Nextcare Action 2 encompasses a portfolio of modular and personalized services aiming at promoting daily physical activity in: (i) citizens at risk and patients with mild disease; (ii) clinically stable chronic patients managed at community level; and, (iii) pre-habilitation program for candidates to high-risk surgery. The latter being currently a mainstream service of Hospital Clinic of Barcelona. Nextcare Action 2 aims are to increase accessibility, cost-effectiveness and sustainability of effects of standard rehabilitation programs.

**Nextcare Action 2** - Promotion of Physical Activity in: (i) citizens at risk and/or patients with mild disease; (ii) chronic patients; and, (iii) candidates to high-risk surgery

Authors: NEXTCARE Action 2 working group
Date: 22/04/2017
1. Purpose

The current document analyzes the Pre-habilitation (PREHAB) intervention in high risk candidates for major surgery at Hospital Clinic de Barcelona as a use case representative of a portfolio of self-management services aiming at promoting daily physical activity in chronic patients and in citizens at risk (Action 2 in the Nextcare project - www.nextcarecat.cat/ris3cat_a2). The report describes the basics of PREHAB, it’s synergies with other ongoing strategies and developments for enhanced management of Complex Chronic Patients (Action 3 in the Nextcare project) and analyzes the three main areas for action in Nextcare:

i. Service workflow definition and execution
ii. Service evaluation; and,
iii. Risk assessment/stratification and service selection

The document also identifies existing gaps for extensive deployment of the service(s), namely: i) accessibility, ii) behavior change; and, iii) financial sustainability; and proposes specific developments to be achieved within Nextcare lifetime.

2. The setting

The positive impact of physical activity (PA) on human health, as well as the high burden of physical inactivity (i.e. fourth cause of mortality) on healthcare systems worldwide, are exceedingly well demonstrated. Moreover, the underlying biological mechanisms explaining the beneficial effects of PA by enhancing efficiency of cellular bioenergetics are known in detail, which provides a strong rationale to foster preventive interventions aiming at reducing the negative impact of physical inactivity on both occurrence and severity of chronic disorders. Moreover, PA enhances health-related quality of life by reducing anxiety and depression often present in chronic patients.

It is of note that standard rehabilitation programs, despite their potential to generate a high healthcare value to cost ratio, fail to achieve large scale implementation because of multifactorial causes, namely: limited patient accessibility, high rate of dropouts, as well as poor economical sustainability. Moreover, training-induced increases in aerobic capacity achieved by rehabilitation programs do not necessarily translate into behavioral changes leading to active life styles. Consequently, effective promotion of active lifestyles is still a highly relevant unmet societal need.

Considering all of the above facts, Action 2 in the Nextcare project, works with the hypothesis that the design of flexible and modular PA services, based on self-management and with proper technological support, can increase accessibility, cost-effectiveness and sustainability of effects of rehabilitation programs, thus facilitating large scale adoption. Both feasibility, usability and user acceptance of the approach\(^1\), and its high potential for large scale adoption\(^2\), has been reported in previous studies.

Therefore, **Action 2 in the Nextcare project targets three layers of candidates proposing different modular PA services in each of them:**


(i) **Citizens at risk** and patients with **mild disease**.
(ii) Community-based program for **clinically stable chronic patients**.
(iii) **Pre-habilitation** program for candidates to high-risk surgery.

Based on the positive results demonstrating efficacy of a recent clinical trial (accepted for publication in Annals of Surgery, April 2017)\(^3\), the pre-habilitation program is currently a mainstream service of Hospital Clinic of Barcelona (>1,000 patients/year) and will be extended to a general program for prevention of surgical complications currently being implemented at Hospital Clinic.

Whereas the current document focuses on the Pre-habilitation (PREHAB) intervention in high risk candidates for major surgery at Hospital Clinic de Barcelona, the other two layers of candidates (i.e., citizens at risk and patients with mild disease; and community-based program for clinically stable chronic patients) are being developed as pilot experiences of the EIT-Health innovation project Sports4Health and will be scaled-up following the PREHAB experience.

