62%*	*65%*
1	*1%*	*36%*	*38%*	*29%*	*27%*
2	*1%*	*26%*	*18%*	*5%*	*4%*
>=3	*0%*	*26%*	*11%*	*4%*	*3%*
Total	***100%***	***100%***	***100%***	***100%***	***100%***

Response rate: 69% at pre-op, 73% at 6weeks & 3months, 76% at 12months, 51% at 24months.

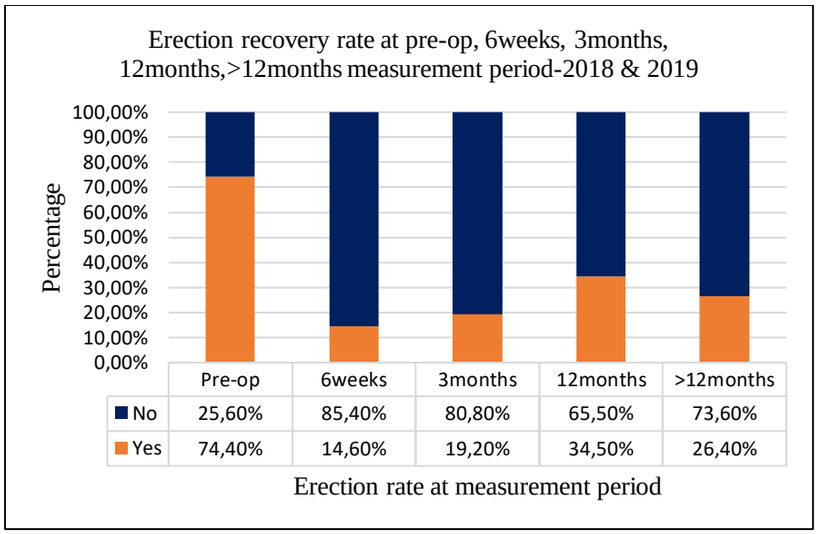
Comparison of results: The continence rate during the year 2018-2019 in OLV, Aalst at pre-op period is 97.9%, at 6weeks is 53.8%, 3months is 80%, and 12months follow-up period is 91.4% and at 24 months it is 86.7% whereas in Rijnstate pre-op period is 99%, at 6weeks 48%, 3months 71%, during 12months follow-up period it is 91% and at 24months 92%.

Indicator 10- Erection function recovery rate

Percentage of patients for those erection is stiff enough for sexual intercourse without medication at pre-operative, 6weeks, 3months, 12months, >12months follow-up period.

Data retrieved from PROMS database

OLV Aalst

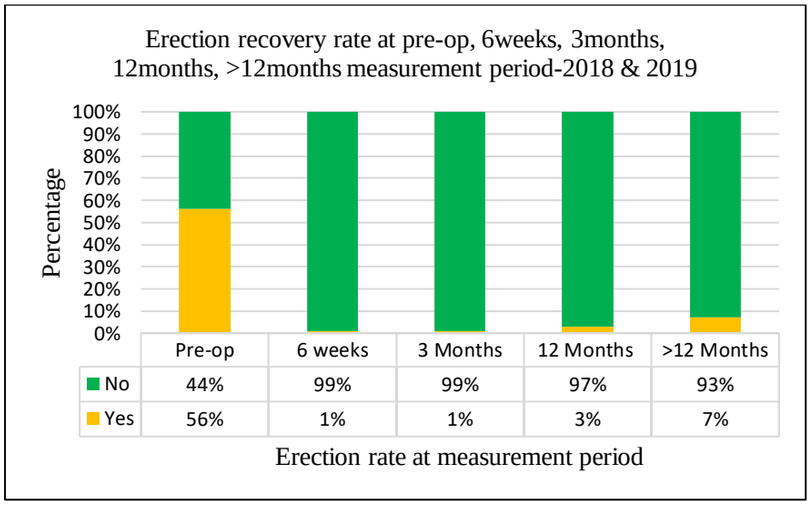


Erection rate- 2018&2019					
Category	***Pre-op***	***6 weeks***	***3 months***	***12 months***	***>12months***
Yes	*163*	*25*	*33*	*51*	*33*
No	*56*	*146*	*139*	*97*	*92*
Total	*219*	*171*	*172*	*148*	*125*

Erection rate- 2018&2019					
Category	***Pre-op***	***6 weeks***	***3 months***	***12 months***	***>12months***
Yes	*74.4%*	*14.6%*	*19.2%*	*34.5%*	*26.4%*
No	*25.6%*	*85.4%*	*80.8%*	*65.5%*	*73.6%*
Total	*100%*	*100%*	*100%*	*100%*	*100%*

Response rate: 30% at pre-op, 24% at 6weeks & 3months, 20% at 12months, 17% at 24months.

Rijnstate



Erection rate- 2018&2019					
Category	***Pre-op***	***6 weeks***	***3 months***	***12 months***	***>12months***
Yes	*79*	*1*	*2*	*4*	*7*
No	*62*	*117*	*145*	*145*	*92*
Total	*141*	*118*	*147*	*149*	*99*

Erection rate- 2018&2019					
Category	***Pre-op***	***6 weeks***	***3 months***	***12 months***	***>12months***
Yes	*56%*	*1%*	*1%*	*3%*	*7%*
No	*44%*	*99%*	*99%*	*97%*	*93%*
Total	***100%***	***100%***	***100%***	***100%***	***100%***

Response rate: 71% at pre-op, 72% at 6weeks & 3months, 75% at 12months, 51% at 24months.

Comparison of results: Erection rate at different measurement periods in OLV, Aalst is pre-op 74.4%, 14.6% at 6weeks, 3months is 19.2%, 12months is 34.5% and 26.4% at 24months follow-up period , in Rijnstate 56% at pre-op period , 1% at 6 weeks and 3months, 3% at 12 months follow-up period, 7% at >12months period for the patients underwent RARP during the year 2018-2019.

