Original Paper

Effect of a Mobile Application on Preoperative Patient Preparation for Major Ambulatory Surgery: Protocol for a Randomized Clinical Trial

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Abstract

Background: Inadequate preoperative patient preparation causes organizational, economic, and emotional problems in patients and professionals. In a context of increasing healthcare burdens, introducing innovative tools based on mobile Health Apps can have a significant effect on healthcare systems.

Objective: To evaluate the effectiveness of the Listeo+ mobile Health App as a tool for improving adherence to preoperative recommendations in major ambulatory surgery (MAS) versus standard of care (SoC).

Methods: A multicenter, randomized, open-label clinical trial that compares SoC to the additional use of Listeo+, a specific mobile Health App for MAS preoperative patient monitoring, is being conducted. The study will include patients aged ≥18 years with surgical indication for MAS who meet the necessary technological and connectivity requirements. Patients in the control group will receive written preoperative recommendations, and those in the intervention group will additionally use the Listeo+ mobile Health App. There will be a competitive recruitment of 790 patients during six months in four hospitals of Andalusia (Spain) that belong to the National Health System. The main efficacy variable is adherence to preoperative recommendations. Secondary variables include the rate of cancellations, associated resource consumption, and perceived usability and utility with Listeo+ by participants of the intervention group.

Results: The technological development of Listeo+ and the integration and interoperability of the information systems was completed in September 2017. Subsequently, simulation tests were performed with Listeo+, and a pilot study was initiated with real patients that concluded successfully in October 2017. Patient recruitment began in December 2017 in the four participating centers. After an intermediate analysis performed six months after the start of the recruitment phase, it is expected that the phases of data collection, data cleaning, and final data analysis will be completed in June 2018.

Conclusions: Progress in the integration and interoperability of information systems represents a major step forward in the field of mobile health (mHealth).

Trial Registration

Keywords: mobile health applications; ambulatory surgery; preoperative care; patient safety; patient compliance; economic evaluation
Introduction
Providing quality of care in the different phases of the surgical process has become an important challenge for health systems because of the increase in the care burden, the increase in the complexity of surgical procedures, and increasingly demanded attention focused on the patients’ preferences.

Throughout the surgical process, different factors (organizational, relative to the patient’s clinical condition, or medical) can lead to surgery cancellations or surgical delay. The implications of surgery cancellations can be analyzed from the perspectives of health management and patient safety, since their effects on health resource consumption can be considered adverse events (AEs) that require control and monitoring. One major cause is the inadequate preoperative patient preparation because the safety guarantees for the intervention are not met; this affects both the quality of the surgical process and the consumption of hospital resources as a result of the increase in hospital stay and consumption of medicines.

Major ambulatory surgery (MAS) is characterized by short-term postoperative care and does not require hospital admission; it has greatly increased in developed countries in recent decades. In Spain, it represents 62.5% of the total number of surgeries performed by the National Health System (NHS), which is one of the highest rates among OECD countries. Although the rate of cancellations in MAS is approximately 4%—lower than that reported in other countries where cancellations on the day of surgery oscillate between 5 and 40%—a quarter of those cancellations (27%) are due to poor compliance with preoperative recommendations and are therefore avoidable. Conversely, inadequate preoperative patient preparation for MAS is also considered one of the main causes of patient no-shows on the day of surgery, which is likely due to patient anxiety before surgery.

What Tools are Useful for Improving the Quality and Safety of the Preoperative Patient?
There are tools, such as preassessment clinics (PACs) and the surgical safety checklist (SSC), that help to minimize risks in the preoperative process by assessing the patient’s anesthetic risk or verifying compliance with essential surgical aspects from the beginning to the end of surgery. Regarding these two elements, one of the initiatives to ensure that the requirements established in the preoperative assessment are met is to provide recommendations to the patient so they can participate in their own care in aspects such as the use of medications (e.g., anticoagulants, biologicals) and hygienic and dietetic measures. In this way, risky situations that can lead to surgery cancellations are avoided.