### 3. Service workflow

In the context of the perisurgical treatment, being unfit increases the risk of death and complications after major surgery. To this end, a trimodal prehabilitation (supervised endurance training, nutritional counseling and mindfulness) is an intervention performed in the preoperative period aimed to the preoperative optimization of the surgical patient with the objective of reducing perioperative complications, especially in patients with higher risk. The program is also focused on improving the patient’s healthy lifestyles after the immediate postoperative period.

The general structure of the service workflow encompasses five main steps:

1. **Case identification** - It refers to identification of candidates for inclusion into the protocol following pre-defined inclusion/exclusion criteria;
2. **Case evaluation** - Initial holistic characterization of the patient, including health risk assessment, done at entry into the program;
3. **Personalized work plan definition** - Elaboration of a personalized action plan based on case evaluation;
4. **Work plan execution, follow-up and event handling** - Execution of the work plan will be done with technological support to facilitate the protocol follow-up and the handling of unexpected events by: i) fostering patient empowerment for self-management; ii) enhance patient adherence to the protocol; iii) facilitating remote supervision; and, iv) allowing patient monitoring; and,
5. **Discharge** - At the end of the protocol evaluation, the patient can remain in the program or he/she can be moved to other types of integrated care services depending upon his/her needs.

#### 3.1. Eligibility criteria

Patients will be considered eligible when they fulfill two or more of the following inclusion criteria:

- >70 years.
- Scheduled for major surgery: esophagectomy, gastrectomy, colorectal major surgery, Whipple surgery or major pancreatic resection, hepatic resection, or bariatric surgery.
- High risk score (risk levels 3-4) for perioperative complications, as assessed by the American Society of Anesthesiologists (ASA) criteria.

\(^3\) *Anaël Barberan-Garcia A et al. Personalized prehabilitation versus standard care in high risk patients undergoing elective major abdominal surgery: a randomized double-blind controlled trial. Annals of Surgery 2017 (Accepted for publication)*
3.2. Current work plan

The personalized work plan will be adapted to the different scenarios related to the surgical event: before surgery, during hospitalization, and after hospital discharge.

Before surgery

**Case manager:**
- To coordinate the three phases of the program: (i) before surgery, (ii) during hospitalization (including intensive care unit, ward, and home hospitalization), and, (iii) after hospitalization.

**Anesthesiologist:**
- To propose the inclusion of the patient into the program.

**Nurse:**
- Empowerment for self-management, including educational material, and information on interventions.

**Physiotherapist:**
- 3 sessions per week of supervised exercise program combined intervallic aerobic exercise training, upper and lower limbs strength training, and breathing exercises.
- Individual motivational interview session where in the three main pillars of the working plan will be explained and agreed (co-designed) with the patient. The three main pillars are: i) empowerment for self-management and educational content aiming at generating behavioral change; ii) non-supervised sessions to promote physical activity, and, iii) explanations on the clinical intervention.

**Nutritionist:**
- Group sessions on balanced nutrition and protein-enriched diets in low risk patients.
- Individualized sessions and nutritional intervention in patients at risk of malnutrition or overweight.

**Actor - Psychologist:**
- Group sessions for patients and their relatives.

**During hospitalization:**

**Case manager:**
- Transitional care through the intensive care unit (if it was needed), ward, and home hospitalization.

**Anesthesiologist:**
- Follow-up the clinical situation of the patient.
- Intervention related to specific clinical situation.

**Nurse:**
- Empowerment for self-management, including educational material, and information on interventions.

**Physiotherapist:**
- Specific intervention of physiotherapy related to surgery.
- Early mobilization and adaptation of the physical activity intervention depending on environment: the intensive care unit, ward, and home hospitalization.
- Empowerment for self-management for after hospitalization phase.

**After hospitalization:**

**Case manager:**
- Transitional care to HH to community care.

**Anesthesiologist:**
- Follow-up the clinical situation of the patient.
- Intervention related to specific clinical situation.

**Nurse:**
- Empowerment for self-management, including educational material, and information on interventions.

**Physiotherapist:**
- Personalization of the program for promotion of physical activity using ICT:
  - **Home-based activities:** indoor walking and functional exercises (i.e.: sit-to-stand exercise, stairs climbing, elastic bands, etc.).
  - **Community-based activities** (individual or group based-sessions) - Walking either in individual or groups sessions (the first objective will be to add 1000 steps to the daily average. After a week and depending on the daily average steps performed, keep increasing the walking routine until the patient reach 5000 to 6000 steps per day. If the condition of the patient allows it, keep increasing up to 10,000 steps per day).
  - **Wellness center** (individual or group-based sessions) - The selection of the exercise routines and activities will depend on the patient’s preferences and clinical profile (this option will be mainly focused in mild patients with physically healthy lifestyle).