Indicator 11- Measurable PSA level >0.1

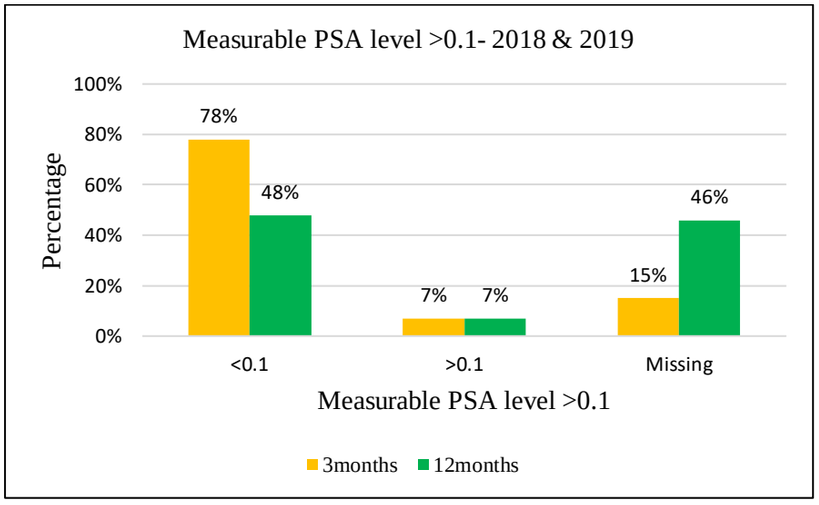
Percentage of patients whose PSA level is >0.1 (Measurable PSA level >0.1 at 3 months and 12 months post-surgery).

11a. Measurable PSA level >0.1 at 3 months

11b. Measurable PSA level >0.1 at 12 months

For the measurable PSA level indicator, only Rijnstate data is available. Since the data of OLV Aalst on this particular indicator has to be validated which is still in progress, the OLV Aalst data is not included for comparison in this thesis. Therefore, Rijnstate data is compared with the results found in literature.

Rijnstate



Measurable PSA level- 2018 & 2019				
Category-PSA level	***3 months***	***Percentage***	***12months***	***Percentage***
<0.1	*177*	*78%*	*108*	*48%*
>0.1	*16*	*7%*	*15*	*7%*
Missing	*33*	*15%*	*103*	*46%*
Total	***226***	***100%***	***226***	***100%***

Results found in literature: There are many studies conducted in evaluating the RARP outcomes. Some of the study results are discussed below,

Ahmed et al in 2021 conducted a study on the analysis of detectable prostate specific antigen value following robotic assisted radical prostatectomy, the concluded that the biochemical recurrence rate (i.e., PSA level >0.1ng/dl was 19.1% at 24months measurement period(42).

Tholomier, C., et al, conducted a study on Oncological and functional outcomes of a large Canadian robotic-assisted radical prostatectomy database with 10 years of surgical experience in 2019, the study involves analysis of the prospective data of 1,034 RARP cases performed by two high-volume experienced surgeons at two academic centers. Preoperative characteristics, surgical, oncological, and functional outcomes were assessed up to 72 months postoperative. Based on the results, Biochemical failure is found in 10.2% of patients at 12months follow-up period (43).

The measurable PSA level >0.1ng/dl in Rijnstate at 3months and 12months is 7%. Though this is less compared to the values found in literature factors associated with the biochemical failure should be analysed.

Indicator 12 - Complication rate

Percentage of patients who had complications related to urologic conditions during the stay or in 90 days post-op.

12a. Death during stay and post-op 90days

OLV Aalst

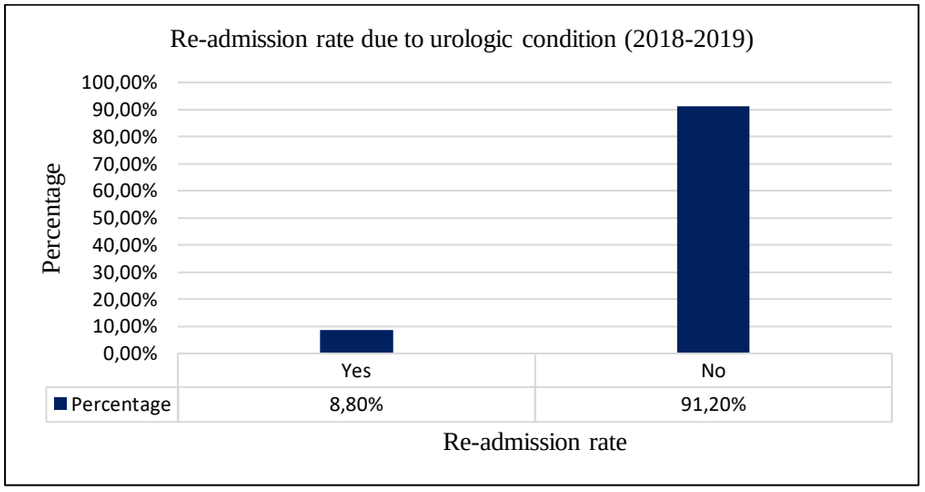
Death rate during stay and post-op 90days			
Category	***2018***	***2019***	***2018-2019***
Yes	*0%*	*0%*	*0%*
No	*100%*	*100%*	*100%*
Total	***100%***	***100%***	***100%***

Rijnstate

Death rate during stay and post-op 90days			
Category	***2018***	***2019***	***2018-2019***
Yes	*0%*	*0%*	*0%*
No	*100%*	*100%*	*100%*
Total	***100%***	***100%***	***100%***

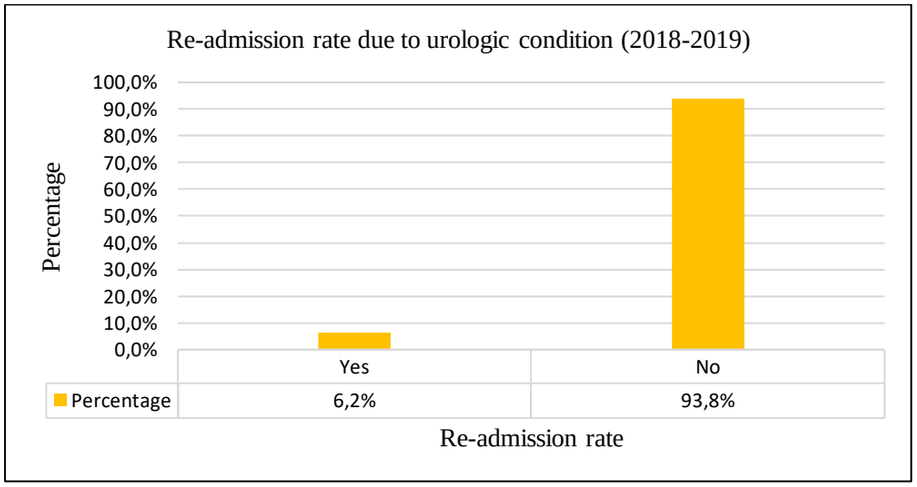
12b. Re-admission at<90days due to Urologic condition

OLV Aalst



Category	***Re- admission rate***			
	2018	***2019***	***2018-2019***	
	Percentage	***Percentage***	***No.of.patients***	***Percentage***
Yes	*10,10%*	*7,50%*	*64*	*8,80%*
No	*89,90%*	*92,50%*	*663*	*91,20%*
Total	***100%***	***100%***	***727***	***100%***