Currently, there is evidence of the benefits of PACs and the SSC on the reduction of postoperative complications in the ambulatory setting, preoperative anxiety, and
cancellations for medical reasons (e.g., inappropriate use of medication before surgery)\textsuperscript{22-23}. However, there is no evidence of the impact of good compliance by patients with preoperative recommendations.

**Application of mHealth Apps in the Preoperative Patient**

Some experiences based on information and communication technologies (ICT), such as incorporating the SSC in digital form to the Electronic Health Record (EHR) or sending text messages as a reminder of health appointments, have made it possible to improve adherence to treatment and surgical recommendations, reduce cancellations, and avoid no-shows\textsuperscript{1,24-27}.

Currently, mobile devices (tablet, mobile phone, and/or wearable) have a very high degree of penetration in Spain\textsuperscript{28} and Andalusia in particular, with 70.9\% of the population (some 4.8 million inhabitants) connecting to the Internet through these devices\textsuperscript{29}. Because of its characteristics, (e.g., mobility, instant access, connectivity, and variety of functionalities) mobile health (mHealth) can influence patient attitudes and behaviors and facilitate the asynchronous information exchange between patients and health professionals\textsuperscript{30}. Some mHealth-based interventions, such as the use of mobile Health Apps, have proven effective in the management of chronic diseases (e.g., diabetes, asthma, hypertension) by improving clinical parameters, adherence, and reducing disease costs\textsuperscript{31}. Despite their great potential, the few initiatives undertaken thus far in the ambulatory surgical setting have been limited to postoperative patient monitoring\textsuperscript{32-33}. Thus, there is no available evidence of the effect of mobile Health Apps on adherence to preoperative recommendations and, consequently on the reduction of surgical cancellations.

Listeo+ is a multifunctional mobile application that provides personalized information to surgical patients (date and time of surgery), adjusted to their clinical condition. In addition to sending reminders on critical aspects of the operation at different times, Listeo+ monitors compliance with preoperative recommendations by establishing a communication channel between patients and healthcare professionals, which facilitates intervention in the case of possible AEs.

The aim of this study is to evaluate the impact of Listeo+ as a complement to SoC in patient adherence to preoperative recommendations, surgery cancellations, and associated resource consumption in the ambulatory surgical setting, in a clinical context of real-world evidence (RWE), and to evaluate the user experience with the application (perceived usability and utility).
Methods

Study Design
A multicenter, randomized, and open-label clinical trial is being conducted to evaluate the Listeo+ mobile Health App as a complement to SoC in patients undergoing MAS. This study has two arms: patients who receive preoperative written recommendations (control group) and patients who use the Listeo+ mobile Health App as a multifunctional tool to monitor personal recommendations from health professionals (intervention group).

Participating Centers
Patients are being recruited from four High Resolution Hospital Centers (HARCs), with a reference population of 187,957 inhabitants; these hospitals belong to the Public Health System of Andalusia and are part of the NHS hospital network. HARCs encourage ambulatory surgery and short-term hospitalization using MAS, so they were considered suitable centers to evaluate the initiative.

Study Variables
The main variable is the difference in adherence to preoperative recommendations in patients undergoing MAS at the participating centers.

The secondary variables include the rate of surgery cancellations (number of cancellations compared to the number of scheduled operations) and the associated consumption of hospital resources assessed by a cost analysis between the control and intervention groups. To evaluate the user experience with the Listeo+ application in the intervention group, the perceived usability and utility of mobile Health Apps will be analyzed. The level of usability, defined as the extent to which Listeo+ is utilized by users to achieve specific objectives of mobile Health Apps\textsuperscript{34}, will be evaluated exclusively in patients, whereas the perceived utility of Listeo+ will be evaluated in health professionals using qualitative techniques.

Characteristics and Selection Criteria of Patients Undergoing MAS
The patients participating in this study will be adults aged 18 years or older at the start of the study, who will undergo MAS in the specialties of traumatology, orthopedic surgery, ophthalmology, or general surgery.