3.3. **ICT-supported work plan**

The personalized work plan will be adapted to the different scenarios related to the surgical event: before surgery, during hospitalization, and after hospital discharge.

**Before surgery**

**Case manager:**
- To coordinate the three phases of the program: (i) before surgery, (ii) during hospitalization (including intensive care unit, ward, and home hospitalization), and, (iii) after hospitalization.
- This will be done with a case management system for healthcare professionals which uses a process engine (e.g., Camunda - https://camunda.org/, RedHat jBPM - http://www.jboss.org/, etc.). This case management system will be integrated into current Electronic Medical Record of the Hospital Clinic (SAP-IPA) and in future phases with Electronic Medical Records of Primary Care Centres (e.g., eCAP).
Anesthesiologist:
- To propose the inclusion of the patient into the program.
- This will be done via the case management system for healthcare professionals. The process will facilitate a checklist of patient inclusion criteria.

Nurse:
- Empowerment for self-management, including educational material, and information on interventions.
- The nurse will explain to the patient that will have access to a patient gateway (e.g., CAT@Salut LMS, self-management application, etc.) wherein will be able to (left-hand side of Figure 1):
  - Check the patient action plan (agenda with medical appointments, self-management tasks, etc.).
  - Access to the patient medical records (i.e., HC3)
  - Access to electronic prescriptions (i.e., Recepta electrónica)
  - Access to educational material
  - Remote consultations (i.e., eConsultes)
  - Remote visits (i.e., videoconference)
  - Remote monitoring (self-administered questionnaires, daily physical activity, pulsoximetry, weight, etc.)

Physiotherapist:
- 3 session per week of supervised exercise program combined intervallic aerobic exercise training, upper and lower limbs strength training, and breathing exercises.
- The Physiotherapist will use the case management system for healthcare professionals to annotate the progress of the sessions and to update the patient action plan: educational material, PA prescription, next appointment, etc.
- Individual motivational interview session where in the three main pillars of the working plan will be explained and agreed (co-designed) with the patient. The three main pillars are: i) empowerment for self-management and educational content aiming at generating behavioral change; ii) non-supervised sessions to promote physical activity, and, iii) explanations on the clinical intervention.

Patient:
- The patient will use the patient gateway (e.g., CAT@Salut LMS, self-management application, etc.) to follow the educational material, to use the agenda to adhere the patient action plan: the daily PA prescription, answer scheduled self-management questionnaires, etc., and to contact the healthcare professionals if needed (e.g., e-Consulta, etc.).

Nutritionist:
- Group sessions on balanced nutrition and protein-enriched diets in low risk patients.
- Individualized sessions and nutritional intervention in patients at risk of malnutrition or overweight.
- The Nutritionist will use the case management system for healthcare professionals to annotate the progress of the sessions and to update the patient action plan: educational material, nutritional plan, next appointment to group/individual sessions, etc.
**Actor - Psychologist:**
- Group sessions for patients and their relatives.
- The Psychologist will use the case management system for healthcare professionals to annotate the progress of the sessions and to update the patient action plan: educational material, next appointment to the group sessions, etc.

**During hospitalization:**

**Case manager:**
- Transitional care through the intensive care unit (if it was needed), ward, and home hospitalization.
- The case manager will use the case management system for healthcare professionals to establish the action plan of the patient for transitional care purposes.

**Anesthesiologist:**
- Follow-up the clinical situation of the patient.
- Intervention related to specific clinical situation.
- The Anesthesiologist will use the case management system for healthcare professionals to annotate the progress of the patient and to update the patient action plan accordingly: pharmacological (HC3 – recepta electronica) and non-pharmacological intervention (educational material, remote monitoring (PA, nutrition, questionnaires, etc.)).

**Nurse:**
- Empowerment for self-management, including educational material, and information on interventions.
- The Nurse will use the case management system for healthcare professionals to follow the progress of the patient.