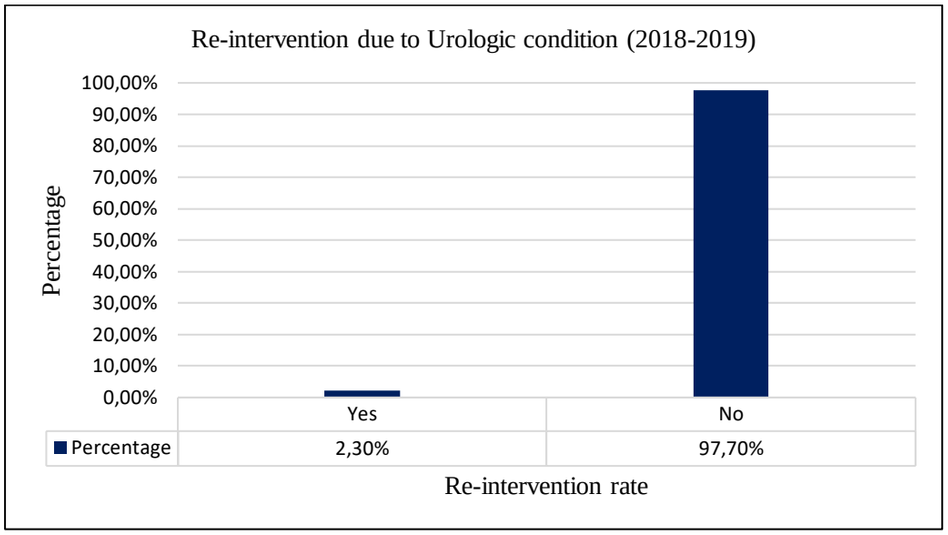
Rijnstate



Category	***Re- admission rate***			
	2018	***2019***	***2018-2019***	
	Percentage	***Percentage***	***No.of.patients***	***Percentage***
Yes	*6.7%*	*5.7%*	*14*	*6.2%*
No	*93.3%*	*94.3%*	*211*	*93.8%*
Total	***100%***	***100%***	***225***	***100%***

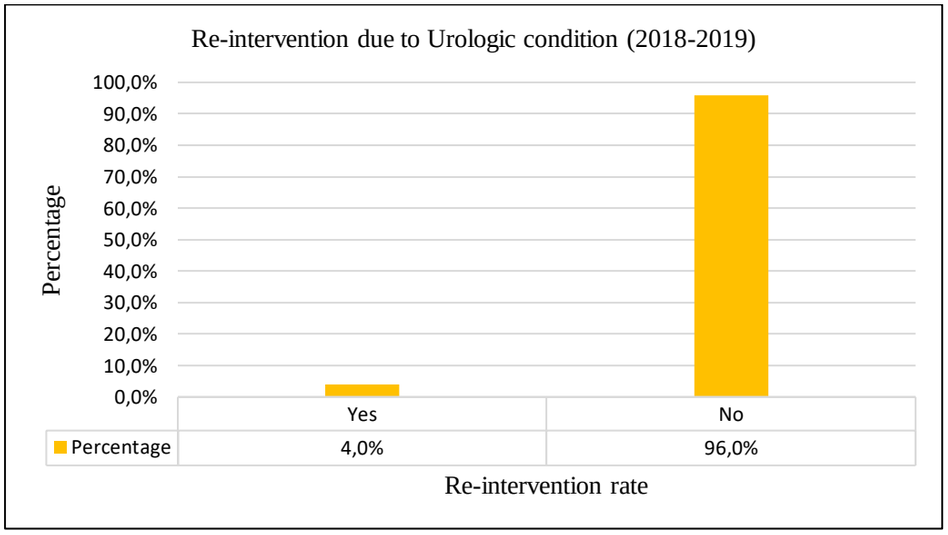
12c. Re-intervention at<90days due to Urologic condition

OLV Aalst



Category	Re- Intervention rate			
	2018	2019	2018-2019	
	Percentage	Percentage	No.of.patients	Percentage
Yes	*2.2%*	*2.5%*	*17*	*2.3%*
No	*97.8%*	*97.5%*	*710*	*97.7%*
Total	***100%***	***100%***	***727***	***100%***

Rijnstate



Category	Re- Intervention rate			
	2018	2019	2018-2019	
	Percentage	Percentage	No.of.patients	Percentage
Yes	*4.2%*	*3.8%*	*9*	*4%*
No	*95.8%*	*96.2%*	*216*	*96%*
Total	***100%***	***100%***	***225***	***100%***

Comaprison of results:

- **Death:** There is 0% mortality rate in both centres during the year 2018-2019.
- **Re-admission rate:** OLV, Aalst has 8.8% of re-admission rate during the year 2018-2019 whereas, Rijnstate has low re-admission rate of 6.2%.
- **Re-intervention rate:** OLV, Aalst has low re-intervention rate of 2.3% whereas Rijnstate has 4% of re-intervention rate during the year 2018-2019.

From the results, re-admission rate is high in both the centres. Reasons for the high re-admission is analysed. Since, Rijnstate has longer catheter time, to verify that the longer catheter days had any influence in the complications rate of the patients (i.e., re-admission rate), further analysis was

done. From the literature, it is found that longer catheter days can lead to high infection rate(44) and can influence the continence rate over a period(45). To identify the association between the catheter time and the infection rate, percentage of patients who received antibiotics as a result of complication in <90days post-op were calculated. The results are as follows,

Category	***Percentage of patients received Antibiotics***	
	2018-2019	
	No.of.patients	***Percentage***
Yes	*10*	*4%*
No	*215*	*96%*
Total	***225***	***100%***

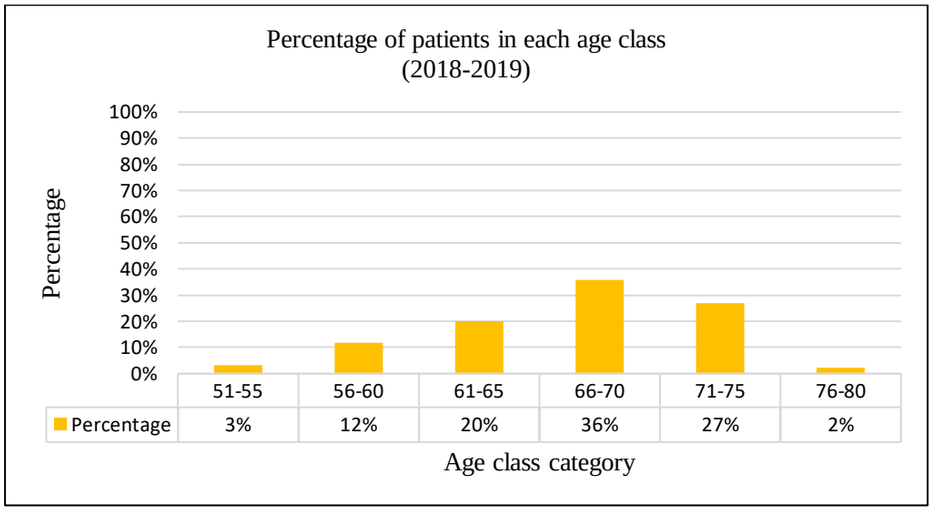
Results: The results conclude that 4% of patients received antibiotics as a result of infection in <90days post-op, which could be due to longer catheter time (10days).

