

PRoF Award abstract – Call 2018

Deadline for submission: Thursday March 1st 2018 (12 o'clock noon)

Please send to: PRoF-Award@uzgent.be.

Mobile Trauma

1. Research Outline

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| Acronym | |
| Project name in English | Mobile Trauma |
| Pitch (1 sentence) | Patient-controlled follow-up after trauma using mobile health |
| Executive summary (max. 10 lines) | Both after conservative and surgical treatment trauma patients return to the consultation floor for follow-up at fixed time points. However, these do not coincide with clinical recovery milestones whereby time is lost in a patient's recovery process and consultations become useless for both patient and doctor. Using a home based red flag follow-up system, telemedicine can provide a solution. Functional scores and measurable data, using motion sensors, can be combined in a cellphone application. This renders the possibility to develop a patient-controlled follow-up system based on critical clinical recovery milestones with the possibility of patient-doctor interaction. An aberrant healing process can be detected in an early stage and a more personalized revalidation process ensures high value creation for both patient and doctor. |

2. Cause and context of the research

A wide variety of patients visit the department of traumatology: both after conservative and surgical treatment trauma patients revisit the consultation floor at standard defined intervals (6 weeks, 12 weeks, 6 months and 1 year postoperative). Hereby the number of control appointments exceeded 17.000 in 2014. However, this classic way of monitoring trauma patients does not meet the criteria of value based medicine. The time points do not coincide with the clinical recovery milestones such as mobilization, built up weight bearing, anticipated radiographic healing etc. Due to this mismatch time is lost in a patient's recovery process.

In addition to this problem, the majority of these patients are doing well, causing high direct and indirect costs (e.g time and travel distance) that are not in proportion to their problem. In addition to these expenses for the patients, performing consultations at this high rate is also cost-inefficient for the hospital itself. Moreover, the overcrowding of the consultation floor jeopardizes the good health care we wish to provide to our patients due to a lack of time.

Together with the growing habituation of information and communication technologies during the last decade, telemedicine provides a possible solution for these problems. It could allow us to monitor patients from their own home using the concept of a home based follow-up red flag system.

This system is built upon two major pillars:

1. **Subjective measure:** Internationally validated functional questionnaires (DASH, ASES, PRWE,...) are used to get a clear image of a patient's experienced pain and functionality
2. **Objective measure:** Range of motion sensors (external or implant sensors) are used to measure functionality

The combination of both pillars in a cellphone application would make it possible to develop a patient-controlled follow-up system with patient-doctor interaction. Above all, instead of fixed time points in follow-up, this system would be based on **critical clinical recovery milestones:**

- Wound healing
- Mobilization
- Weight bearing
- Radiographic healing

Hereby patients can be monitored on short term. This enables us to detect an aberrant healing process in an early stage and invite these patients as soon as possible for a clinical (and radiographic) checkup.

The expected result is that the number of complications will decrease which will in turn lead to cost savings for both the patients and the hospital. Patient outcomes will improve while costs will drop whereby a higher value creation will be generated.

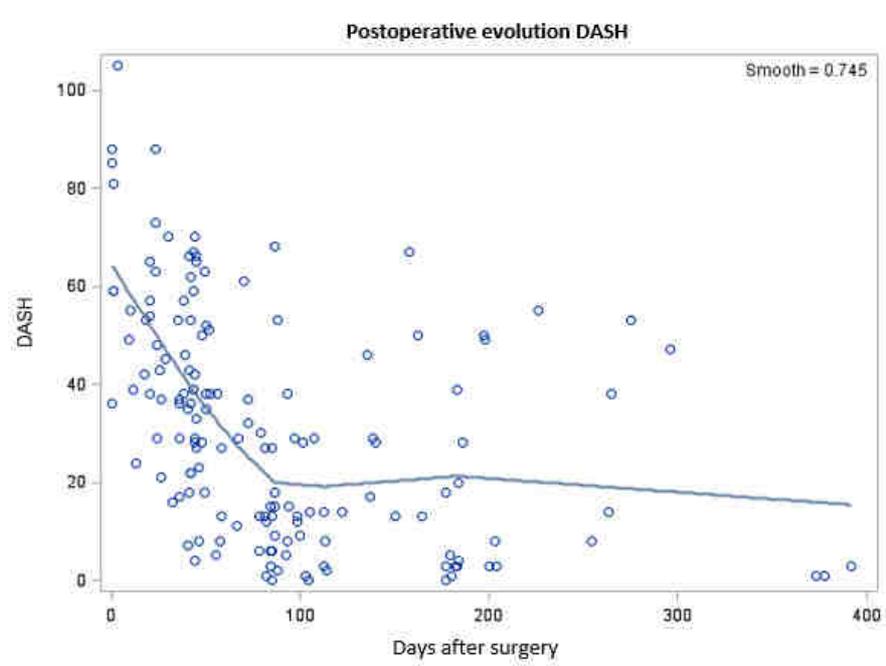
As a result, a personalized revalidation process is created with earlier weight bearing, revalidation and work resumption for patients with above-average results. In addition, a reduction of the number of postoperative consultations for these patients will decrease their medical expenses.