**Physiotherapist:**
- Specific intervention of physiotherapy related to surgery.
- Early mobilization and adaptation of the physical activity intervention depending on environment: the intensive care unit, ward, and home hospitalization.
- Empowerment for self-management for after hospitalization phase.
- The Physiotherapist will use the case management system for healthcare professionals to annotate the progress of the specific intervention and to update the patient action plan: educational material, PA prescription, next appointment, etc.

**After hospitalization:**

**Case manager:**
- Transitional care to HH to community care.
- The case manager will use the case management system for healthcare professionals to establish the action plan of the patient for transitional care purposes.

**Anesthesiologist:**
- Follow-up the clinical situation of the patient.
- Intervention related to specific clinical situation.
- The Anesthesiologist will use the case management system for healthcare professionals to annotate the progress of the patient and to update the patient action plan.
accordingly: pharmacological (HC3 – recepta electronica) and non-pharmacological intervention (educational material, remote monitoring (PA, nutrition, questionnaires, etc.)).

**Nurse:**
- Empowerment for self-management, including educational material, and information on interventions.
- The Nurse will use the case management system for healthcare professionals to follow the progress of the patient.

**Physiotherapist:**
- Personalization of the program for promotion of physical activity using ICT:
  - **Home-based activities:** indoor walking and functional exercises (i.e.: sit-to-stand exercise, stairs climbing, elastic bands, etc.).
  - **Community-based activities** (individual or group based-sessions) - Walking either in individual or groups sessions (the first objective will be to add 1000 steps to the daily average. After a week and depending on the daily average steps performed, keep increasing the walking routine until the patient reach 5000 to 6000 steps per day. If the condition of the patient allows it, keep increasing up to 10,000 steps per day).
  - **Wellness center** (individual or group-based sessions) - The selection of the exercise routines and activities will depend on the patient’s preferences and clinical profile (this option will be mainly focused in mild patients with physically healthy lifestyle).
- The Physiotherapist will use the case management system for healthcare professionals to annotate the progress of the specific program for promotion of PA and to update the patient action plan: educational material, PA prescription, next appointment, etc.

**Patient:**
- The patient will use the patient gateway (e.g., CAT@Salut LMS, self-management application, etc.) to follow the educational material, to use the agenda to adhere the patient action plan: the daily PA prescription, answer scheduled self-management questionnaires, etc., and to contact the healthcare professionals if needed (e.g., e-Consulta, etc.).

### 3.4. Adaptive case management to support service workflow

Clinical processes, typically elucidated and modelled by physicians and nurses as part of a co-design process, provides a generic recommendation for a particular profile of patients, ultimately aiming to improve the quality of patient care through efficient use of resources and clear responsibilities. Moreover, clinical processes tend to be flexible as treatment processes vary for each individual patient. Flexibility is required by the fact that the clinical process execution depends on the health state of the patient and therefore, needs to be adopted dynamically by medical doctors and nurses. Thus, deviations from planned treatment processes are frequent.

Adoption of adaptive case management to support collaborative work constitutes a novel approach that facilitates case managers to adapt well-structured service workflows to the continuously evolving needs of the patients. This implies selection and scheduling of specific tasks during case management and ad-hoc collaboration with other professionals across healthcare and social...
support tiers, which facilitates collaborative decisions triggered by expected and unexpected events. Therefore, the peri-surgical intervention will be supported by a case management software platform that will allow the execution of well-structured but adaptable clinical workflows. To this end, the clinical workflow of the peri-surgical intervention is conceptualized in **ANNEX I** using the Case Management Model and Notation standard (version 1.1).

The adaptive case management system will be open source and built-up on top of the current health information systems of the different healthcare providers and using existing regional interoperability infrastructures (see **Figure 1**).

In order to support both patient collaborative work and self-management, the personal health folder already deployed in the region is currently being adapted (see **ANNEX II**) for the purposes of the program. The personal health folder (lamevasalut.gencat.cat) and certified self-management mobile applications (appsalut.gencat.cat) will constitute a key ICT support for the execution of the work plan, facilitating: i) access to on-line educational material, ii) data collection (automatic & manual), and, iii) interactions (mostly off-line) with health professionals. Moreover, the personal health folder will contain information that can be pulled to the electronic medical record (EMR) by the health professional.

