

# AMBULATORY SURGERY

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We come towards the end of another year with this edition of *Ambulatory Surgery*, and with this, an opportunity to review the state of play of healthcare in our nations.

In the United Kingdom, the situation is not encouraging. Driven by healthcare staff shortages, presumed to be as a consequence of the UK leaving the European Union, hospital throughput has continued to fall, with a consequent rise in waiting times for surgery. The COVID pandemic further exacerbated this, with hospitals full of sick patients and therefore unable to admit from accident and emergency environments. Add to this, the unprecedented inflation rates driven by events in the Ukraine, and reduced staff campaigning for increased pay by threatening strike action. Little wonder therefore, that levels of morale are at an all time low.

Surely there is an answer? One solution provided was published in this Journal a year ago, indicating that Ambulatory Surgery offers a cost-effective and quality pathway for both patient and hospital, with reduction in waiting times for much-needed surgery and minimal impact on hospital stay times (1). Similarly, one of our partner organisations have focussed on day case surgery as a solution to reduce waiting lists and increase bed capacity with fewer cancellations, infection risk and more equal access to care. Perhaps there is an onus on us to similarly advertise the benefits that Ambulatory Surgery can bring in potentially troubled times.

And so to the papers in this quarter's edition. Lemos and colleagues from Portugal present the results from an international questionnaire involving 400 citizens enquiring of their experience with ambulatory surgery in their home country and satisfaction with the process. They reported a high level of satisfaction with the procedure with no differences in geographical areas of origin. However, those interviewed wished to have more

information related to ambulatory surgery from their National Health Authorities.

An American study reviews the use of iPACK block in reconstruction of the Anterior Cruciate Ligament. This is a relatively new regional block that deposits local anaesthetic between the popliteal artery and the capsule of the knee and the authors compared it with a standard femoral block. They found that the iPACK group required lower doses of perioperative opioid and propofol as well as shorter length of stay.

Bamania et al evaluated an artificial intelligence model using logistic regression was used to predict discharge outcomes of patients on admission. Using the model, they found a prediction accuracy of 73%, an area under the ROC curve of 0.7 and average model precision of 0.75. Although not optimal, the model provides an ideal introduction to prediction of outcomes that the authors hope to work on in due course.

The fourth paper in this edition is written from Shanghai, where the authors report on their experiences with the establishment of a new ambulatory surgery centre. They evaluate the advantages and disadvantages of the model developed to provide a balanced view within their paper.

And finally; may I take the opportunity to wish all readers an enjoyable and peaceful season at the end of the year, and prosperity in their dealings as we enter 2023.

**Dr Mark Skues**  
Editor-in-Chief

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# Knowledge and Views of Common Citizens Regarding Ambulatory Surgery: A Pilot International Survey

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## Abstract

**Background and Aims:** Ambulatory surgery (AS) has increased rapidly in most countries since the 1990's. There is an increasing effort by national healthcare systems to disseminate clinical information about this type of surgical environment to their populations. We conducted a public survey to understand what citizens think about AS and its organization in countries across the world.

**Methods:** This prospective observational study used a survey presented on a tablet computer. Subjects were asked about their surgical experience and those submitted to AS were asked about their satisfaction rate. Subjects were also asked if they associate AS to a surgical programme and the level of information obtained from their National Health Services.

**Results:** 400 citizens from 47 different countries were divided in six geographical areas, European (n=4, North, Central, East and South)

**Key words:** Day Surgery; Ambulatory Surgery; Population Groups; Public Opinion; Patient Satisfaction.

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and non-European (n=2, Developed and Non-Developed Countries / Emergent Economies). 51.0% reported they had heard of AS, and 29.3% had undergone an AS procedure. Those who had undergone AS, reported a high level of satisfaction with the procedure, with no differences in geographical areas (P=0.229). 90.5% would recommend AS to relatives and friends. Nevertheless, those interviewed wished to have more information related to AS from their National Health Authorities (NHA). This was significant in East, South-European, and Non-Developed Non-European countries (P<0.001).

**Conclusion:** The majority of the citizens relates AS as a surgical programme. Although more than 90% of all interviewed would recommend this surgical setting, all agree that more information related to AS should be available from their NHA.

## Introduction

Ambulatory surgery (AS) also known as day surgery or outpatient surgery has increased rapidly in the countries since the 1990s. AS accounts for more than 50% of all elective surgeries performed, particularly in North America, Europe and Oceania (1). The complexity of procedures performed on an outpatient basis continues to increase, with a wider range of patients and procedures now considered suitable for AS (2). It is estimated that approximately 75% of elective surgeries could be performed as AS (3). Therefore, it is necessary to increase awareness of this surgical setting with National Healthcare Services (NHS) promoting AS to the public (4-6). However, there is no data regarding public knowledge of AS. Similarly, common citizen views regarding AS have not been assessed. The aim of the present study was to survey the knowledge and views of subjects from multiple countries about AS.

## Methods

This prospective observational study was based on a survey of tourists, older than 17 years of age, visiting to the city of Porto, Portugal. Porto was chosen because it receives over two million tourists a year from across the world. The survey was performed between November 2018 and February 2019 by an interviewer who was familiar with AS. For privacy reasons the survey was performed on a tablet computer using multilingual Google Forms (English, Chinese, Spanish, Portuguese, Russian, Turkish, French, German, Italian, Japanese, Polish, Swedish, Danish, Slovak), translated by natives-speakers. The first screen had information regarding AS (or

alternative term day surgery), and the objective of this anonymous survey. In order to be able to proceed with the questionnaire subjects had to give their written informed consent through an acceptance box. Ethical approval for this study (Ethical Committee P2020-CE-P03) was provided by the Ethical Committee of Centro Hospitalar Universitário do Porto (CHUP) / Instituto de Ciências Biomédicas Abel Salazar (ICBAS), Porto, Portugal, on 18 March 2019.

Anaesthesiologists who were familiar with AS developed the survey questions. We included demographic variables (age, gender, nationality and country of residence) but no other personal identifiable data were collected. Subjects were asked about their past surgical experience including the surgical setting (i.e., inpatient or AS), and those that were submitted to AS were asked about their satisfaction rate on a 10-point scale and the importance of different variables related to their satisfaction (Table 1). Subjects were also asked if they associate AS to a surgical programme and the relative importance of potential advantages of AS, such as easier scheduling and registration process (7,8), patient-centered care (friendlier) (9,10), less disruptive environment (less time spent in the facility) (8,11), reduced acquired hospital infections (4,12,13), reduced rate of complications (thrombosis, obstipation, cognitive dysfunction, etc) (14-16), quicker functional recovery (4,17), and quicker return to social and professional life (4,17). Subjects were also asked about the availability of information related to AS activity by the Health Authority in their country. All these variables were quantified through a four level Likert-scale: 1 – not important at all; 2 – less important; 3 – important; 4 – very important. However, these questions had a no opinion option.