Written informed consent duly signed by all patients, legal representatives, or caregivers participating in this study will be collected regardless of group assignment.
**Inclusion Criteria**

To participate in the study, the following inclusion criteria should be met: 1) autonomous patients or dependents of one or more caregivers to perform their preoperative preparation, with the necessary technological and connectivity resources; 2) patients or caregivers who have a smartphone or tablet mobile device with an Android or iOS operating system with an Internet connection; and 3) familiarity with mobile technologies. Those patients who are autonomous to perform their preoperative preparation and lack the technological requirements but have a caregiver with the necessary technological and connectivity resources who can supervise their preoperative preparation may also be included in the study.

**Exclusion Criteria**

Those patients with two scheduled operations during the same clinical episode or time period will be excluded from the study. Non-autonomous patients, whose caregivers cannot be located when personal preoperative recommendations are provided, and patients of the intervention group who have not downloaded and registered on Listeo+ will also be excluded. To avoid loss of patients, a rescue procedure will be used with those patients who, within a period of 7 to 14 days, have not registered on the Listeo+ app. A telephone call will be made urging them to register on the Listeo+ app. If the patient has not registered within 72 hours (three days) after the rescue call has been made, the patient will be excluded from the study.

**Instruments**

The Barthel index\(^{35-36}\) will be used to assess physical dependence and loss of autonomy of patients, and the criteria of the *American Society of Anesthesiologists*\(^{37}\) (ASA) will be used to evaluate the anesthetic risk and identify the clinical variables of the patient.

Adherence will be measured as the level of compliance with personal preoperative recommendations. The information about mobile application usability by the intervention group will be collected through a modified version of the *Computer System Usability Questionnaire* (CSUQ)\(^ {38} \). A discussion group will be organized to collect qualitative information about the utility perceived by health professionals. In the event an incident occurs involving the cancellation, suspension, or rescheduling of surgery, the consumption of hospital resources will be recorded (consumption of medications, hospital stay, consumption of laboratory tests, diagnostic imaging, etc.).

**Patient flow in the Control and Intervention Groups**

Subjects who meet the inclusion criteria and sign informed consent will be provided with an information sheet about the project and evaluated before participating in the study. A 1:1 randomization scheme will be used. Given the characteristics of the study, it is not possible to blind the patients and professionals. Subsequently, we will
collect sociodemographic data (age, sex, area of residence of the patient, level of studies of the patient/caregiver using the application or patient/caregiver of the control group, occupation, marital status, knowledge/handling of apps); clinical data (type of surgery, medical diagnosis (ICD-9), anesthetic evaluation, medications taken); and functional situation by measuring disability (Barthel Index).

The patient flow from the MAS assessment appointment to hospital discharge is represented in the flowchart in Figure 1. This includes a first visit to surgery consultation; a second face-to-face anesthesia consultation (all patients except for ophthalmological patients with indication for topical anesthesia); and a third hospitalization visit to undergo MAS. Patients in the control group will follow the existing MAS patient assistance route in the centers, which consists in providing written recommendations. Patients included in the intervention group will be provided with personal recommendations through Listeo+ (Figure 2). For this, they will be given access to the mobile application through a link and/or QR code. Personal recommendations will be printed and the application downloaded from the EHR platform. Through the personalized QR of the recommendations, the app can access the episode identification data and specific recommendations for that particular case. Subsequently, there will be communication and interactions between the Listeo+ and EHR systems.

All the study data will be collected through an electronic case report form (eCRF). To facilitate the completion of the eCRF, a specific module has been created and integrated into the EHR of the participating centers. The information that the researchers include in the eCRF will be exported to an anonymized database (without identifying patient data to ensure data confidentiality) for further analysis of the study data. The researchers will be responsible for creating a system that relates the numbers of the EHR (containing the eCRF data) with the anonymized code in the database where the data are exported and keeping the list of identification codes.