![Figure 1 – Depiction of main actors and technological support to the peri-surgical intervention.](image)

4. Service evaluation

Both feasibility, usability and user acceptance of the approach⁴, efficacy³, as well as its high potential for large scale adoption⁵, has been assessed in previous studies. The latter⁵ describes the

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protocol for regional implementation of collaborative self-management services to promote PA in Catalonia (7.5M habitants).

Nextcare considers convergent evaluation strategies for both action 2 and 3 (see dossier for Collaborative management of complex chronic patients) with the following main goals: (i) demonstration of cost-effectiveness of the interventions; (ii) identification of factors that modulate success of large scale deployment, (iii) evaluation of key performance indicators useful for long-term follow-up, and, (iv) collection of key information needed for service refinement.

5. Risk assessment/Stratification and service selection

Health risk assessment and stratification have proven highly relevant for large-scale implementation of integrated care services by facilitating services design and case identification. Therefore, NEXTCARE considers, as main objective of Action 1 (www.nextcarecat.cat/rdi-ris3cat), developments and evaluation of risk assessment predictive models to feed novel clinical decision support systems for supporting service selection.

To this end, the conceptual steps required for deployment of health risk assessment and patient stratification strategies into the clinical workstations of healthcare professionals participating in the execution of PA services (Nextcare Action 2), will be based on the steps used to develop and validate enhanced clinical predictive modeling for Collaborative management of complex chronic patients (see dossier of Nextcare Action 3).
6. ANNEX I - Adaptive case management

Pending incorporation of a story board showing the added value of ACM

Case Management Model and Notation depiction of the workflow for the perisurgical intervention:
## 7. ANNEX II – ICT support

**FITXA DE SERVEI DE Cat@Salut La Meva Salut**

| Entitat o empresa que sol·licita homologació: | NEXTCARE |
| Plataforma: Serveis de promoció d’activitat física (Activapp) |

<table>
<thead>
<tr>
<th>SERVEI</th>
<th>Activapp</th>
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</thead>
<tbody>
<tr>
<td><strong>Descripció</strong></td>
<td><strong>Descripció del servei (English)</strong></td>
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<td></td>
<td>- Descripció funcional del servei (inclòent manual d’usuari)</td>
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<td></td>
<td>The service workflow is adapted to the different stages of the surgical event: before surgery, during hospitalization, and after hospital discharge:</td>
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Physiotherapist: Personalization of the program for promotion of physical activity using ICT:

- **Home-based**: indoor walking and functional exercises (i.e.: sit-to-stand exercise, stairs climbing, elastic bands, etc...).
- **Community-based activities** (individual or group based-sessions) - Walking either in individual or groups sessions (the first objective will be to add 1000 steps to the daily average. After a week and depending on the daily average steps performed, keep increasing the walking routine until the patient reach 5000 to 6000 steps per day. If the condition of the patient allows it, keep increasing up to 10,000 steps per day).
- **Wellness center** (individual or group-based sessions) - The selection of the exercise routines and activities will depend on the patient’s preferences and clinical profile (this option will be mainly focused in mild patients with physically healthy lifestyle).

The Activapp Mobile APP will support the execution & follow-up of the personalized work plan; by, i) providing patient access to on-line educational material, ii) patient data collection (automatic & manual), and, iii) patient interactions (mostly off-line) with health professionals. Moreover, the interaction of Activapp with LMS would allow such information to be pulled to the electronic medical record by the health professional.

- **Descripció del procés d’adhesió d’un ciutadà al servei com client/usuari**
  Patients will be considered eligible when they fulfill two or more of the following inclusion criteria: (1) >70 years; (2) Scheduled for major surgery: esophagectomy, gastrectomy, colorectal major surgery, Whipple surgery or major pancreatic resection, hepatic resection, or bariatric surgery; (3) High risk score (risk levels 3-4) for perioperative complications, as assessed by the American Society of Anesthesiologists (ASA) criteria. If considered eligible, the Anesthesiologist proposes the inclusion of the patient into the program.

- **Període de prestació de servei**
  Between four and eight weeks before the date scheduled for surgery.