**Table 1** Importance towards Patient satisfaction in ambulatory surgery, only interviewers submitted to a surgical procedure on ambulatory setting answered these questions (n=117).

	<b>Total (n=117)</b>	<b>CE (n=33)</b>	<b>EE (n=9)</b>	<b>NE (n=14)</b>	<b>SE (n=35)</b>	<b>NED (n=14)</b>	<b>NEEE (n=12)</b>	<b>No Opinion</b>
Surgery well done, without complications	4.00 [1-4] P=0.890	4.00 [2-4] (n=32)	4.00 [4-4] (n=9)	4.00 [3-4] (n=14)	4.00 [2-4] (n=35)	4.00 [1-4] (n=14)	4.00 [3-4] (n=12)	n=1 (0.9%)
Extensive information related to surgery	4.00 [2-4] P=0.848	4.00 [2-4] (n=30)	4.00 [3-4] (n=9)	3.50 [3-4] (n=14)	4.00 [2-4] (n=35)	4.00 [2-4] (n=13)	4.00 [2-4] (n=12)	n=4 (3.4%)
Painless surgical experience	4.00 [2-4] P=0.110	4.00 [2-4] (n=29)	4.00 [3-4] (n=8)	3.00 [2-4] (n=13)	4.00 [2-4] (n=35)	4.00 [3-4] (n=14)	3.50 [3-4] (n=12)	n=6 (5.1%)
Free nausea and vomiting surgical experience	3.00 [1-4] P=0.682	4.00 [2-4] (n=27)	4.00 [3-4] (n=8)	3.00 [2-4] (n=14)	3.00 [2-4] (n=29)	3.00 [1-4] (n=13)	3.00 [2-4] (n=10)	n=18 (15.4%)
Careful and personalised treatment	4.00 [2-4] P=0.520	4.00 [2-4] (n=31)	4.00 [3-4] (n=9)	4.00 [3-4] (n=13)	4.00 [2-4] (n=34)	4.00 [3-4] (n=14)	4.00 [3-4] (n=12)	n=4 (3.4%)
Privacy and anonymously treatment	3.00 [1-4] P=0.236	3.00 [2-4] (n=28)	4.00 [3-4] (n=7)	3.00 [2-4] (n=10)	4.00 [1-4] (n=33)	3.50 [2-4] (n=12)	3.00 [2-4] (n=9)	n=18 (15.4%)
Clean and modern facilities	4.00 [2-4] P=0.0090	4.00 [2-4] (n=31)	4.00 [3-4] (n=8)	3.50 [3-4] (n=14)	4.00 [2-4] (n=35)	4.00 [3-4] (n=14)	4.00 [3-4] (n=12)	n=3 (2.6%)

CE – Centre Europe, EE – East Europe, NE – North Europe, SE – South Europe, NED – Non-European Developed, NEEE – Non-European Emerging Economies. 1 – not important at all; 2 – less important; 3 – important; 4 – very important. Data are median (minimum - maximum).

Data were processed in Microsoft Excel and analysed in IBM – SPSS® for Windows (version 25.0). For analysis purposes we divided the questionnaires obtained in six geographical areas (see Table 2): four European (North, Centre, East and South) and two non-European (Developed and Non-Developed Countries / Emerging Economies). As people are likely to know and use the NHS of the country where they live, the division of the results was based on the country of residence for the last 5 years. Data are n (%), mean  $\pm$  SD or median (minimum - maximum). Demographic variables, patient satisfaction factors and level of information were identified with descriptive statistical analysis. Non-parametric Kruskal-Wallis test and X<sup>2</sup> independent test were used to compare data distribution between groups. Internal consistency was analysed with Alpha-Cronbach. Differences were considered significant when P<0.05.

This manuscript adheres to the applicable Strobe guidelines.

## Results

Four hundred citizens from 47 countries agreed to participate in this survey, there were no dropouts. The subjects were divided into four age groups: 36.75% between 18-29 years, 29.0% between 30-44 years, 25.0% between 45-59 years, and 9.25% older than 60 years. Female subjects represented 60.5%, noting that three citizens (0.75%) opted to register themselves as “other gender”. Table 2 presents the subjects in the various geographical areas described above. We found no differences between geographical areas in relation

to the gender (P=0.568). The age of subjects interviewed from Northern Europe (NE) were older (14 out of 26 were older than 44 years old) and those from Eastern Europe (EE) were younger (17 out of 33 were younger than 30 years old), than in other groups (P=0.011).

Due to the lower representation from Nordic countries (Norway, Sweden, Finland and Denmark) we included residents from United Kingdom and Ireland in this group because of their geographical proximity and because these countries have similar national expression of AS practice (5), entitled this as NE. There is significant heterogeneity in the group Non-European Emergent Economies (NEEE) with countries showing different social and economical development and where some emergent economies like Brazil and China are awakening for this surgical practice.

Two hundred and fifteen subjects (53.8%) had a previous surgical experience, 117 (29.3%) of them had undergone surgery on an AS basis, with those from NE and Non-European Developed (NED) countries reporting highest percentages (Figure 1) without any differences among the geographical areas (P=0.422).

The questionnaire had a good internal consistency with an Alpha-Cronbach of 0.870, considering the 15 Likert opinion questions.

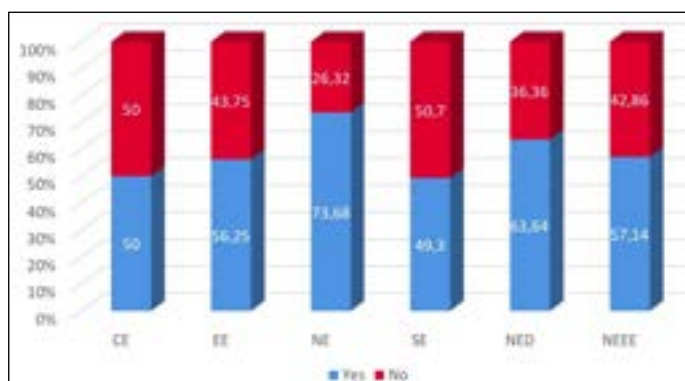
High satisfaction scores with a median score of 9 [8.5 – 10] without differences between geographical areas (P=0.229), were found in subjects who had AS experience.