**Sample Size and Statistical Plan**

The sample size required to estimate the main objective of the study was calculated as 395 patients per group for a total of 790 patients. This estimate was made assuming an alpha risk of 0.05, a beta risk of 0.2, and a difference in proportions between the groups of 10%. The analysis will be performed considering per intention to treat (ITT) and per protocol (PP) populations. The ITT population will include all randomized patients, whereas the PP population will include randomized patients who finally obtain an appointment to undergo MAS.

Statistical analyses will be performed using the R software version 3.3.2. For all analyses, an alpha ($\alpha$) risk of 0.05 will be assumed; therefore, to consider a
statistically significant difference, the p value of the contrast statistic should be ≤0.05. The statistical analysis planned a priori will consist of a descriptive analysis of the demographic and clinical characteristics of the patients. For the quantitative variables, the mean, standard deviation, 95% confidence intervals (95% CI), variance, standard error, 5% trimmed mean, median, minimum, and maximum will be calculated. For the qualitative variables, frequency distributions with their respective percentages will be calculated. To determine whether there are differences in the level of compliance with surgical recommendations between the group with written recommendations and the group with written recommendations plus the app, Fisher’s exact test will be performed.

Sociodemographic variables (age, gender, status, etc.) and baseline characteristics of the patients will be shown for each group. The reasons for exclusion of the ITT population will be included.

**Technological Development, Integration, and Interoperability**
To ensure proper communication between mobile Health App users (patients and health professionals), a process of integration of information systems and interoperability between Listeo+ and EHR has been developed. This process was planned in four phases: a) co-design of the system and pilot; b) integration and technical tests; c) simulation and pilot testing; and d) real environment testing.

**Ethical Aspects of the Study, Confidentiality, and Privacy**
The study protocol has been evaluated and approved by the Regional Ethics Committee of Andalusia through the Biomedical Research Ethics Portal of Andalucía (PEIBA, for its acronym in Spanish). The present study will be conducted in accordance with the principles of the latest version of the Declaration of Helsinki and will follow the Good Clinical Practice guidelines of Spain.

Data confidentiality will be protected under the Spanish law that ensures the protection of personal data (Organic Law on Protection of Personal Data, 15/1999, December 13). The researcher of each center will be responsible for keeping a study file containing patient identification and information, including the informed consent form signed by the patients. Throughout the study, all related documents will be located in a secure area of the participating center. Any analysis derived from the study will be performed from an anonymized database; it will not contain any identification of the patient or caregiver but only a numeric code by which it will not be possible to reveal their identities. At the end of the study, the researcher will be responsible for preserving the necessary documentation for at least five years.

**Data Monitoring and Validation**
An electronic monitoring of the completion of the eCRFs will be performed to detect missing information and possible data inconsistencies, thus ensuring their quality.
For this purpose, the researchers will be contacted during the patient recruitment phase, three and six months after the start of the project, using confidential information access codes. The inclusion of patients according to the established criteria (inclusion/exclusion criteria), the correct completion of the eCRFs, the signing and filing of the informed consent form of the participating patients, and any other aspects required by the research team will be reviewed. The monitor will communicate to the corresponding research team the variables that must be reviewed in cases of lost or inconsistent data.

**Results**

Currently, this study is in the recruitment phase, which will end once 790 patients are included (395 for each arm). The data collection and cleaning phases are estimated to be completed in July 2018, and the analysis with the final results will be conducted in September 2018.

Previously, the technical aspects of interoperability between the hospital and the Listeo+ application backend (set of system components accessible only to the developers or platform administrators) were resolved successfully, defining an application programming interface (API) for web services. In December 2016, an eCRF was created that was fully integrated into the EHR of the participating centers.