<table>
<thead>
<tr>
<th>Dades</th>
<th>Tipologia i ubicació de les dades:</th>
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<tbody>
<tr>
<td>Dades que s’utilitzen: Tipus de dades que s’utilitzen (administratives, assistencials,...)</td>
<td>Dades personals i professionals dels usuaris clínics del servei (nom, cognoms, posició, nom d’usuari i contrasenya, idioma, adreça i telèfon de contacte, etc.), dades personals del pacient (nom, cognoms, nom d’usuari, telèfon de contacte, e-mail i contrasenya, etc.) i del cuidador (nom, cognoms, relació amb el pacient, e-mail, telèfon, etc.), dades clíniques dels pacients (CIP, número d’història clínica, data de naixement, edat, sexe, gestor del pacient, metge del pacient, descripció en text lliure del cas, etc.) i dades assistencials dels pacient</td>
</tr>
<tr>
<td>Dades que genera el servei: Tipus de dades que genera (administratives, assistencials,...)</td>
<td>Dades d’adherència del pacient al servei (passes per dia, intensitat de l’activitat física, etc.)</td>
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<td>Les dades que es generen es guarden?</td>
<td>Sí</td>
</tr>
<tr>
<td>Dades que es compartiran amb LMS o que transitaran entre LMS i el servei</td>
<td>Dades d’usuari i contrasenya del pacient per tal que LMS permeti fer single sign-on amb el servei.</td>
</tr>
<tr>
<td>País on s’ubiquen les dades:</td>
<td>País de la Unió Econòmica Europea</td>
</tr>
</tbody>
</table>

**Actors**

- **Usuaris o clients del servei**: Pacients candidats a cirurgia d’alt risc admesos al programa de pre-habilitació de l’hospital clínic.
- **Proveïdors de serveis**: Hospital Clínic
- **Personal que intervé a la prestació del servei**: En cas de professionals sanitaris explicar com s’identifiquen i si deixen traça de les seves accions. Fisioterapeutes, nutricionistes, psicòlegs i anestesistes s’identifiquen mitjançant usuari i contrasenya. El sistema emmagatzema en un log totes les accions que es duen a terme per als diferents usuaris.
- Desenvolupadors de la plataforma: EURECAT
- Dipòsitari de les dades: Qui custodia les dades (incloure identificació i direcció) EURECAT?

### Relació entre actors
- Descriure les relacions entre els diferents actors identificats. Tots els actors treballen de forma col·laborativa en la gestió del pla terapèutic del malalt per tal de que arribi en les millors condicions clíniques a la cirurgia. La anestesista s’encarrega d’identificar i incloure el pacient al servei, així com de gestionar la globalitat del cas amb la resta dels actors. El fisioterapeuta s’encarrega presencialment de la rehabilitació aeròbica del malalt i de forma remota de la promoció i monitorització de l’activitat física que ha de realitzar el malalt fora de l’entorn assistencial. Finalment, el nutricionista dissenya de forma personalitzada la intervenció nutricional i el psicòleg gestiona les sessions presencials de mindfulness.

### Seguretat
- Sistema previst de auditoria de seguretat. Esta previst aplicar les mesures tècniques i organitzatives necessàries per garantir la confidencialitat i la integritat de les dades, dels equips, dels sistemes, dels programes, de les instal·lacions i de les persones que intervinguin en el tractament de les dades de caràcter personal, segons les mesures previstes en el reglament de desenvolupament de la Llei Orgànica de Protecció de Dades de caràcter personal (LOPD) 15/1999, de 13 de Desembre, per a les dades personals de nivell de seguretat alt.
- Tercer que fa la auditoria de seguretat si existeix. GeoTrust Global CA
- Certificats de seguretat del servei. *.cannecare.eu public key

### Canvis al donar el servei des de LMS
Conseqüències previstes que es donaran al prestar el servei des de LMS (El servei haurà de incorporar el logo de LMS en totes les seves pantalles si s’està executant des de Cat@Salut La Meva Salut)

**Afectacions pel:**
- **Servei.** La porta d’entrada al servei serà a través de LMS com a eina oficialment promoguda per CatSalut per a l’empoderament del malalt.
- **Usuaris del servei.** Els usuaris poden utilitzar LMS com a single sign-on, i per tant facilita la seva identificació reutilitzant la de LMS per accedir al servei.

### Observacions
-