**Table 2** Residence countries of the interviewed citizens.

Geographical Area	N (%)	Country	N (%)
South Europe (SE)	136 (34.00%)	Spain	71 (52.20%)
		Portugal	41 (30.15%)
		Italy	24 (17.65%)
Centre Europe (CE)	108 (27.00%)	Germany	41 (37.96%)
		France	36 (33.34%)
		Switzerland	11 (10.19%)
		Belgium	7 (6.48%)
		The Netherlands	7 (6.48%)
		Luxembourg	4 (3.70%)
		Austria	2 (1.85%)
Non-European Developed Countries (NED)	53 (13.25%)	United States America	12 (22.64%)
		South Korea	12 (22.64%)
		Canada	9 (16.98%)
		Israel	5 (9.43%)
		Japan	4 (7.55%)
		Singapore	4 (7.55%)
		Taiwan	4 (7.55%)
		Australia	2 (3.77%)
Non-European Non-Developed Countries / Emergent Economies (NEEE)	44 (11.00%)	United Arab Emirates	1 (1.89%)
		Brazil	26 (59.09%)
		China	6 (13.64%)
		Argentina	2 (4.55%)
		Venezuela	2 (4.55%)
		Thailand	2 (4.55%)
		Philippines	1 (2.27%)
		India	1 (2.27%)
		Mexico	1 (2.27%)
		Peru	1 (2.27%)
		Turkey	1 (2.27%)
East Europe (EE)	33 (8.25%)	South Africa	1 (2.27%)
		Poland	7 (21.21%)
		Czech Republic	7 (21.21%)
		Russia	4 (12.13%)
		Lithuania	3 (9.09%)
		Hungary	2 (6.06%)
		Macedonia	2 (6.06%)
		Romania	2 (6.06%)
		Serbia	2 (6.06%)
		Croatia	1 (3.03%)
		Slovakia	1 (3.03%)
		Moldova	1 (3.03%)
		Ukraine	1 (3.03%)
North Europe (NE)	26 (6.50%)	United Kingdom	17 (65.38%)
		Denmark	3 (11.54%)
		Norway	3 (11.54%)
		Sweden	2 (7.69%)
		Ireland	1 (3.85%)

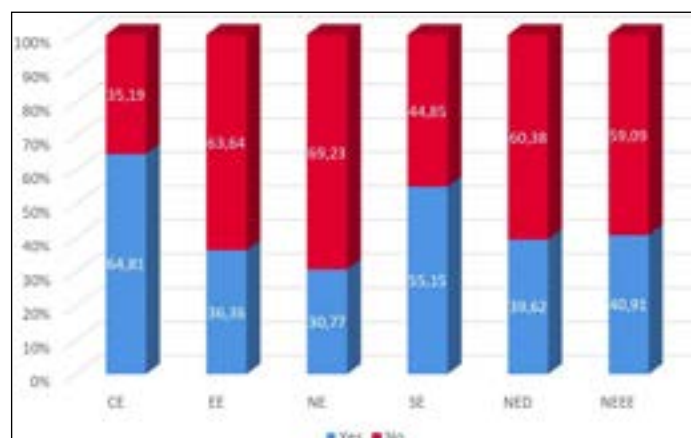




**Figure 1** Percentage of interviewed citizens submitted to ambulatory surgery.  
CE – Centre Europe, EE – East Europe, NE – North Europe, SE – South Europe, NED – Non-European Developed, NEEE – Non-European Emerging Economies.

In relation to the relative importance of different variables related to patient satisfaction, although there is no difference amongst groups (Table 1), overall subjects identified free nausea and vomiting surgical experience and privacy and anonymously treatment, as not so important.

Heterogeneity between groups was observed when we asked subjects if they associate AS to a surgical programme ( $P=0.001$ ), being Centre Europe (CE) (64.8%) and Southern Europe (SE) (55.2%) the groups that the majority of subjects confirmed that knowledge (Figure 2).

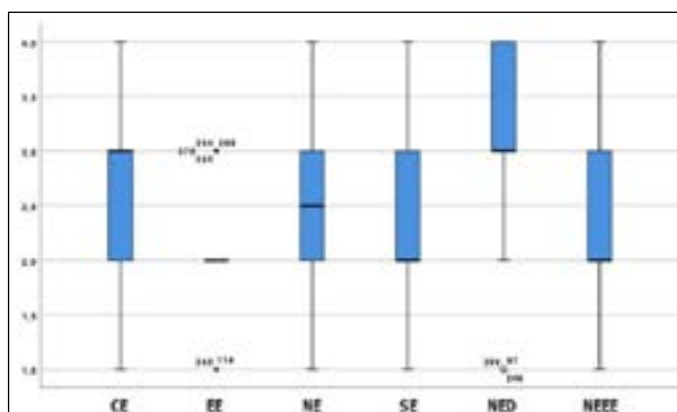


**Figure 2** Percentage of interviewed citizens that associates ambulatory surgery to a surgical programme.  
CE – Centre Europe, EE – East Europe, NE – North Europe, SE – South Europe, NED – Non-European Developed, NEEE – Non-European Emerging Economies.

All subjects were asked to give their opinion about different variables related to AS advantages. There was no difference among geographical areas. However, overall subjects score less importance to less disruptive environment or to an easier scheduling and registration process in comparison with other aspects (Table 3).

90.5% ( $n=362$ ) of those interviewed would recommend AS to relatives or friends, and with no difference between groups ( $P=0.102$ ), with a minimum of 83% ( $n=44$ ) for those representing NED countries and a maximum of 97% ( $n=32$ ) for EE countries. Reasons for recommendation were related to faster process (54.7%), a safer regimen (39%) or an easier surgical programme (34.3%). Unsafe (25%), less supportive (25%) or less quality (15.6%), where reasons stated by those who would not recommend AS to relatives or friends.

Level of information about AS programmes available from Health Authorities was heterogeneous between groups ( $P<0.001$ ), noting that 3 of the 6 groups (Figure 3) refer insufficient level of information (SE, EE and NEEE countries).



**Figure 3** Box-plot of the level of information related to ambulatory surgery available from the Health Authorities per geographical area.

CE – Centre Europe, EE – East Europe, NE – North Europe, SE – South Europe, NED – Non-European Developed, NEEE – Non-European Emerging Economies  
1 – Non-existent; 2 – Insufficient; 3 – Sufficient; 4 – Very Good.

## Discussion

Information of the level of knowledge and thoughts related to AS on common citizens are lacking. Given the diversity of countries included in our survey, we divided our sample in six groups according to their geographical position for European countries and their economical development for non-European countries.

NE had the higher number reporting AS experience, but the lowest median satisfaction. Being NE an older age group composed by people from countries where AS is a tradition, we would expect greater satisfaction scores (18-20).

NE group reported pain as a less relevant factor for satisfaction with AS than other groups, in spite of being the older participants. In fact, LD Wandner et al. found that typical older adults are more pain sensitive and willing to report pain than both typical middle-age adult and typical young adult (21).

Surprisingly, in addition to having a not so important score, free nausea and vomiting surgical experience had a higher percentage (15.4%) of no opinion, which could show an overall indifference regarding this aspect. In contrast to what was found by TJ Gan about the expressive value that patients are willing to pay for a completely effective antiemetic (22).

Privacy and anonymously treatment was similarly considered overall a not so important aspect related to AS, also reflected by the higher percentage of no opinion responders (15.4%). Amongst other factors, D Fenton-Lee et al. reported that there was a high level of patient satisfaction with day surgery when there was ward privacy (23). This might be cultural, as although without significant difference, SE and EE groups scored higher than other groups, noting that subjects from these countries give more importance to this aspect.