Prior to the recruitment of patients, a pilot phase was conducted in January 2017 with the aim of identifying complications in the subsequent phases of recruitment and data analysis. During the pilot phase, face-to-face sessions were held in the hospitals with both health professionals and specialized ICT personnel. In these sessions, test runs were performed with several patients, verifying the effective communication between the systems and the usability of the new functionality integrated in the EHR. As a result, a telephone call was included in the protocol, at 7 and 14 days after the provision of recommendations during the anesthesiologist appointment, for those patients of the intervention group who had not downloaded their personal preoperative recommendations using the QR code. In addition, two new recommendations were added (see Annex: R1_18 and R3_24), and the wording of the recommendations was modified to facilitate patient understanding. Simultaneously, improvements were made in the design and functionality of Listeo+.

**Discussion**

The introduction of new multifunctional technologies allows achieving different objectives in patient preparation, providing personalized information, and establishing an effective communication channel that facilitates patient monitoring by health professionals.

The evaluation of initiatives based on new technologies in the health sector is a fundamental element because of its subsequent adoption by the different stakeholders (patients, health professionals, decision makers). According to the
World Health Organization (WHO), the lack of evidence on the effectiveness and economic impact of mHealth-based interventions is one of the most important barriers for implementing these programs within the framework of the European Union\textsuperscript{39}. In this sense, it is necessary to perform initiatives aimed at generating evidence on the effect of adherence to preoperative recommendations and on their economic impact in MAS using mobile Health Apps, which evaluate their utility and efficiency in critical areas such as surgical patient safety. Taking into account the increasingly important role of citizens and patients in health systems, the possibility of having information about user experience (perceived usability and utility) makes it possible to evaluate the suitability of these tools in a real clinical setting.

Relevance of the Study

Improvements in systems integration and interoperability could have great relevance. Currently, it has been possible to incorporate into the EHR of the participating centers a generator of preoperative recommendation lists that allows selecting the information according to individual patient characteristics. In addition, the structure of information systems for data exchange has been modified from the user’s mobile device using Listeo+ and the EHR in these centers. The learning process and the improvement in systems integration and interoperability can be used for other initiatives within the framework of mobile Health Apps in Andalusia, a region with a favorable environment for the development of initiatives based on new technologies and, by extension, to the rest of the NHS.

Furthermore, the interest of the study lies in the increase in MAS and the adoption of mobile devices and acceptance of mobile Health Apps by the population. Thus, the number of MAS operations in developed countries has continued to increase in recent years. In 2015 in Spain, 1,632,824 MAS operations were performed, corresponding to an increase of 4.2% from the period of 2010-2015\textsuperscript{11}. It also highlights that the penetration level of smartphones is also increasing, even among the elderly, reducing the generation gap\textsuperscript{40}. Finally, data from a local survey on the use of mobile Health Apps shows that 73.8% of patients would use them if recommended by their doctor, which suggests a high level of acceptance of mobile Health Apps by the population\textsuperscript{41}.

Limitations

The present study has some limitations related to the design of the intervention and the methodology used. First, it is a randomized clinical trial with an \textit{open-label} design. Although not blinding patients and professionals could lead to potential bias in the interpretation of results, this type of design is widely accepted in complex non-pharmacological interventions (e.g., surgery and medical devices)\textsuperscript{42} in which masking cannot be applied. Second, Listeo+ has been evaluated as a complement to SoC (written recommendations). In this sense, other published clinical trials based on MAS and Patient Support Programs also use this methodological approach where intervention is assumed as a complement to SoC\textsuperscript{43-44}. 
**Conclusions**
In line with WHO guidelines, mobile Health Apps help search for new formulas that support patient safety by involving them in the care process and making them responsible for their own safety. The achievements obtained in the integration and interoperability of information systems prior to recruitment are considered a fundamental advance in the development of strategies for mobile Health Apps-based solutions.