General measurements:

The following are the general measurements of patients who underwent RARP/RALP in both centres during the year 2018-2019. The age of the patients are discussed below,

Rijnstate

Age of the patients	
Average	67
Median	67
Minimum	52
Maximum	76
Range	24



Class category	***No.of.patients***	***Percentage***
51-55	7	3%
56-60	27	12%
61-65	45	20%
66-70	81	36%
71-75	61	27%
76-80	5	2%
Total	***226***	***100%***

OLV Aalst- The average age of patients is 65 years, detailed analysis of age of patients from Aalst data was not possible.

Summary of Findings

The highlighted centre performs well in the indicator.

Indicators	Benchmarking Findings
1. ASA physical status score	**OLV Aalst** has treated more patients with ASA score of 2- 79.4% whereas Rijnstate is 65%, **Rijnstate** has treated more patients in category 3- 16%, whereas OLV Aalst is 8.3%.
2. p-TNM Classification	**Rijnstate** treated more pT2a-8%, pT3a-25%, pT3b-12%Tumor category patients. OLV Aalst treated pT2a-4.8%, pT3a-23.2%, pT3b-10.6% Tumor category patients. **OLV Aalst** treated more pT2c- 58.6% whereas in Rijnstate pT2c is 44%.
3. Surgical margins	**OLV Aalst** has fewer positive margins which is 14.7% whereas Rijnstate has 36% of positive margins.
4a. Blood loss rate	**Rijnstate** has less blood loss <500ml-96%, in OLV Aalst blood loss <500ml is 81.8%
4b. Transfusion rate	**Rijnstate** has no transfusions made in 2018-2019, OLV Aalst transfusion rate is 2.20%
5. Surgical duration	**Rijnstate** has recorded less surgical duration in both category (with and without lymph -node dissection) which is 216 minutes and 167 minutes respectively on an average. In OLV, Aalst it is 247 minutes with node dissection and 175 minutes without node dissection.
6. Lymph node dissection	**OLV, Aalst** has performed less lymph-node dissection which is 32.2%, whereas Rijnstate has performed 50% of lymph node dissection.
7a. Hospital days- Entire stay	**Rijnstate** with lower hospital days- entire stay of 1.7 days whereas OLV, Aalst has 4.6 days.
7b. Hospital days-post-op stay	**Rijnstate** with lower hospital days- post-op stay of 1.6 days whereas OLV, Aalst has 3.8 days.
8. Catheter time	**OLV, Aalst** has recorded lower catheter time of 3.2 days whereas Rijnstate has 10.9 days.
9. Continence rate	**Rijnstate** continence rate at pre-op period is 99%, at 6weeks 48%, 3months 71%, during 12months follow-up period it is 91% and at 24months 92% whereas in OLV, Aalst at pre-op period is 97.9%, at 6weeks is 53.8%, 3months is 80%, and 12months follow-up period is 91.4% and at 24 months it is 86.7%.
10. Erection recovery rate	Erection rate in **OLV, Aalst** at pre-op is 74.4%, 14.6% at 6weeks, 3months is 19.2%, 12months is 34.5% and 26.4% at 24months follow-up period , whereas in Rijnstate 56% at pre-op period , 1% at 6 weeks and 3months, 3% at 12 months follow-up period, 7% at >12months period for the patients underwent RARP during the year 2018-2019.
11a. Measurable PSA level at 3months	There is no data available on the indicator measurable PSA level from OLV Aalst and therefore cannot be compared at present, can be helpful only in the future measurements.
11b. Measurable PSA level at 12months	
12a. Complication rate- Death during stay and <90days post-op	Both centres- No deaths recorded
12b. Complication rate- re- hospitalization <90 days post-op	Re- admission- **Rijnstate** has less re- admission rate of 6.2% whereas, OLV, Aalst has 8.8%.
12c. Complication rate- re- intervention <90 days post-op	Re- intervention rate- **OLV, Aalst** has less re- intervention rate of 2.3% whereas Rijnstate has 4%.

Table 1: Summary findings

7 Discussion

As is shown earlier, the ***section 5*** describe the development of indicators which is used in the benchmarking study, this is mainly based on literature and experts' opinion and gives answer to the first research sub-question, **which performance indicators can be used for benchmarking the quality of RARP?** Based on the literature review and expert opinion the following 12 indicators are the defined and used in this study,

1. ASA Physical status score
2. p-TNM Classification
3. Surgical margins rate
4. Blood loos and blood transfusion rate
5. Surgical duration
6. Lymph node dissection
7. Hospital days
8. Catheter time
9. Continence rate
10. Erection recovery rate
11. Measurable PSA level
12. Complication's rate

These listed indicators are the standard performance measurements of RARP found in literature but during the course of the study it was found that there are some other explanatory variables that might influence the outcome indicators defined earlier. The explanatory variables are the number of lymph nodes dissected, Hospital volume (Number of RARP surgeries performed each year in the hospital), patient characteristics such as Age, BMI, prostate volume etc., percentage of patients received adjuvant therapies, overall survival rate. These variables are studied in a limited extent (i.e., average age of patients per hospital was included), but it needs a detailed analysis to better understand its impact on the other indicators. Therefore, these variables can be included and studied in the future research.

The ***section 6*** described earlier compare the results of both the centres and answers the second research sub-question, **how do the benchmarking centres perform on these performance indicators?** Based on the comparison of results between the centres, there is difference in the outcome in certain indicators. Though the variation in some of the indicators is not that remarkable, surgical margins, surgical duration, catheter time, hospital days, erection rate, blood loss and transfusion rate, lymph node dissection showed up a high notable difference between the centres which will be discussed in the following report.