In spite of the spread of AS over the World only in two groups (CE and SE) the majority of participants confirmed to associate AS with a surgical programme. In opposition, only one third of NE and NED groups reported to have heard AS as a surgical programme. In fact, two thirds of these respondents live in the United Kingdom, United States of America, Canada, Denmark, Norway, Sweden and Australia where AS represent more the majority of all elective cases. For that reason, we would expect different results and that more participants with residence in those countries would already have heard about this surgical setting. Moreover, being NE group an older age group (more than 50% over 44 years old), eventually exposed to more surgical procedures and more healthcare information, we would

**Table 3** Perspective of interviewed citizen in relation to the advantages of Ambulatory Surgery (n=400).

	Total (n=400)	CE (n=108)	EE (n=33)	NE (n=26)	SE (n=136)	NED (n=53)	NEEE (n=44)	No Opinion
Patient is the centre of treatment by health professionals	4.00 [1-4] P=0.387	3.00 [1-4] (n=90)	4.00 [3-4] (n=24)	4.00 [3-4] (n=18)	4.00 [1-4] (n=128)	4.00 [2-4] (n=45)	4.00 [2-4] (n=41)	n=54 (13.5%)
Less disruptive environment (less time spent in the facility)	3.00 [1-4] P=0.254	3.00 [2-4] (n=91)	3.00 [2-4] (n=27)	3.00 [2-4] (n=20)	3.00 [1-4] (n=123)	3.00 [2-4] (n=48)	4.00 [2-4] (n=39)	n=52 (13.0%)
Reduced patient acquired hospital infections	4.00 [1-4] P=0.254	4.00 [2-4] (n=96)	4.00 [3-4] (n=26)	4.00 [3-4] (n=18)	4.00 [1-4] (n=123)	4.00 [2-4] (n=49)	4.00 [1-4] (n=39)	n=49 (11.3%)
Reduced rate of complications (thrombosis, obstipation, cognitive dysfunction, etc)	4.00 [1-4] P=0.331	4.00 [2-4] (n=86)	4.00 [3-4] (n=27)	3.00 [3-4] (n=19)	4.00 [1-4] (n=123)	4.00 [2-4] (n=47)	4.00 [1-4] (n=37)	n=61 (15.3%)
Higher patient satisfaction rate (personalised treatment)	4.00 [1-4] P=0.390	3.00 [1-4] (n=88)	4.00 [2-4] (n=24)	3.00 [2-4] (n=20)	4.00 [1-4] (n=97)	4.00 [2-4] (n=45)	4.00 [2-4] (n=38)	n=88 (22.0%)
Easier scheduling and registration process	3.00 [1-4] P=0.239	3.00 [1-4] (n=80)	3.00 [2-4] (n=25)	3.00 [2-4] (n=19)	4.00 [1-4] (n=114)	3.00 [1-4] (n=44)	4.00 [2-4] (n=36)	n=82 (20.5%)
Quicker functional recovery	4.00 [1-4] P=0.180	4.00 [2-4] (n=92)	4.00 [3-4] (n=26)	3.00 [2-4] (n=19)	4.00 [1-4] (n=119)	4.00 [1-4] (n=47)	4.00 [3-4] (n=39)	n=58 (14.5%)
Sooner return to social and professional life	4.00 [1-4] P=0.091	4.00 [2-4] (n=88)	4.00 [3-4] (n=27)	3.00 [1-4] (n=22)	4.00 [1-4] (n=119)	4.00 [1-4] (n=46)	4.00 [3-4] (n=39)	n=59 (14.8%)

CE – Centre Europe, EE – East Europe, NE – North Europe, SE – South Europe, NED – Non-European Developed, NEEE – Non-European Emerging Economies. 1 – not important at all; 2 – less important; 3 – important; 4 – very important. Data are median (minimum - maximum).

expect different results. On the other hand, the EE group, being the younger group (more than 50% younger than 30 years old), are more confident in recommending AS to relatives and friends, although referring the lowest level of information to AS activity available from Health Authorities.

Subjects score less importance to less disruptive environment or to an easier scheduling and registration process in comparison with other aspects. It seems that the society when approaching health systems attributes less importance to administrative or social issues than to safety or clinical aspects. This can be reinforced by the percentage of no opinion answers (20.5%) on the advantage of the easier scheduling and registration process associated to AS.

Worth to note is the high percentage of no opinion regarding patient satisfaction rate / personalised treatment. This can be a reflection of lack of knowledge about a surgical process (only 215 patients had a surgical experience).

It would appear that, AS has an excellent image across the World be that for speed, safety or process facility, reinforced by more than 90% of participants who would recommend this surgical regimen to relatives and friends. Several papers state that it is possible to undertake most surgeries in adults and children as day cases (2,3). Indeed “AS should be considered the default for many elective surgical procedures” is the first statement in the joint 2016 statement from the Royal College of Anaesthetists and the Royal College of Surgeons of England (4).

Finally, there is a large consensus that more information related to this type of surgical programmes should be available from National Health Authorities even in those countries where AS has a high practice (24,25).

This study has some limitations due to the fact that only travelling citizens were selected. It is likely that this selects people with higher income and higher education attainment and so eventually better information in relation to their fellow citizens. This might skew the results obtained preventing a true representation from each country. In addition, the questionnaire was developed for this study and not previously validated in the AS context or in the language context. Being the target population very heterogeneous and internationally multicultural, the validation of the questionnaire would be an extremely complicated task even just for the AS context. Nevertheless, the authors developed the questions based on simple concepts associated with AS for the last 40 years, that can be considered a classic for the AS health literacy. The next step in our research in this field would be to increase the sample size with citizens living in countries where there is no great representation and avoid differences in demographic variables that might have interfered with the results.

## Conclusion

In conclusion, the results of our study show that subjects submitted to AS were overall satisfied with their AS experience and the great majority of all interviewed would recommend it to their relatives and friends in spite of asking for more information to be available regarding its organization even in countries where AS represent the majority of surgical cases.

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# The Utility of iPACK Block in Anterior Cruciate Reconstruction Surgery: A Retrospective Study

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## Abstract

The primary aim of this retrospective study was to evaluate the effect of iPACK block in ACL reconstruction surgery. Adults who received a femoral nerve block were compared to those who received femoral block plus iPACK. Opioid requirements, PACU pain scores, and recovery time (a combination of PACU and phase II recovery time)

were compared. A total of 184 patients were included. There were no difference in PACU pain scores, or opioid doses in PACU. However, the iPACK group had lower intraoperative propofol dose and total intraoperative OME requirements, as well as a shorter postoperative stay by 40 minutes.