**Acknowledgements**
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**Conflicts of Interest**
The authors declare no conflicts of interest.
References


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<table>
<thead>
<tr>
<th>#</th>
<th>Recommendation</th>
<th>General/selectable</th>
<th>Notification time</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1_01</td>
<td>Hello! We are going to help you prepare for your operation.</td>
<td>General</td>
<td>7 days after entering the RSD</td>
</tr>
<tr>
<td>R1_02</td>
<td>You will recover better if you have a balanced diet and quit smoking (if you smoke)*.</td>
<td>General</td>
<td>7 days after entering the RSD</td>
</tr>
<tr>
<td>R1_03</td>
<td>On the day of surgery, go to the hospital with your ID so we can perform the surgery.</td>
<td>General</td>
<td>24 hours before surgery</td>
</tr>
<tr>
<td>R1_04</td>
<td>On the day of surgery, you must go to the hospital accompanied by someone else since you cannot leave afterwards without company. Plan the means of transport by which you will return home because you will not be able to drive at that time, and with whom you will spend the first 24 hours, which is the advisable time during which you must be accompanied.</td>
<td>General</td>
<td>24 hours before surgery</td>
</tr>
<tr>
<td>R1_05</td>
<td>On the day of surgery, do not forget to take the medication you usually take at home to the hospital, and, if you use prosthesis (including contact lenses), a container to store them.</td>
<td>General</td>
<td>24 hours before surgery</td>
</tr>
<tr>
<td>R1_06</td>
<td>Leave personal items that are not strictly necessary at home (jewelry, watches...). Do not wear makeup or nail polish.</td>
<td>General</td>
<td>24 hours before surgery</td>
</tr>
<tr>
<td>R1_07</td>
<td>Call the hospital if you have a fever, cough, nasal congestion, earache, chest pain, pain urinating, or unexpected bleeding five days before surgery.</td>
<td>General</td>
<td>6 days before surgery</td>
</tr>
<tr>
<td>R1_08</td>
<td>To avoid infections, it is convenient to attend the hospital with clean skin, so you should shower on the day of surgery before coming to the hospital.</td>
<td>General</td>
<td>24 hours before surgery</td>
</tr>
<tr>
<td>R1_09</td>
<td>On the day of surgery, before showering, trim the hair of the breast to be operated on and the closest armpit, to approximately one millimeter. For this, you can use scissors or an electric razor.</td>
<td>Selectable (male breast surgery)</td>
<td>24 hours before surgery</td>
</tr>
<tr>
<td>R1_10</td>
<td>On the day of surgery, before showering, trim leg hair to approximately one millimeter. For this, you can use scissors or an electric razor.</td>
<td>Selectable (varicose sclerosis in males)</td>
<td>24 hours before surgery</td>
</tr>
<tr>
<td>R1_11</td>
<td>On the day of surgery, before showering, trim abdomen hair to approximately one millimeter. For this, you can use scissors or an electric razor.</td>
<td>Selectable (open supraumbilical eventration in males/umbilical hernias in males)</td>
<td>24 hours before surgery</td>
</tr>
<tr>
<td>R1_12</td>
<td>On the day of surgery, before showering, trim the hair from the anus to the buttocks (included) to approximately one millimeter. For this, you can use scissors or an electric razor.</td>
<td>Selectable (cocygeal cyst)</td>
<td>24 hours before surgery</td>
</tr>
<tr>
<td>R1_13</td>
<td>On the day of surgery, it is important that the underwear you bring to the hospital to use after discharge is elastic and tight.</td>
<td>Selectable (inguinal hernia)</td>
<td>24 hours before surgery</td>
</tr>
<tr>
<td>R1_14</td>
<td>On the day of surgery, it is important that the bra that you take to the hospital to use after discharge is elastic and tight (sports type).</td>
