

PATIENT EMPOWERMENT FOR EFFECTIVE AND RESILIENT HOME CARE TREATMENT

1 Key words

Data analytic, Patient centric treatment, multi stakeholders' intervention repositories, treatment efficiency design, adherence resilience.

2 Context

The support of home care patient with personalized interventions was initiated by Linde Home Care France since more than 5 years through projects with several scientific and technical contributions. For the specific Obstructive Sleep Apnea therapy, the developed concepts cover patient adherence prediction, patient's care pathways, patient profiling, therapy monitoring, interventions dosing, patient's feedback, multi-stakeholders' verification and validations, etc. These concepts were implemented in two mobile applications and tested with 6 patients. Three research papers have been developed under a previous CIFRE project (2018/1575) and published to valorize these contributions:

- <https://doi.org/10.1016/j.ijmedinf.2022.104935>
- <https://doi.org/10.1109/EMBC46164.2021.9629905>
- <https://doi.org/10.1109/CBMS49503.2020.00082>
- <https://doi.org/10.1109/SKIMA47702.2019.8982421>

Therefore, this proposed research is in continuity of the previous CIFRE project to provide personalized intervention for patients at home but also provide customized services to the prescribers and Linde's homecare technicians for an adaptative patient management [1]. This project represents a significant challenge as we need to develop an automated solution to be deployed on a large-scale inclusion (50 000 patients). There is a need to assess the impact of this large-scale deployment on the different data analytic models and repositories.

2.1 Company presentation

The Linde Group is a world leading supplier of industrial, process and specialty gases. Linde is one of the most profitable engineering companies proposing products and services in nearly every industry in more than 100 countries. A success story that began with the separation of air.

Linde Homecare France, a subsidiary company for homecare business, is specialized in patients' following-up with different chronic pathologies (respiratory, infusion, nutritional, etc.). In a permanent purpose of well-being and respect of treatments compliance, the company is totally engaged in a e-health strategy supported by connected devices and a new clinical approach for patients.

2.2 Research lab presentation

1. The DISP Lab (Decision & Information Systems for Production systems, UR4570), gathers researchers from the "Université de Lyon" around a double expertise in Industrial Engineering and Enterprise Information Systems.

The DISP lab brings to this project specific competences in:

- IoT and IoS
- Data analytics
- Service lifecycle management with dedicated efforts in service design, development, implementation, deployment, and performance assessment (quantitative and qualitative)
- Business process modeling and optimization
- Risk and total quality management Software engineering

3 Research objectives and expected results

The proposed research project targets the following objectives:

Research Objectives	Associated results	Associated research issues
Validate test protocol		
Assess the outcomes of the testing phase with 6 patients (running now)	The impacts of these new monitoring data on the existing analytic models	How to assess data analytic model resilience while ingesting new data collection? [4]
Model for continuous and resilient adherence	The robustness of model under different scenarios	What kind of interactions should be proposed in the model?
Perform a clinical trial on a large cohort of patients (at least 70 patients).	Writing and implementation of a clinical test protocol validated by a prescriber expert.	The impact and efficiency of the patient-centric data model on the patient’s adherence level
Dynamic design (profile-oriented) of patient’s, technicians’, physicians’, feedback questionnaires	Models automatically adapted according to the patient’s feedbacks	How to select and propagate the feedback in the different analytic models? [2]
Identify new patient’s feedback collection channels (detect anxiety, uncomfortable feeling, etc.) and measure of treatment quality	New patient feedback channels to be included in the current patient management processes	What are the relevant feedbacks channels for the homecare in a patient-centric approach and patient’s behavior changed?
Define interventions’ repositories for patient empowerment for 3 stakeholders (patient, Linde technicians and managers, and prescribers)	2 new intervention repositories design for Linde’s technicians and manager, prescribers	What are the interventions specific to each homecare stakeholder for high quality care delivery? [3]
Consistency of feedbacks	An analytic model that automatically analyzes the feedbacks from different feedback channels	How to automatize the feedback analysis based on expert experience?