**Key words:** Anterior Cruciate; Reconstruction; Peripheral Nerve Block; iPACK Block; Analgesia.

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## Introduction

The optimum role of peripheral nerve blocks in anterior cruciate ligament reconstruction (ACLR) continues to be debated as a component of multimodal analgesia (1,2). For those choosing to utilize peripheral nerve block for ACLR, there has been variability in addressing pain in the posterior aspect of the joint, usually either by a sciatic nerve block or with local infiltration. However, in keeping with motor preservation, the former is not desirable, and there is less opportunity for directed surgeon infiltration in ACLR, which is primarily conducted with arthroscopy. One possible solution to this dilemma is a relatively new block, Injection between the Popliteal Artery and the Capsule of the Knee (iPACK), which has been effective in providing posterior analgesia for total knee arthroplasty (1-3). However, data is limited regarding the utility of this block in ambulatory ACLR. We evaluated our experience with iPACK block in this retrospective study of ACLR patients. Our hypothesis was that pain levels experienced by patients in the post-anesthesia care unit (PACU) would be significantly lower for patients who received iPACK block in concert with femoral block, as opposed to femoral nerve block alone.

## Methods:

This retrospective review was approved by our Institution Review Board of the University of Pittsburgh (PRO20060152). We included patients with ASA physical status classes 1-2, presenting for ambulatory ACLR, between September 1, 2019 and October 31, 2020, who received either femoral nerve block (n=73) or femoral block in combination with an iPACK block (n=111). There was no discrimination for inclusion based upon graft type. Patients who did not receive the described blocks were excluded.

After informed consent was obtained in the preoperative holding area, patients underwent femoral block under ultrasound guidance with a 6-13 MHz linear transducer (Sonosite Export, Bothell WA), utilizing 20 ml 0.25% bupivacaine or ropivacaine injected through a 5 cm, 22 gauge echogenic needle (Sonoplex II, Pajunk USA, Alpharetta, GA). Patients who consented for iPACK block were subsequently asked to externally rotate, the leg at the hip and provide partial flexion of the knee. A curvilinear, 2-5 MHz transducer (Sonosite Export) was applied at the level of the base of the patella, to image the medial aspect of the distal thigh. The region between the popliteal vessels and the posterior portion of the femoral cortex was targeted,

and an 8 cm, 21 gauge echogenic needle (Pajunk Sonoplex) was advanced into this space. After assuring negative aspiration, 20 ml of 0.25% bupivacaine or ropivacaine was injected in aliquots of 2-5 ml, ensuring spread between the bone and vessels.

All patients received multimodal analgesia including preoperative acetaminophen, and intraoperative decadron and ketamine. Some patients received intraoperative opioids as well, based upon vital sign responses to surgical interventions. All cases were conducted with general anesthesia, utilizing either laryngeal mask airway or endotracheal tube. Muscle relaxation was not generally employed after airway management was carried out.

Patient demographics, PACU pain scores, recovery time, and opioid requirements after surgery were collected. The primary outcome measure was PACU NRS score on arrival from the OR. Secondary outcomes included pain scores at other points during recovery, opioid doses in the OR and in PACU, time to discharge from the hospital, and the incidence of postoperative nausea and vomiting.

Incidences of perioperative outcomes are reported as simple statistics. Comparisons for outcome variables between the two groups were assessed by Chi-square test or by T-test, and Wilcoxon test. The Bonferroni correction was used to account for multiple comparisons. An alpha level of 0.05 was considered statistically significant. A difference in numeric pain rating score, NPRS, of two units between groups was considered clinically significant.

## Results

There were no differences in demographics or operative times (Table 1).

We also found no significant differences between groups for pain scores in PACU. (Table 2). Intraoperative anesthetic requirements including total dose of propofol, and opioid drugs were significantly lower for the iPACK group. In addition, the iPACK group had a significantly shorter postoperative stay (191.1 +/- 80 minutes vs 152.6 +/- 65.9 minutes,  $p < 0.02$ ). Opioid and antiemetic requirements in the PACU were similar in both groups.

## Discussion

In this retrospective analysis, we found that patients undergoing ACLR who had received FNB plus iPACK had similar pain scores

**Table 1** Baseline Characteristics.

	<b>Femoral Nerve Block (n=73)</b>	<b>Femoral + iPACK Block (n=111)</b>	<b>p-value<sup>a,b</sup></b>
Demographics			
Female, n (%)	32 (44)	57 (51)	0.3
Mean age in years (SD)	26.8 +/- 10.0	26.6 +/- 10.7	0.2
BMI (SD)	26.5 +/- 5.4	26.2 +/- 5.75	0.7
ASA classification, n (%)			
I	51 (69.9)	73 (65.6)	0.63
II	20 (27.4)	32 (28.9)	0.86
III	2 (2.7)	6 (5.5)	0.48
ACL side, n (%)			
Right	43 (58.9)	54 (48.7)	0.17
Left	30 (41.1)	57 (51.3)	
ACL repair type, n (%)			
Quadriceps	42 (57.5)	46 (41.4)	0.04
Patellar	14 (19.1)	23 (20.7)	0.85
Allograft	13 (17.9)	38 (34.3)	0.02
Hamstring	4 (5.5)	4 (3.6)	0.71

Abbreviations: SD, standard deviation; ASA, American Society of Anesthesiologists; BMI, Body mass index;

a: p-value compares femoral nerve block vs femoral nerve block + iPACK block

b: chi-squared test used to compare categorical data and t-test to compare means

**Table 2** : Outcomes.

	<b>Femoral Nerve Block (n=73)</b>	<b>Femoral + iPACK Block (n=111)</b>	<b>p-value<sup>a,b</sup></b>
Total OR time in minutes (SD)	203.6 (40)	194.6 (39)	0.1
Intraoperative total propofol dose in mg (SD)	1409.0 (778)	1188.3 (713)	0.04
Intra-Op OMEs			
No opioid use intra op, n (%)	19 (26.0)	24 (21.6)	0.59
Average OME for those who utilized opioids intra-op	20.4 +/- 13.6	16.2 +/- 10.5	0.02
Average NPRS PACU Score (SD)	3.93 (2.0)	3.73 (2.57)	0.57
PACU OMEs			
No opioid use in PACU, n (%)	15 (20.5)	32 (28.8)	0.23
Average OME for those who used opioids in PACU	(n=58) 19.9 (13.8)	(n=79) 21.8 (15)	0.38
Time in minutes to first opioid in the recovery room (SD)	37.1 (36.8)	33 (34)	0.43
Total recovery time in minutes (SD)	191.1 (80)	152.6 (65.9)	0.0004
Rescue antiemetic in PACU, n (%)	8 (10.9)	13 (11.7%)	1.0

Abbreviations: SD, standard deviation; OMEs, oral morphine equivalents; NPRS, numeric pain rating scale;

a: p-value compares femoral nerve block vs femoral nerve block + iPACK block

b: chi-squared test used to compare categorical data and t-test to compare means



in PACU compared to those who received FNB only and did not differ in postoperative opioid requirements. However, they required less intraoperative opioids and lower doses of propofol. These likely contributed to the significantly shorter recovery time in this population, an important variable in ambulatory anesthesia.