<td>Selectable (breast surgery)</td>
<td>24 hours before surgery</td>
</tr>
<tr>
<td>R1_15</td>
<td>Remember that you can eat. You do not need to fast prior to your surgery.</td>
<td>Selectable (local topical anesthesia)</td>
<td>24 hours before surgery</td>
</tr>
<tr>
<td>R1_16</td>
<td>Remember that it is not advisable to consume dairy products, fried foods, eggs, and fatty foods because they can worsen symptoms.</td>
<td>Selectable (cholecystectomy)</td>
<td>From the time of entering the RSD</td>
</tr>
<tr>
<td>R1_17</td>
<td>For your surgery, it is very important that you do not attend the hospital wearing makeup.</td>
<td>Selectable (ophthalmology)</td>
<td>24 hours before surgery</td>
</tr>
<tr>
<td>R1_18</td>
<td>Do not forget to administer the laxative (250 cc) the night before surgery, as we explained during the consultation.</td>
<td>Selectable (Proctologic surgery)</td>
<td>24 hours before surgery</td>
</tr>
<tr>
<td>R2_01</td>
<td>Go to the anesthesia consultation with the medical reports and a list of the medications you take and dosing schedule (including natural products). If you have any allergies, be sure to report them as well. Write down your doubts to ask them.</td>
<td>General</td>
<td>24 hours before the anesthesia consultation</td>
</tr>
<tr>
<td>Type 3</td>
<td>R3_01</td>
<td>You cannot eat or drink seven hours before surgery. In any case, you can drink a small glass of water until two hours before surgery. You cannot drink water two hours before surgery. If your surgery is scheduled in the afternoon, you can have a light* breakfast before 9:00*.</td>
<td>Selectable</td>
</tr>
<tr>
<td>R3_02</td>
<td>Three days before surgery, stop taking acenocoumarol (Sintrom®) and replace it with heparin if the hematologist or anesthetist have directed you.</td>
<td>Selectable</td>
<td>4 days before surgery</td>
</tr>
<tr>
<td>R3_03</td>
<td>Four days before surgery, stop taking warfarin (Aldocumar®) and replace it with heparin if the hematologist or anesthesiologist have directed you.</td>
<td>Selectable</td>
<td>5 days before surgery</td>
</tr>
<tr>
<td>R3_04</td>
<td>Two days before surgery, stop taking cilostazol (Pletal® or Ekistol®) and replace it with 100 mg of acetylsalicylic acid (Aspirin® 100 mg), as the anesthetist has directed you.</td>
<td>Selectable</td>
<td>3 days before surgery</td>
</tr>
<tr>
<td>R3_05</td>
<td>Seven days before surgery stop taking prasugrel (Efient®, and replace it with 100 mg of acetylsalicylic acid (Aspirin® 100 mg), as the anesthesiologist has directed you.</td>
<td>Selectable</td>
<td>8 days before surgery</td>
</tr>
<tr>
<td>R3_06</td>
<td>Five days before surgery, stop taking ticagrelor (Brilique® or Possia®) and replace it with 100 mg of acetylsalicylic acid (Aspirin® 100 mg), as the anesthetist has directed you.</td>
<td>Selectable</td>
<td>6 days before surgery</td>
</tr>
<tr>
<td>R3_07</td>
<td>Two days before surgery, stop taking apixaban (Eliquis®), as the anesthetist has directed you.</td>
<td>Selectable</td>
<td>3 days before surgery</td>
</tr>
<tr>
<td>R3_08</td>
<td>Fourteen days before surgery, stop taking etanercept, as the anesthetist has directed you.</td>
<td>Selectable</td>
<td>15 days before surgery</td>
</tr>
<tr>
<td>R3_09</td>
<td>Seven days before surgery, stop taking leflunomide, as the anesthesiologist has directed you.</td>
<td>Selectable</td>
<td>8 days before surgery</td>
</tr>
<tr>
<td>R3_10</td>
<td>Six weeks before surgery, stop taking infliximab, golimumab, or certolizumab, as the anesthetist has directed you.</td>
<td>Selectable</td>
<td>7 days before surgery</td>
</tr>
<tr>
<td>R3</td>
<td>Three weeks before surgery, stop taking adalimumab, as the anesthetist has directed you.</td>
<td>Selectable</td>
<td>22 days before surgery</td>