The upcoming discussion answer the third research sub-question, **what are the variation in these performance indicators?** And the fourth research sub-question, **how can the benchmarking centres improve their performance based on the results?** From the comparison of results made, there are differences in the results between both the centres. The important ones with the supporting arguments are discussed in this section. The results are discussed with the benchmarking centres and the following discussion is also based on the input received from the Urologist's of the benchmarking centres.

Indicator 3

Surgical margins: There is a remarkable difference in the surgical margins between both the centres. In OLV Aalst the positive margins is low and Rijnstate has recorded with high positive margins compared to OLV Aalst. The reasons for high positive margins in Rijnstate might be due to the extensive Tumor classification of the patients treated in the centre. To identify this, the cross tabulation of Tumor category with the surgical margins is presented in the results section along with the surgical margin indicator. The highest positive margin rate is in Tumor 2c, 3a, 3b category. This is supported with studies from the literature(40). The important risk factor for positive margins are the pathological stage and the Gleason grade. Hence the variation in the results might be due to the selection of more severe category of Tumor in Rijnstate.

Indicator 4

4a. Blood loss rate: Rijnstate has lower blood loss during surgery than OLV Aalst. Blood loss rate can be influenced by multiple patient related factors such as Age, BMI, pre-existing medical conditions, extensive Tumor category which requires longer surgical duration ultimately leading to high blood loss(46). Hence, analysing the influencing factors might provide an insight for arguments to support the blood loss rate for OLV Aalst.

4b. Blood transfusion rate: There is a difference in transfusion rate between the centres, one centre has no records of blood transfusion during the specified years 2018-2019 whereas the other centre has made transfusions. This difference in transfusion rate between the centres could be due to the difference in the blood transfusion protocols between the countries where the benchmarking centres are located. In Netherlands, blood transfusion is considered only when the Hb value is <5mmol/l, in combination with cardio-vascular problems transfusions are given earlier. In OLV Aalst transfusion is considered when the Hb value is <8g/dl. This difference in blood transfusion protocol resulted in variation of blood transfusion rate between the centres.

To explore more on the variation, Rijnstate has checked with the patient records whose blood loss is >500ml to determine if these patients would have received transfusion in Aalst if treated according to the blood transfusion protocol as applied in Belgium. But from the analysis it is concluded that only one patient is fulfilling the blood transfusion protocol of Aalst that is Hb value <8g/dl. Also, there is a difference in units in estimating the Hb levels, in Rijnstate it is recorded in mmol/l and in OLV Aalst it is recorded as g/dl, hence a standard measurement could not be made.

Indicator 5

Surgical duration: The surgical duration with and without node dissection presented a difference between both the centres. Rijnstate has less surgical duration with and without lymph node dissection on an average, whereas in OLV Aalst the average surgical duration with lymph node dissection and without lymph node dissection is higher. Though, the variation in surgical duration without node dissection is not much higher between centres, the duration with node dissection has a remarkable difference. OLV Aalst takes a longer surgical duration with lymph node dissection than Rijnstate. Based on literature review, the difference in surgical duration can due to the approach of the surgery, prostate volume etc (40). Additionally, OLV Aalst is an academic training centre and there are number of resident doctors practicing along with the senior specialist, this can easily pave way for an increased surgical duration as the junior/resident doctors are in their learning stage of practice. However, even in Rijnstate the resident doctors practice along with the senior Urologist but less in number than Aalst. Therefore, the difference in the duration can be studied by process mapping. The time-to-time process can be recorded and compared between centres to identify the variation in the surgical process. The process mapping task will provide information about which steps in the surgical procedure consume more time.

Indicator 6

Lymph node dissection: The two centres differs in the percentage of patients who had lymph node dissection along with RARP/RALP procedure. OLV, Aalst has performed less node dissection whereas in Rijnstate lymph node dissection is done for half of the patients who underwent RARP surgery. This indicator is measured to analyse whether both the centres perform the required rate of lymph node dissection or performs at an increased rate than required. It is stated that Rijnstate performs high lymph node dissection to prevent secondary complications such as biochemical recurrence in future and also due to the fact that Rijnstate has treated more severe Tumor category such as pT3a, pT3b. Hence, relationship between patients who had lymph node dissection and their biochemical recurrence rate can be studied which will support this indicator for Rijnstate as empirical evidence.

From the literature, it is found that on an average 3 to 24 lymph nodes are dissected during RARP/RALP surgeries. It is also stated that lymph node dissection can be curative for particular patients with limited nodal involvement. Additionally, higher number of lymph node removal was associated with improved cancer-specific survival. Also, lymph node dissection represent a stratification tool for identifying patients who benefit from the adjuvant treatment and can improve the survival outcomes(47).

Indicator 7 & Indicator 8

From the comparison of results, it is found that the results of both centres varies in hospital days and catheter time and these indicators are interrelated in both the centres.

Hospital days: Rijnstate has short average length of stay for both entire stay and post-op stay, whereas in OLV Aalst the average hospital days is higher.

Catheter time: The most notable outcome difference between both the centres is the catheter time. OLV, Aalst has significantly less catheter time in comparison with Rijnstate. This major difference in these indicators is due to the procedural variation. OLV, Aalst retains their patients for a longer duration in the hospital and discharge them once the catheter is removed during hospitalization, where in Rijnstate patients are discharged with short stay and the catheter is removed later as a day care procedure.

Based on the results, Rijnstate is suggested with reducing catheter time step-by-step, first with reducing to 7 days and then to 5 days and so on. Rijnstate can also practice the same procedure as Aalst by retaining the patients for a longer duration in the hospital and remove the catheter during their stay before sending them home however, patients' perspective and their opinion to stay for a longer duration should also be taken into consideration. When patients are dissatisfied with longer stay in the hospital, then they can be sent home with the catheter and then the catheter can be removed in a day care unit within 7 days or 5 days, this in turn also requires earlier scheduling of the day care procedure, which needs to be included in the protocol.

From the literature, it is found that longer catheter duration can result in high infection rate and reduced continence rate. However, in Rijnstate the continence rate at 12months follow-up period is 92% and the infection rate (patients who received antibiotics as a result of complication in <90days post-op) is 4%. Based on the comparison between the literature and the Rijnstate results, it clearly indicates that the longer catheter time does not have a greater impact on the infection rate and the continence rate. Therefore, Rijnstate can continue with the same catheter removal protocol or can check for feasibility of changing the practice of catheter removal procedure in order to reduce the number of Trial without catheter (TWOC) days though it doesn't have any impact on patient related outcomes.