A paucity of evidence has accrued regarding blocks specifically targeting the posterior portion of the knee in ACLR, particularly in outpatients, in whom such a block might impact time required for recovery and facilitate earlier discharge. Two studies of inpatients reported a reduction in opioid requirements after surgery. Amer et al, in a randomized trial comparing adductor canal block with iPACK to adductor canal block plus surgeon-applied local infiltration in ACLR patients, reported lower pain scores and reduced opioid consumption in the iPACK group (4). When iPACK was compared to LIA in addition to femoral triangle block in a group of surgical inpatients undergoing ACLR, the authors noted that 24 hour morphine consumption was significantly reduced, with no effect on reported pain levels or functional outcomes (3).

However, like Vichainarong et al, who studied outcomes with iPACK block in total knee arthroplasty, we were unable to demonstrate a reduction in postoperative opioids in iPACK patients, though this group did require fewer opioids during the surgery (5). Further, we did not identify differences in pain scores when the iPACK block was added to femoral block, though

this may be explained by the increased dose of opioids that were provided in the OR to the group with femoral block only

Limitations of this study include relatively limited numbers of patients in the two groups, as well as the retrospective design, which allows for bias that may not be apparent during data analysis. In addition, there was a higher proportion of allografts, and lower proportion of quadriceps tendon autografts, in the Femoral-iPACK group. However, this was not associated with differences in PACU pain reported by patients.

In conclusion, addition of an iPACK block to a femoral block did not reduce reported pain levels in PACU, but did provide other benefits for ambulatory ACL reconstruction patients, including shorter length of stay, and lower intraoperative propofol and opioid requirements, when compared to those receiving only a femoral nerve block. Future prospective studies will permit greater elucidation of the benefits of iPACK in this setting.

1.

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# Using Artificial Intelligence to Predict Discharges from a Day Surgical Unit in a District Hospital

AM Bamania, F Belfield, N Deshmukh

## Abstract

Artificial intelligence is changing the way we approach healthcare problems. A new day-case trauma pathway was developed and commenced in July 2017 at Withybush general hospital, a district hospital in west Wales. In a recent retrospective analysis to assess the number of successful emergency orthopaedics patients treated on a day case basis, a same-day discharge rate of 52% was found. A logistic regression machine learning model was trained on the data of patients who were treated via

this pathway. A 5-fold grid search cross-validation method was applied for hyper-parameter tuning and model evaluation. The model has a prediction accuracy of 73.3%, the area under the ROC curve is 0.7, and the average precision of the model is 0.75. The model efficiently predicts discharge outcomes of patients on admission. This will help in tailoring care for identified patients to improve discharge outcomes and will result in an efficient allocation of hospital resources.

**Key words:** Day Surgery, Quality Improvement, Artificial Intelligence.

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## Introduction

Artificial intelligence is changing the way we approach healthcare problems.

Machine learning, a subset of artificial intelligence, is popularly classified into supervised, unsupervised, and reinforcement learning. Supervised learning algorithms learn from labelled data sets. Using labelled datasets, the algorithms can learn how the known input variables relate to the labelled outputs. These algorithms then predict outcomes or classify data using the new inputs and become efficient by learning by trial and error.

Withybush hospital is a district general hospital situated in the coastal town of Haverfordwest. It caters to a population of approximately 375,000 in Pembrokeshire, Carmarthenshire, and Ceredigion in west Wales.

A new day-case trauma pathway was developed and commenced in the hospital in July 2017 [1]. In a recent retrospective analysis to assess the number of successful emergency orthopaedics patients treated on a day case basis, we found a same-day surgery and discharge rate of 52% [2].

We propose a supervised machine learning model to improve the efficiency of this pathway.

## Methods

We trained a logistic regression supervised machine learning model on the data of patients treated via the day surgery pathway in our hospital using the sci-kit-learn machine learning library.

Scikit-learn is an open-source machine learning library that supports supervised and unsupervised learning.

Age (median age of 48.5 (15-92) years), gender (male/female), and the type of injury sustained (upper limb injury, upper limb fracture, lower limb injury, lower limb fracture) were used as input variables/features (represented by variable 'X').

The target variable (represented by variable 'y') was defined as whether the patient was discharged from the day surgery unit on the same day or not.

Categorical variables (sex, type of limb injury) were converted into dummy variables.

The dataset was split into training (75% of the total dataset) and testing datasets (25% of the total dataset) and was stratified according to the target variable. A logistic regression model was trained on the training dataset. The GridSearchCV method was used to find the best fitting parameters for the logistic regression algorithm using a 5-fold cross-validation strategy (hyper-parametric tuning).

The model was retrained using these parameters, and prediction accuracy over the testing dataset was calculated.

## Results

Demographics of patients treated via the day surgery pathway

240 patients were treated as emergency day surgery cases with the orthopaedics department in Withybush hospital, from July 2017 to December 2019.

52.5% of patients were female (126/240). The median (range) age of all patients was 48.5 (15-92) years. 124 (51.7%) patients were admitted with upper limb fractures and 44 (18.3%) patients were admitted with other upper limb injuries. 38 (15.8%) patients had lower limb fractures on admission and 24 (14.2%) patients had other lower limb injuries.

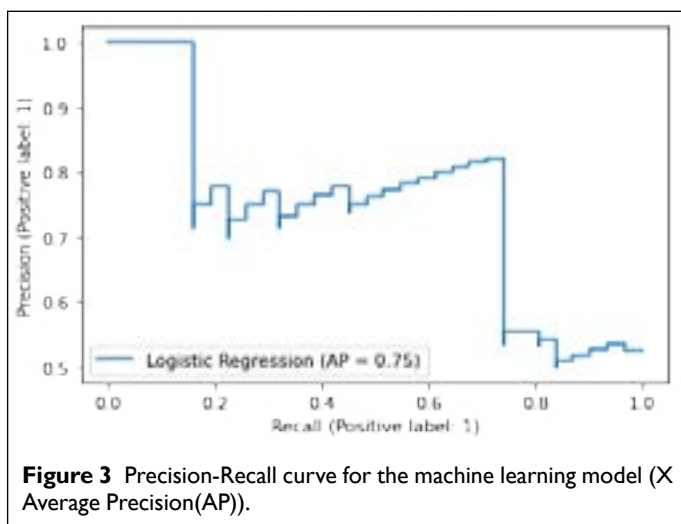
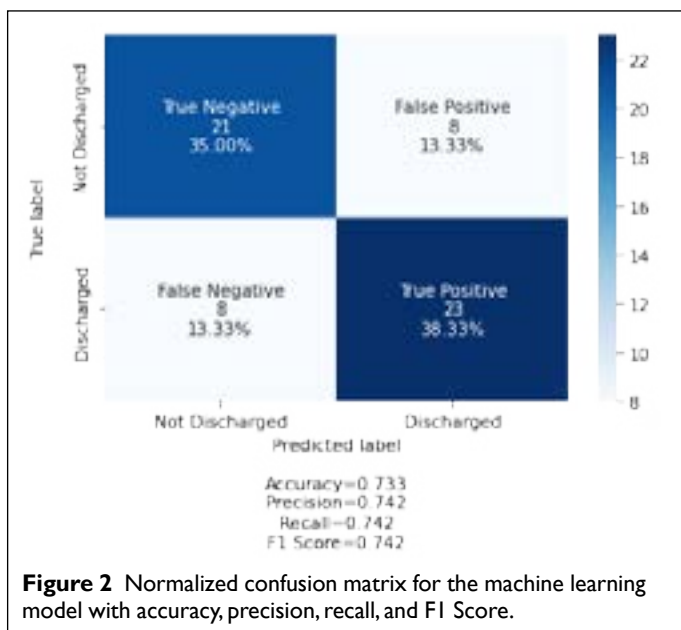
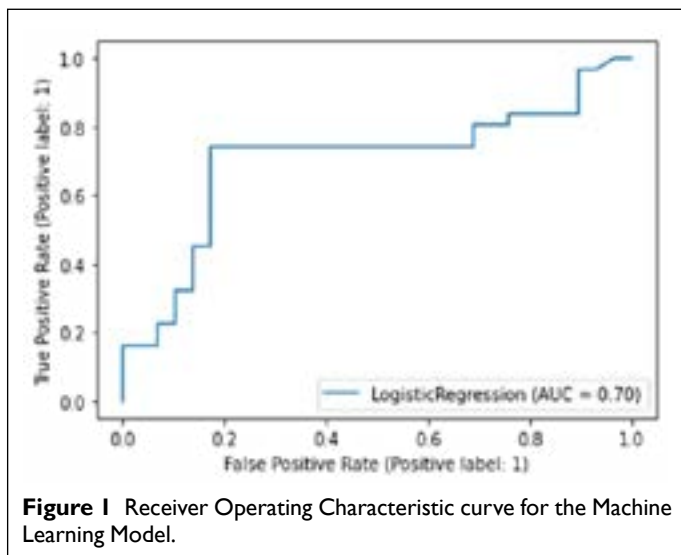
### Description of the machine learning model