</tr>
<tr>
<td>------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>R3</td>
<td>Four weeks before surgery, you should stop oral contraceptives and use alternative contraceptive methods for up to a week after the operation.</td>
<td>Selectable</td>
<td>29 days before surgery</td>
</tr>
<tr>
<td>R3</td>
<td>Ten days before surgery, stop taking meloxicam or piroxicam and replace them with another analgesic, as the anesthetist has directed you.</td>
<td>Selectable</td>
<td>11 days before surgery</td>
</tr>
<tr>
<td>R3</td>
<td>Two days before surgery, stop taking ibuprofen, naproxen, ketoprofen, or indomethacin and replace it with another analgesic, as the anesthetist has directed you.</td>
<td>Selectable</td>
<td>3 days before surgery</td>
</tr>
<tr>
<td>R3</td>
<td>Seven days before surgery, stop taking the medication of medicinal plants containing garlic, Gingko biloba, Ginseng, St. John's wort, Hypericum, or Ephedra, as the anesthetist has directed you.</td>
<td>Selectable</td>
<td>8 days before surgery</td>
</tr>
<tr>
<td>R3</td>
<td>The night before surgery, stop taking oral medications for high blood sugar (oral antidiabetics), as the anesthetist has directed you.</td>
<td>Selectable</td>
<td>24 before surgery</td>
</tr>
<tr>
<td>R3</td>
<td>The night before surgery, reduce the slow insulin dose by half and do not administer any on the day of surgery, as the anesthetist has directed you.</td>
<td>Selectable</td>
<td>24 before surgery</td>
</tr>
<tr>
<td>R3</td>
<td>On the day of surgery, do not forget to take your usual medication, except for those that we have told you to stop.</td>
<td>Selectable</td>
<td>24 before surgery</td>
</tr>
<tr>
<td>R3</td>
<td>Two days before surgery, stop taking dabigatran (Pradaxa®), as the anesthetist has directed you.</td>
<td>Selectable</td>
<td>3 days before surgery</td>
</tr>
<tr>
<td>R3</td>
<td>Two days before surgery, stop taking rivaroxaban (Xarelto®), as the anesthetist has directed you.</td>
<td>Selectable</td>
<td>3 days before surgery</td>
</tr>
<tr>
<td>R3</td>
<td>Seven days before surgery, stop taking 300 mg of acetylsalicylic acid (Aspirin® 300 mg) and replace it with 100 mg of acetylsalicylic acid (Aspirin® 100 mg), as the anesthetist has directed you.</td>
<td>Selectable</td>
<td>8 days before surgery</td>
</tr>
<tr>
<td>R3</td>
<td>Seven days before surgery, stop taking ticlopidine (Ticlodone® or Tiklid®) and replace it with 100 mg of acetylsalicylic acid (Aspirin® 100 mg), as the anesthetist has directed</td>
<td>Selectable</td>
<td>8 days before surgery</td>
</tr>
<tr>
<td><strong>R3_23</strong></td>
<td>Seven days before surgery, stop taking clopidogrel (Plavix®) and replace it with 100 mg of acetylsalicylic acid (Aspirin® 100 mg), as the anesthetist has directed you.</td>
<td><strong>Selectable</strong></td>
<td>8 days before surgery</td>
</tr>
<tr>
<td><strong>R3_24</strong></td>
<td>The anesthetist has established specific recommendations for your case. Check the anesthesia consultation report and make sure you follow the recommendations.</td>
<td><strong>Selectable</strong></td>
<td>8 days before surgery</td>
</tr>
</tbody>
</table>

a. This recommendation is accompanied by additional information on how to quit smoking ("Know more"); b) This recommendation is accompanied by additional information on what constitutes a light breakfast ("Know more"); ▲: Recommendations that may pose a risk to the patient or in which patient non-compliance may lead to the suspension, cancellation, or rescheduling of surgery.

RSD: Registry of Surgical Demand;
Type 1: Surgical recommendations; Type 2: Anesthesia recommendations; Type 3: Dietary and pharmacological recommendations
Figures

Figure 1. Patient flowchart.

Figure 2. Graphical application environment of Listeo+ V 1.1