Indicator 9

Continence rate: The Continence rate of patients underwent RARP in Rijnstate is high in comparison with OLV, Aalst. Based on the literature continence rate is influenced by multiple factors such pelvic lymph node dissection, nerve sparing technique and age of the patients. Although, the continence rate of OLV Aalst is almost equal to Rijnstate, association between the factors stated in the literature and the continence rate can provide a better understanding in improving the outcome.

Indicator 10

Erection recovery rate: The erection recovery rate is higher in OLV, Aalst than Rijnstate The significant factor influencing erection recovery rate is the BMI-Body mass index and the sexual status (level of sexual activity) of the patients at pre-op period.

Erection recovery rate is calculated based on the results of the PROMS questionnaire whereas , in OLV Aalst the patients filling in the PROMS questionnaire is very low and thus results in difference in outcome. For example, the percentage of patients filled-in PROMS questionnaire for erection recovery rate at OLV Aalst is 24% at 3months, 20% at 12months, 17% of 727 samples at 24months follow-up period and in Rijnstate 72% at 3months, 75% at 12months, 51% of 226 samples at 24months follow-up period. Due to the huge difference in response rate of the PROMS questionnaire it is difficult to compare the results of the indicator-erection recovery rate between both the centres. Only when a sufficient data is available these outcomes can be compared between centres. Hence it would be suggested to increase the response rate by motivating the patients to fill-in the PROMS questionnaire at different measurement period from which a reliable data can be generated.

Also, in particular the method in which the data of erection recovery is recorded in both the centres is different. In OLV Aalst, it is recorded as Yes-Functional erection and No-No functional erection whereas in Rijnstate it is recorded as 1- No erection at all, 2-Not stiff enough for sexual activity, 3- Stiff for Masturbation,4- Stiff enough for sexual intercourse and therefore in order to compare between centres and based on the Urologist's opinion Rijnstate erection option of 1,2 and 3 are considered as No- No functional erection and 4 is considered as Yes- Functional erection. Although, option 3- stiff for masturbation is counted as satisfied erection recovery by Rijnstate, it is not included in the category Yes- Functional erection. This difference in data recording is an important source of variation in the outcomes.

Indicator 11

Measurable PSA Level >0.1: This indicator is measured to evaluate the biochemical recurrence after RARP at 3months and 12months follow-up period but the data of the Measurable PSA of the OLV Aalst is not available, this is because the data recording method in OLV Aalst is different from Rijnstate. Therefore, OLV Aalst had to verify all the patient records which will consume a lot of time, hence due to time constraints the data could not be included and compared with the Rijnstate outcome. Therefore, this indicator will be helpful only in the future research.

However, Rijnstate data is compared with the values found in literature, the biochemical failure (i.e., PSA level >0.1). Rijnstate measurable PSA level >0.1ng/dl is less compared to the results found in literature. However, relationship between the measurable PSA >0.1ng/dl and the other variables such as patients who received adjuvant therapies and for whom lymph node dissection was performed might provide a better insight about the outcome of the indicator. In future, OLV Aalst outcome should be compared with Rijnstate to get a better understanding and derive a meaningful result.

Indicator 12

Complication rate: Both the centres has 0% mortality rate during the specified year 2018-2019. OLV Aalst has less re-intervention rate in comparison with Rijnstate and Rijnstate has less re-admission rate than OLV Aalst.

From the discussion of the results between the centres, it is known that OLV Aalst administer a single dose of antibiotics mandatorily for all the patients underwent RARP post-operative, whereas in Rijnstate such procedure is not followed. In Rijnstate patients are advised to report when there are signs of infection such as increase in temperature, swelling and pain. Though OLV Aalst administers antibiotics proactively there is increased re-admission rate which is a point of further analysis and additionally identifying the reasons for re-admission in both the centres might clarify the cause of the difference in the results between the centres.

The reasons for re-admission and re-intervention in Rijnstate is mentioned below,

Reasons for re-admissions are,

- Hematoma
- Thrombosis, pulmonary embolism, Sepsis
- General malaise
- Lymphocele
- Hyponatremia-sodium imbalance
- UTI-Urinary tract infection
- Wound leakage

Reasons are in-intervention are,

- Hematoma
- Anastomosis Surgical clip removal through scopy
- Intra- abdominal abscess
- Lymphocele drainage
- Spleen haemorrhage and coiling
- Inguinal hernia
- Rectal injury with fistula

The average re-admission rate found in literature at 30days is 4% and at 90days is 9%(48). The re-intervention rate after RARP surgery is found to be 3.7% (i.e.,) Clavien Dindo 3b-5 (49). Both the centres are performing within the reference values found in the literature. Henceforth, better understanding of the causes of complications can even lower the re-admission and re-intervention rate.

8 Study Implications

Apart from answering the research questions, the researcher wants to share what is learned during the process of the research. To the best of our knowledge, this study is the first initiation that shows a clear inclusion of surgical, oncological, and functional outcomes of RARP/RALP between two centres in Europe. Over the years, many studies have been conducted to show the functional outcomes of RARP and comparing the effectiveness of RARP over other surgical procedures such as Open radical prostatectomy, Laparoscopic radical prostatectomy. This kind of benchmarking is a process of establishing a standard of excellence and comparing the service provided in order to improve the quality of care and simultaneously reducing the cost. In this study the interaction between the benchmarking centres itself is a source of improvement. There were many hurdles during the study in data gathering and sharing, and there was missing data in the RARP/RALP group due to the referral system in the Netherlands and Belgium where one hospital refers their patients for surgery to a second hospital (In this case, Rijnstate and OLV Aalst) but the first hospital remains the primary care giver. A strength of this present study is that it is a guideline for an international benchmarking in evaluating the quality of robotic assisted radical prostatectomy for prostate cancer patients. The pitfalls of the study would be a point of improvement in the future research.

The main learning from the study is that, conducting international benchmarking is a real challenge. Organizations conducts a benchmarking study to drill down into the performance gaps to identify areas of improvement. Developing a standardized set of processes and metrics can be gold standards to obtain a quality label for the RARP/ RALP surgeries. It is always better to understand the protocol difference existing between the countries, sometimes there might be difference in the policies and the methods in which the data is recorded. In this study, there were similar issues with the protocol of blood transfusion which was analysed to an extent. In the future when multiple centres are included, there should be a clear definition on the standards and protocol pertaining to the particular benchmarking candidate chosen which makes the comparison easier and reliable.

9 Reflection on the Benchmarking process

In this research van Lent et al benchmarking process model is used based on which the performance indicators are developed. In this section the use of this model is discussed in detail with the Author's reflection on each phase of the model. The benchmarking process by van Lent et al was a good guideline for performing this study but few suggestions can improve the process in the future benchmarking research.