- The trained logistic regression machine learning model with its parameters is as follows:

```
LogisticRegression(C=3.2374575428176464, class_weight=None, dual=False,
fit_intercept=True, intercept_scaling=1, l1_ratio=None,
max_iter=100, multi_class='auto', n_jobs=None, penalty='l2',
random_state=None, solver='lbfgs', tol=0.01, verbose=0,
warm_start=False)
```

- The model has a prediction accuracy of 73.3% on the testing dataset.
- The area under the ROC curve for the model is 0.70 (Figure 1).
- The normalized confusion matrix for the model is shown in Figure 2.
- The Precision-Recall curve for the model demonstrates an average precision of 0.75 (Figure 3).





## Discussion

Applications of artificial intelligence to solve healthcare problems are increasing in modern medicine. Healthcare-related problems could be effectively dealt with by machine learning approaches that limit human error.

## Strengths

Our model efficiently predicts discharge outcomes of patients on admission.

Integration of the model with the existing patient records / PAS can help identify patients who are less likely to be discharged on the same day from the day surgery unit.

This will help in tailoring care for identified patients to improve discharge outcomes and will result in an efficient allocation of hospital resources.

## Limitations

Our model has a few limitations.

Firstly, the model does not directly highlight all the factors that could preclude same-day patient discharge. These include the patients' comorbidities and functional status. These also include post-operative conditions of the patient or cancellation of surgery for the patient due to hospital-related issues.

Secondly, the accuracy of the model could be further improved. This could be achieved using other machine learning algorithms or a deep learning neural network.

We trained other machine learning algorithms on the same dataset (K-Nearest neighbour classifier (KNN), Support vector machine (SVM), Random Forest classifier, and Decision tree classifier) and achieved the following accuracies on the testing dataset (Table 1).

**Table 1** Prediction accuracies of different machine learning algorithms.

Machine Learning Algorithms	Prediction Accuracy on the testing dataset
Logistic Regression	73.3%
K- Nearest Neighbor classifier (KNN)	60%
Support Vector Machine (SVM)	70%
Decision Tree Classifier	58.3%
Random Forest Classifier	51.6%

As more patients are treated within the day surgery unit, we believe this could increase the prediction accuracy of the model (due to an increase in sample size).

As the sample size increases, a deep learning neural network could be trained on the data to get superior prediction accuracy.

Additionally, more patient characteristics can be used as variables to train the model to increase the prediction accuracy.

We will plan to implement the model in our day surgery unit for further validation and retrain the model with a 'learning-from-shortcomings' approach.

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# How Did We Set Up Independent Private Ambulatory Surgery Centers?

Masatoshi Tomonari, Junmei Wu, Keying Song

## Abstract

**Purpose:** Yosemite Clinic functions as independently operating private ambulatory surgery centers with its first site opened in Pudong District, Shanghai. We have provided international standard ambulatory surgery services since 2016. Some of our patients are even coming from United Kingdom, Indonesia and Japan to have surgeries. These inbound patients commented that they could get better treatments and medical services than that in their own country. We applied these experiences into setting up our second ambulatory surgical center at JingAn, Shanghai after more than two years of operation. We reviewed our facilities and verbalized the operations. Hereby, we share our efforts from our past operations with medical colleagues in China who are also struggling to set up similar ambulatory surgery centers.

**Method:** We carefully reviewed international guidelines of ambulatory surgery centers, and analysed our type of ambulatory surgery center and reviewed our advantages and disadvantages as being our type of ambulatory surgery centers.

**Results:** Yosemite Clinic is defined as a chained medical institution providing independent private ambulatory surgery centers with multi-departmental medical services. Independent ambulatory surgery center we state here is not what we usually indicated as a part of surgical center in larger hospital. It sometimes has to rely on tertiary hospital for backup of its medical care, and mostly treats commonly seen surgery-related

illness and commonly seen minimally invasive procedures. When comes to complicated procedures, it has to seek medical support from partnered tertiary hospitals. Therefore, the patient and surgical selection should have to be more carefully. Three limitations are related to patient selection. First is the limitation of medical team. The surgeons need certain training of minimally invasive surgery skills. Anesthesiologists working in ambulatory surgery centers must be familiar with ambulatory surgery workflows. Additionally, the role of nursing care also is fundamental and crucial in operating ambulatory surgery centers. Second is the limitation of patient condition. Ambulatory surgery centers have to evaluate both physical and social condition before acceptance of surgeries. Third is the limitation of facilities. Based on these limitations, each ambulatory surgery center should make their own patient selection. We have multi-surgical departments and therefore could provide multi-department surgeries. Since patients often have multiple problems in addition to the surgery-related illness, they could be better evaluated and managed better from multi-disciplinary aspects inside our facilities. At the same time, we could share some equipment and save cost by providing such services.

**Conclusion:** There is no reliable guideline specifically instructing for operating an independent private ambulatory surgery center providing multi-department services. Our experience will be helpful to establish standard operation workflows in China.