4 Socio-economic interest

In the local regulation, compliance is the first challenge to empower the patient with his treatment and a basis for the refund of receivers. The job environment is moving from an obligation of means to results requirements. Therefore, the main targeted socio-economic interests are:

- Detect nighttime and daytime symptoms: High blood pressure, Irregular heartbeat, heart disease/heart attack, Stroke, etc.
- Improve patient well-being.
- Reduce treatment cost.
- Improve the efficiency of the ecosystem: the treatment prescriber, the patient as treatment receiver and Linde as the treatment operator.

5 Research methodology

To support the development of this research project, we identify from the literature three research topics to investigate and develop in an integrated methodology:

1. Design of feedback channels and interaction modes
2. Feedback analysis based on patient profiling.
3. Model checking and validation over clinical trial.

6 Project Environment

To support the development of the proposed research project, both partners involve the support of the following resources. Linde Homecare France will supply Electronic Health Record (EHR) and the Patient Health Record (PHR) for this research project. These records contain all the compulsory information needed for the patient modelling and also include unexplored data like the technicians' feedback.

6.1 Linde Homecare France Company

- Olivier Grasset: Scheduling with competences in operational process development and assessment.
- Alain Chatelet: Clinical center manager with competences in home care giving and remote health data collection.
- Jerome Lasselin: Digitalisation manager with competences in business process and software development.

6.2 DISP Lab

- Néjib Moalla: Professor in computer science with competences in data analytics and software engineering.
- Tao Wang, Associate Professor in computer science with competences on patient profiling in the health care domain
- Aicha Sekhari Seklouli: Associate Professor in computer science with competences on process modeling, service lifecycle management, risk management and total quality management.

The PhD student will integrate the Linde Homecare France as IT researcher for 36 months in CIFRE contract <https://www.anrt.asso.fr/fr/le-dispositif-cifre-7844> (the salary will be fixed according to the HR rules). The research project will be developed within the Linde Homecare France - Clinical Coordination team (60%) at Bourg-En-Bresse and the DISP research Lab (40%) at University Lumière Lyon 2 –Bron.

7 Required qualification

- A master or engineering degree in one these fields: computer science, data science or applied mathematics
- French B2 level
- English B1 level
- Experience in SQL
- Experience in Python and R is a plus

8 Application

For application in this PhD position, applicants are invited to communicate:

- An updated CV
- A motivation letter with explicit interest in this research project

- The last academic transcripts
- The last produced report
- At least two recommendation letters

For applications and further request of information, please contact: Nejib.Moalla@univ-lyon2.fr,
aicha.Sekhari@univ-lyon2.fr, tao.wang@univ-st-etienne.fr

Olivier.Grasset@linde.com and alain.chatelet@linde.com, Jerome.lasselin@linde.com

Position open on: [01/03/2023](#)

Application open till: [30/06/2023](#)

9 Bibliography

- [1] L. M. Donovan, A. Shah, C. L. Chai-Coetzer, F. Barbe, N. T. Ayas, and V. K. Kapur, "Redesigning Care for OSA," *Chest*, vol. 157, no. 4, pp. 966-976, Apr 2020, doi: 10.1016/j.chest.2019.10.002.
- [2] J. S. Joymangul, A. Sekhari, A. Chatelet, N. Moalla, and O. Grasset, "Obstructive Sleep Apnea compliance: verifications and validations of personalized interventions for PAP therapy," in *2021 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)*, 1-5 Nov. 2021 2021, pp. 2367-2373, doi: 10.1109/EMBC46164.2021.9629905.
- [3] E. Franzosa, E. K. Tsui, and S. Baron, "Home Health Aides' Perceptions of Quality Care: Goals, Challenges, and Implications for a Rapidly Changing Industry," *New Solut*, vol. 27, no. 4, pp. 629-647, Feb 2018, doi: 10.1177/1048291117740818.
- [4] J. L. Pepin, S. Bailly, and R. Tamisier, "Big Data in sleep apnoea: Opportunities and challenges," (in English), *Respirology*, Review vol. 25, no. 5, pp. 486-494, May 2020, doi: 10.1111/resp.13669.