Step 1: Determine what to benchmark

The uniqueness of the benchmarking methodology is the identification of the right benchmarking candidate that can lead the organization to a superior performance. In this study, we chose to benchmark the quality Robotic assisted radical prostatectomy surgery outcomes. This selection is based only based on the assumption that the process is stable with less variation. But however, there could be other processes which can lead to a superior performance than the chosen one. Hence the first step is to analyse the processes of different interventions and the performance indicators to measure them based on which performance gaps can be identified and compared with other organizations. The second step is determining how these indicators will be measured, the standards measurements or criteria. These performance indicators along with the standard criteria should be approved by the executive board.

Step 2: Form a benchmarking team

A complete benchmarking team should include the executive board along with the benchmarking project coordinator, process owner, data collectors, data analyst, benchmarking support staffs and facilitators. For this study, people involved in the study performed multiple tasks. There were no specific designated staffs for the study as it is described in the literature.

Step 3: Choose benchmarking partners

As mentioned in the earlier sections, choosing the right benchmarking partner is a complex procedure. The benchmarking partner categories can be equal, higher, best practices and best in class. The partner selection process should also consider the attributes such as technical issues and the cultural aspects in order to successfully compare between the centres. One of the main disadvantages of this study is that the benchmarking centres are located in different countries within Europe. Hence there were difference in protocol for certain indicators such blood transfusion and due to different ethical guidelines sharing of patient level data was not possible. This makes the entire study more complex but at the same time it is an advantage to learn and get more information on the procedures that are different in different countries. In the future research focus should in understanding the difference in protocol among cross-countries and be to seek ethical committee approval in sharing the data.

Step 4: Define and verify the main characteristics of the partners

For this study, both the benchmarking centres are equally performing and are expert in the field of robotic surgeries. Both the centres perform a significant number of robotic surgeries every year.

Step 5: Identify stakeholders

In this study, the stakeholders involved are the patients (Indirect stakeholders) and the Urologist's, management staffs and the quality staffs (Direct stakeholders). No direct information from patients are gathered, only the retrospective data of patients under RARP surgery is gathered from various sources. But the parties who will be affected by the results are both the direct and indirect stakeholders.

Step 6: Construct the framework to structure the indicators

To carry out the study, support of the benchmarking process model alone can lead to gap in the measurement of the indicators and hence an additional framework will provide a better connection with the indicators, and it should focus on all aspects of quality as mentioned by IOM-Institute of medicine. Such a framework will be guiding tool in the future research which is not discussed in detail in this study.

Step 7: Develop relevant and comparable indicators and Step 8: Stakeholders select indicators

For this study, a list of comparable indicators are identified through literature review. The predefined list of indicators was already determined by the stakeholders before this phase of research. Hence there was not much scope for including some of the indicators found in the literature at the later stages.

Step 9: Measure the set of performance indicators

In this study, the measurement of the performance indicators was mainly focused in gathering the retrospective data of the patients who underwent robotic assisted radical prostatectomy during the year 2018-2019. Limited data availability and the lack of uniformity of data across the different centres posed a substantial challenge to assess the quality of RARP surgery.

Retrieving data from various existing sources/database consumed more time and the data sometimes is incomplete and inaccurate which further required cross verification in patient records. Hence, in future it is advisable to measure the data prospectively based on the standard criteria set rather than collectively them retrospectively or a standard excel software database can be created to record data for these indicators.

Step 10: Analyse performance indicators

In this phase, only descriptive statistical analysis was possible. The study involves only two centres and due to ethical considerations of the centres access to patient level data was not feasible. Both centres had different measurement methods which also required modifications in calculating the results.

Step 11: Take actions: results are presented in a report and recommendations are given

The result from the study with recommendation is presented. Some suggested improvement possibilities can be discussed with the top management and can be implemented with their approval based on the feasibility.

Step 12: Develop relevant plans & Step 13: Implement the improvement plans

Due to the time constraints, the development of improvement plans, and implementation was not feasible, and it is considered out of the scope of this study.

10 Limitation of the study

The study has few limitations,

- Due to time constraints, extensive statistical analysis in finding the association and relationship between the performance indicators was not possible.

- Since this study involves two centres of different countries within Europe, the Ethical guidelines for sharing patient level data is limited/restricted and hence analyses of patient level data of the benchmarking centres is not performed which would have paved way for a detailed analysis.
- Study about the variation in process was not under the scope of the study.
- Due to difference in methods in which data are recorded, OLV Aalst had to validate their data before sharing them. Data validation procedure is a time-consuming procedure and therefore the validation of data is still in progress. Henceforth, comparing measurable PSA level indicator of both the centres was not possible.
- This benchmarking study involves only two centres, hence the result from this study is more specific in nature and it cannot be generalized.

11 Future research scope

The main objective of the study is to identify the variations in RARP surgery outcomes between the benchmarking centres and to learn from each other. During the study, there were many learning lessons. The 13-step process of benchmarking by Van lent et al was carried out as specified. The recommendations based on the findings can be implemented as a next step by both centres depending upon the feasibility. The following are the future recommended plan for both the centres,

For OLV Aalst,

- Identifying factors influencing blood loss rate by finding association between the patient related characteristics and the blood loss during surgery.
- Process mapping for reducing surgical duration.
- Increasing the response rate of PROMS questionnaire

For Rijnstate,

- Catheter time reduction- Restructuring the procedure based on the feasibility, step by step reduction of catheter days.
- Increasing the response rate of PROMS questionnaire

One of the limitations of the study is that the focus is on two centres, the lessons learned during this research and with the structured benchmarking process which resulted in a strong framework can be used as a reference in future by involving multiple centres within Europe to gain more knowledge about the benchmarking process and a broader comparison of performance between the centres.

The following points are suggested by the Urologists during the discussion of the results between both the centres for further analysis.

- Pre-op and post-op Hb value analysis, in the aim of identifying its impact on the functional outcome.
- How does the bladder neck spare surgery contribute to the continence rate?
- Analysis on number of lymph nodes per surgeon.
- Pre-op PSA value analysis to study its effect on the surgical margins and the p-TNM staging.
- A standard excel template with all the indicators and the data on the indicators is to be developed.