Today an estimated 50% of the consultations are merely a confirmation of a good progression after surgery. This is by definition unnecessary and thus unprofitable. Consultations constitute a high expense for both patient and clinic. The latter was estimated to be € 945.855 in 2014. Consequently the cost per consultation for the hospital is € 55. As a conclusion, the implementation of this project will in second instance also correspond to a cost-saving for the hospital.

3. Innovation results achieved

56 patients with an upper limb trauma have completed sets of functional questionnaires during their entire follow-up using the secure web application *Mynexuz*. Using *Mynexuz*, patients get access to their own medical file with automated appointment reminders and the possibility to view radiographics and validated consultation reports. These patients were asked to complete the questionnaires 4-1 days before the date of their routine appointment.

In this patient group, the plot below demonstrates an expected improvement in DASH score (lower score = higher functionality) over time after surgery ($p < 0.001$).



Today we are collecting these functional scores in the waiting room using tablets (*quest on tab*). These data are automatically stored in the patient's electronic medical file. Further data

registration will increase the power of the more extensive statistical analyses that is planned in the future.

The ultimate goal is to implement the use of *quest on tab* in the standard of care until a phone application is available where these questionnaires can be combined with the use of range of motion sensors. Quest on tab is a simplified alternative to the phone application where a one-off random access code is generated. Hereby access is granted to complete specific questionnaires without further access to the medical file.

Today the mynexuz application is already available for Android users.

In addition, by the means of inertial sensors we would have the opportunity to assess a patient's functional performance and compare it to norm values. Research has already demonstrated that the use of an inertial measurement units (IMU) based system has the required accuracy, consistency, safety and usability to study human motion, for example in rehabilitation programs (CoRehab).

In conclusion we can state that today we are in the initial phase of the project:

- Collection of functional scores in patients with an upper limb trauma
- Preliminary statistical analyses
- The cooperation with the IT department is in the explorative phase in order to generate a link between the sensors (delivered by an external partner) and the in-house electronic patient file. In a primary phase these sensors will be used during consultation, in a second term the use will be extended to a home-setting. The range of motion is measured as a difference from the norm.

4. Link to the PRoF values

Minimal comfort – As previously mentioned patients are faced with high direct and indirect costs associated with the routine follow-up. Implementation of this home-based system renders the possibility to reduce both. Thanks to the growing digitalization patients can be monitored from their home. Possible benefits for the elderly might be that they don't need to transfer to the hospital to acquire adequate follow-up. However, attention should be given to digital training of this patient group.

Privacy – The app writes directly to the patient's medical file. The application is thus no standalone system nor is there cloud based data storage. Only care providers with a therapeutic association can consult the captured data. The necessary ACLs in the patient file software ensures privacy. Lastly, data are encrypted in such way that these cannot be shared by a third party.

Security/safety - The patient receives a QRcode scan via the nexuz health patient portal. The mynexuz application uses this together with a self-chosen username and pincode to set up

the secure communication with the patient's medical file. The key and the username are stored in an encrypted master database on the device. Hereby the app can be used by only entering a pincode. The master database encryption is built via several device characteristics and algorithms that are hard to reverse engineer. Above all, the mynexuz application is always completely obfuscated, analogous to the typical mobile banking apps.

Several apps capture patient parameters that are interpreted by the clinical decision support system together with other patient data. These findings are sent to the relevant specialists through the eHealthBox.

We wish to emphasize that patients will not be excluded from the hospital. The main goal is to reduce the number of **unnecessary** consultations. Patients should be ensured that the quality of care will not be compromised but on the contrary will become more personalized.

Anti-loneliness – This homebased follow-up system provides extended information to the patient in terms of typical red flags where they need to be attentive to, a typical questions and answers section and patient-doctor interaction. Hereby the patient is well informed and will not feel excluded. He/she will feel more secure in their home situation.

Non stigmatizing solutions - Patients with posttraumatic or postoperative wounds, an abnormal walking pattern or other problems, might be ashamed or humiliated while remaining in the waiting room. Among others, home based wound control is achieved thanks to the application. Patients don't need to be physically present in the hospital anymore to acquire adequate care.

Intergenerational - Patients are increasingly stimulated to become more digitalized. Younger generations can educate and help the elderly which benefits the intergenerational relationship.

Flexibility - One of the most important goals we wish to achieve with this project is a follow-up based on critical clinical recovery milestones. This implies a more flexible follow-up system where patients should have the opportunity to revisit a specialist when they personally experience it to be crucial.

Secondly, in general it is our goal to reduce the length-of stay department-wide with the implementation of several clinical pathways to make sure our healthcare becomes as sufficient as possible.

5. Applicable IPR rules

Inapplicable.

6. Information on the partners

CoRehab is a company that uses a separate software and sensors to measure the range of motion. The system is already clinically validated and used by professionals around the world.



The biofeedback training program assists a patient's revalidation to improve neuromuscular control and motor skills. Altogether this leads to a shorter recovery time.

The results are sent to the server of this company but need to be integrated in the electronic patient file we use in the hospital of UZ Leuven. The integration is still under construction.



Addendum: Contact information

Head of department traumatology UZ Leuven:

Prof. Dr. Stefaan Nijs

Stefaan.nijs@uzleuven.be

Direct contact:

Clinical support manager Traumatology

Jorien Ilians

Jorien.ilians@uzleuven.be

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