**Key words:** Ambulatory Surgery Centre, Establishment.

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## Introduction

Yosemite Clinic is a pioneering healthcare institution, tagged as chained independent private ambulatory surgery centers, started its first site operation on Nov 30 2017, at Pudong District, Shanghai. We have followed Chinese regulation and have provided international standard ambulatory surgery services in a comprehensive clinic setting. Our patients' characters are quite unique. Most of our patients are Chinese and foreigners living within 10km from our clinic. Thus, we provide different language services here, such as English, Japanese in addition to Chinese. Some of our patients are even coming from United Kingdom, Indonesia and Japan to Yosemite to have surgeries. These inbound patients commented that they could get better treatments and medical services than that in their own country. We have collected vast experiences from the past more than two years' operation, and we applied them into setting up our second ambulatory surgical center at JingAn, Shanghai. We reviewed our facility and verbalized the operations. Hereby, we share our efforts from our past operations with medical colleagues in China who are also struggling to set up similar ambulatory surgery centers. Hope our experience of setting up independent private ambulatory surgery centers to helpful to peers in this field.

## Method

We carefully reviewed Chinese, European, American and Japanese guidelines of ambulatory surgery centers, and analyzed our type of ambulatory surgery center and reviewed our advantages and disadvantages as an ambulatory surgery center (1-4).

Yosemite Clinic is defined as chained private ambulatory surgery providers with multi-department medical services. The concept of a freestanding ambulatory surgery center in private medical institution has a short history in China. Unlike most of current ambulatory surgery centers in China, Yosemite ambulatory surgery center is not a part of larger hospital. And being independently operating is our unique character, and it also provides multi-departmental surgical services. We would like to discuss about our experience of independent and multi-departmental ambulatory center here.

Firstly, we would like to share the difference between dependent ambulatory center and independent one. Dependent ambulatory surgery center belongs to a large hospital and share the facility and staff with large hospital. It has benefits that large hospitals can provide backup support, such as advanced diagnostic examinations, specialist consultation, inpatient services and peri-operative intensive care units, especially when patient has commodity diseases and when unexpected complications happen. However, an independent ambulatory surgery center is not a part of surgery center in larger hospital. It is also called freestanding and isolated ambulatory surgery

center, which needs much less investments than a large hospital and could be copied faster. Independent ambulatory surgery centers have limited facilities and limited human resource. It sometimes has to rely on large hospital for state-of-the-art medical examinations, specialist consultation, and backup team supports. Therefore, the patient and surgical selection should have to be more careful. And we partnered with Shanghai No. 10th People's hospital and set up green channels with Renji Hospital and other tertiary hospital to make sure the quality & safety of our surgical patients. Once patients developed complications which could beyond control of our staff and facilities, we could immediately transfer the patients for further intensive care.

Three limitations are related to patient selection. First is the limitation of medical team capability. Minimally invasive surgery, such as laparoscopic surgery and arthroscopic surgery is a good fit for ambulatory surgery centers. Minimally invasive surgery makes it possible for patients to recover faster after surgery. In general, minimally invasive surgery requires advanced skills; the surgeons involved need certain training of minimally invasive surgeries. The surgeon or the team also needs the ability to convert minimally invasive surgery to classic open surgery when major surgical complication happens, for instance, surgeon have to convert laparoscopic surgery to open abdominal surgery when massive bleeding happens. Blood bank is crucial for a safely operating freestanding ambulatory surgery centers. Anesthesiologists working in an ambulatory surgery center must be familiar with ambulatory surgeries. In an ambulatory surgery center, patient usually can be discharged within several hours after the surgery. Less side effects and early fast-track recovery from anesthesia are necessary for patients to be discharged smoothly. Administration of short acting anesthesia drugs, pain management controlled by several kinds of nerve blocking and other pain killers play pivotal roles in minimizing the postoperative discomforts such as nausea and vomiting. The major causes of unexpected delayed discharge or patients returning to hospital are mostly post-operative pain, post-operative nausea and vomit, over sedation, delayed medical emergencies and post-operative bleeding. Multi-modality pain management plan and ultrasound-guided nerve block can reduce the dose of opiate medicine usage and can achieve fast-track recovering from anesthesia. Additionally, thorough and detailed nursing care is also fundamental and crucial in an ambulatory surgery center setting. We have to realize the variation of patients' health conditions. Children, elderly and adult with commodity disease need special review, skills and medical knowledge for the nursing team are also important. Second is the limitation of patients' condition. According to the guidelines, the patient getting admitted into an ambulatory surgery setting with absolute contraindications is rarely seen, especially when surgery is performed under local anesthesia or monitored anesthetic care. In addition to this, an ambulatory surgery center has to consider the access to our partnered hospital, escorting person and care giver at home for each patient before we make the decision to go for surgery. Third is the limitation of facilities inside an ambulatory surgery center. It has to evaluate its capability of treating complications before surgery occurs. Ventilators care should be prepared in advance if respiratory or heart failure occurs. Coronary revascularization should be needed for acute coronary syndrome. Smaller size of airway devices, SpO2 sensors and blood pressure cuffs are needed in advance for pediatric surgeries. Based on the above-mentioned limitations, each ambulatory surgery center should make their own patient selection. We strictly

evaluated our own capability of these factors and selected our surgical patients. Yosemite clinic is an independent ambulatory surgery center; therefore, our capability is smaller than dependent surgery center, in which emergency patient transferring system to large hospital and maintain close collaborations with partner hospitals are required.

Secondly, we would like to explain the difference between single-department ambulatory surgery center and multi-department one. The former is where only single department surgeries are performed, for instance, an orthopedic ambulatory surgery center just provides arthroscopic joint surgeries. The advantages are the followings. It can save cost of equipment and facility. Initial cost is relatively more economical. Medical staff can focus on specific surgeries and they can be trained well in short term. The disadvantage of it is less patient volume and need efforts to work with more freelancing doctors and to find such patients. However, when we talk about an ambulatory surgery center which has multi surgical departments and provides multi-department surgeries, the advantages are the followings. An individualized patient mostly doesn't present a single illness. Patients often have multiple problems in addition to the surgery-related illness, they could be better evaluated and managed better from multi-disciplinary aspects in an ambulatory surgery centers providing multi-departmental services. At the same time, some departments could share same equipment and would promote to more effective usage of them. The use of luminous source of laparoscopy and arthroscopy by General Surgery department, Gynecology department and Orthopedics department are a good example. The disadvantages are the following. Anesthesiologists and operating room nurses and observation room nurses have to have the capabilities to manage many types of surgeries. They need a broader range of skills and knowledge of surgeries. These would put some difficulties in looking for capable human resources. Additionally, such a surgical center carries a vast inventory of consumables. Ability to make a precise budget planning is required.

## Conclusion

After conducting the literature review, we found out that no reliable guidelines for operating an independent private ambulatory surgery center with multi-department services. Our experience will be helpful to establish standard workflows for the setting up of independent ambulatory centers in China. We sincerely wish our experience sharing could be beneficial to colleagues also in this field and contribute to a better healthcare for our patients.

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