12 Quality aspects of RARP/RALP with Hospital volume

In recent times, Robotic assisted radical prostatectomy has become the most frequently used surgical approach in the management of prostate cancer. Hence evaluating its quality on patient outcomes has become essential. From the results of the studies found in literature it is known that the hospital volume and surgeon volume plays a major role in the improved outcomes. This is explained in the article by Rebeca in 2021, that high hospital and surgeon volume results in less surgical duration, fewer positive margins etc(50). Hence these variables are considered as an explanatory variable which can influence the perioperative outcome of the RARP/RALP surgery. Analysing volume-outcome relationships has important health policy implications(51). In the Netherlands, a hospital must carry out a minimum of 20 robotic procedures annually to be eligible for a contract with the healthcare insurers. According to the Dutch federation of patients with prostate cancer at least 50 procedures should be performed annually(52). From the literatures it is identified that hospitals with very low case volume <10 annual procedures per centre is associated with high risk of complications,

prolonged length of stay and greater hospital volume is directly related with shorter length of stay(53). However, the greater hospital volume plays a significant role only in the short-term outcomes of robotic assisted radical prostatectomy whereas there is no clear evident on the long-term outcome such as overall survival rate etc.

A German based study conducted by Ch Groeben, states that hospitals with >= 100 cases a year reported with lower mortality rate than hospitals with <50 cases a year. Concerning blood transfusion, the surgical approach was the strong predictor with minimally invasive surgery followed by caseload volume. Length of stay is less with >200 cases a year. The major conclusion of the study is that annual volume of hospitals is the most important factor for improved in-hospital outcomes(54).

Based on the investigation of the above-mentioned studies, Rijnstate and OLV Aalst is performing a significant number of RARP/RALP cases every year which is >=100 and hence satisfies the category of high-volume centres with decreased complication rate and better functional outcome such as continence rate and no in-hospital death.

13 Overall Conclusion

There is a growing interest in international benchmarking to systematically assess the quality of care provided. This is mainly done through developing standard quality indicators that can be used internationally. However, cross-national data comparison is a real challenge. Benchmarking is a process of identifying the gap in the performance of the organization and making plans to continuously improve to be “best of the best”. Every organization compares its performances with its peers to identify and improve their weakness. The objective of any international benchmarking study can be many but some of the common basic objectives are to assess performance, create sustained pressure for improvement, expose areas where improvement is needed, identifying superior processes, focus on links between the processes and the results and to test whether improvement has been successful. In this study, patient outcomes are measured to analyse the quality of robotic assisted radical prostatectomy surgery. Therefore, this study created a healthy learning environment to expose the areas of improvement between the benchmarking centres without naming and shaming through outcome measurements and how they vary between both the centres and process variations in ultimately improving the patient related outcomes. Though both the hospitals provides the same service, there is difference in outcome which could be due to various social and economic factors which the organization has no control over it. Henceforth, comparing the results between the centres is not sufficient, the results have to be linked to the processes that can explain the factors influencing the outcome. However, benchmarking is not only copying from each other, the interaction between the benchmarking centres during each phase of the study is an important source for improvement.

Additionally, access to data is a key component in identifying the differences in outcome between the centres located cross-nationally. Hence, comparing quality across countries helps to assess the causes underlying the differences in the outcome of the service provided (intervention) and determines what appropriate actions need be taken to improve the health outcomes. This study provides a model for international benchmarking using the quality indicators defined for the robotic assisted radical prostatectomy outcome measurement which can be used as a reference when multiple centres are involved in the future studies.

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Appendix

Quality chasm of IOM: (37)

Safe- avoiding injuries to patients from the care that is intended to help them.

Effective- providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit.

Patient centred- providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions.

Timely- reducing waits and sometimes harmful delays for both those who receive and those who give care.

Efficient- avoiding waste, in particular waste of equipment, supplies, ideas, and energy.

Equitable- providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status.

Indicator's suggestion: These are the other indicators suggested during the study, but it is not that recommendable by the Urologists.

List of Indicators	Arguments supporting indicators
Setup time and docking time of da Vinci robot (More of a process indicator)	Setup time is defined as the time interval from patient entry to the operating room to the surgical start time, and the docking time is the time interval from port placements to docking of the robot. This two time seems to extend the operating duration. For this period patient must be anaesthetized which has an overall impact on the outcome of the surgery
Post-operative pain	RARP is a minimal invasive procedure which is performed through small incisions. One of the significant advantages discussed about this procedure in literature is less pain. Data: PREMS data Post-operative medication prescription (painkiller dosage)
Surgeon's experience (Structural indicator)	No. of procedures needed in an acceptable period. Based on the literature review, the surgeon's experience plays a vital role in the outcome of the surgery. Experience of the surgeon has impact on the operating time, resection margin, post-operative complications.
Institutional volume (Structural indicator)	No. of prostatectomies performed. This is also based on the experience the centre has in performing robotic surgeries. The institutional volume indicates the experience. Increased institutional volume: • Standard protocol • Minimal errors • Better surgical and functional outcomes

Criteria for measuring the performance indicators:

Indicators	Definition & Measurement Criteria
1. ASA physical status score	1-6 ASA Score
2. p-TNM Classification	p-TNM classification of UICC 8th edition
3. Surgical margins	R0, R1+R2 ➢ R0- Clean margins, Negative ➢ R1- Microscopic residual Tumor, 1 location with max 3mm length ➢ R2- Macroscopic residual Tumor, more locations AND/OR total length >3mm
4a. Blood loss rate	Blood loss in OR, measured through aspirator. ➢ 0-500ml,501-1000ml, >1001ml ➢ 0-250ml,251-500ml, 501-750ml, 751-1000ml, >1001ml
4b. Transfusion rate	Blood transfusion in OR and during post-op stay Yes/ No
5. Surgical duration	From the time of first incision till closing suture, with and without lymph node dissection. Average surgical duration with lymph node and without lymph node dissection
6. Lymph node dissection	Yes/ No
7a. Hospital days- Entire stay	From Day of admission + hour to discharge day (days with decimals) Average number of hospital days- Entire stay
7b. Hospital days-post-op stay	From the first incision to discharge time (days with decimals) Average number of hospital days- post-op stay
8. Catheter time	From surgery end time till the time of trial without catheter (TWOC) in days Average catheter time
9. Continence rate	Continent (0 & 1 pads), Incontinent (>1 pad) Pre-op, 6weeks, 3months, 12months, 24months
10. Erection recovery rate	Yes/ No Pre-op, 6weeks, 3months, 12months, 24months
11a. Measurable PSA level at 3months	PSA level >0.1 at 3months
11b. Measurable PSA level at 12months	PSA level >0.1 at 12months
12a. Complication rate- Death during stay and <90days post-op	Death due to urology during stay and <90days post-op
12b. Complication rate- re-hospitalization <90 days post-op	Re-hospitalization due to urology <90days post-op
12c. Complication rate- re-intervention <90 days post-op	Re-intervention due to urology <90days post-op

Table 2: Criteria for measuring the indicators