



Which place for Artificial Intelligence in the concept of “the nursing home of the future”? Intel@Care project in the region of Nouvelle Aquitaine in France¹

Quelle place pour l'Intelligence Artificielle dans les EHPAD du futur ? Expérimentation Intel@Care en territoire Nouvelle Aquitaine

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Abstract: While the needs of dependent seniors needs are important in Nursing Home (NH), the medical resources are low in residences located in a medical desert. Access to care in these NH is very unequal and can result in a loss of chance for residents who are immediately transferred to emergency with a risk of iatrogeny or inappropriate hospitalization. *Objective:* We aim to find new models of care organization to optimize management of elderly in NH thanks to new technologies Artificial Intelligence (AI) associated to telemedicine. *Method:* Intel@Care is a 3 steps program planned over 5 years : 1- faisability study : Intel@Med-Faisa (2019-2020); 2- proof of concept : Intel@Med-POC with socio-environmental study (2020-2022); 3- efficiency study with medico-economic assessment Intel@Med-Efficiency (2022-2024). *Results:* Intel@Med-Faisa : 18 residents were included in 2 NHs; 20 additional diagnoses were created to adapt the Artificial Intelligence algorithm to the clinical characteristics of the elderly. Intel@Med-POC: (study in progress): 306 residents to be included to validate development of evidence-based decision tool to

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help physician to make decisions to manage healthcare interventions, verify the acceptability of the new care organization. A medico-economic study is also conducted. *Perspectives* : This program aims to secure the use of this tool by professionals and to identify the obstacles and levers about use, perception and find an economic model for the deployment on the territory. In parallel, a clinical research will be conducted in order to adapt this organization to elderly people living at home in medical desert areas.

Keywords: Artificial Intelligence, older people, telecare, healthcare circuit, silver economy, medical desert

Résumé : Le vieillissement de la population s'accompagne de la problématique des pathologies chroniques et de la dépendance parfois lourde, imposant une admission en Etablissement d'Hébergement pour Personnes Âgées Dépendantes (EHPAD). En raison d'une démographie médicale hétérogène, l'accès aux soins dans ces établissements est très inégalitaire au niveau national et surtout en Limousin et en Dordogne. L'arrivée de l'Intelligence Artificielle (IA) peut être une vraie opportunité pour trouver de nouveaux modèles d'organisation de soins pouvant pallier à la désertification médicale. *Méthodologie* : Nous avons construit un projet de validation en trois étapes. 1- La faisabilité (2019-2020) : réalisée localement dans deux EHPAD ; 2- La preuve de concept (2020-2022): réalisée dans 7 EHPAD localisés dans des déserts médicaux de la Nouvelle Aquitaine avec une étude socio-environnementale adossée; 3- L'efficacité avec une approche médico-économique et le déploiement (2022-2024) : projet qui sera mené sur le territoire européen. *Résultats* : Intel@Med-Faisa : 18 résidents inclus, création de 20 diagnostics supplémentaires pour adapter l'algorithme d'IA aux caractéristiques cliniques des personnes âgées. Intel@Med-POC : Etude en cours, 306 résidents à inclure pour valider l'outil d'aide à la décision et vérifier l'acceptabilité de la nouvelle organisation de soins. *Retombées* : Le projet Intel@Care est une expérimentation utilisant l'IA, pour répondre à la problématique d'accès aux soins des personnes âgées vivant en zone de désertification médicale sur le territoire en impliquant tous les acteurs du secteur médico-social. Le programme Intel@Care inclus également une expérimentation auprès des personnes âgées vivant à domicile dans les déserts médicaux afin d'adapter une organisation spécifique.

Mots clés : Intelligence Artificielle, parcours de soins, personnes âgées, télésanté, silver économie, désert médical

Introduction

The 2018 French population census counted 67.187 million persons including 19.6% aged 65 and older. Until 2040, the proportion of people aged 65 and over will strongly increase : about one in four people will be aged 65 or over (I.N.S.E.E, 2018). Today, almost 600 000 elderly people are living in nursing homes (NH). According to DRESS projections, 108 000 additional elderly people should live in nursing homes (NH) by 2030 and 211 000 more between 2030 and 2050 (D.R.E.S.S., 2020).

The increase in life expectancy implies an increase in the prevalence of chronic diseases. In France in 2016, from the age of 65 to 84, the simultaneous presence of at least 2 chronic diseases is 12.71% whereas it is 20.33% for people over 85 years (Assurance-Maladie, 2018). In addition to the risks associated with polypathology, there are also those associated with polypharmacy : 30% to 40% of people aged 75 or more take at least 10 different medications per day (Le Cossec, 2015).

Older patients have higher rate of hospitalization : 1/3 of those hospitalized in France in 2018 involved older adults more than 65 years old (including 12% who were 80 years or older) (A.T.I.H., 2018). Hospitalization for vulnerable population is harmful. It is associated with iatrogenic disorders and often results in physical and cognitive declines, frailty that requires more resources (excess health costs) (Helvik, 2013 ; Zisberg, 2015). In some geographic areas, the low density of general practitioners creates inequities in access to primary care, particularly for older adults. According to DREES study (February 2020), geographic accessibility to general practitioners decreased by 3.3% between 2015 and 2018 due to a growing mismatch between supply and demand for care. As a result, older adults may be admitted to the emergency department when this could have been avoided if patients had timely access to primary care (Ansari, 2006).

Incidence of loss of independence related to hospitalization for senior aged 70 years and over is of 30 to 60% (Covinsky, 2011 ; Gill, 2010) and could be available 80% of cases (Sourdet, 2015). Taking care of the elderly who are losing their functional autonomy will be a major challenge in the upcoming years, both for public health authorities and for clinical communities health professionals. The “*Région Nouvelle Aquitaine*” will not be spared by this progression.

New technologies may be a real opportunity to implement new models of care organization for the elderly. Firstly, telemedicine has become a tool for medical care. It is now integrated into healthcare systems. Its effectiveness has been demonstrated in the monitoring of chronic diseases: obesity (Batsis, 2017), cardiovascular diseases (Krishnaswami, 2020) and renal pathologies, cancer monitoring, etc... It also helps to reduce the number of hospitalizations (Grabowski, 2014) due to decompensation of these pathologies through preventive care.

Secondly, Artificial Intelligence (AI) is a very promising technology. Numerous algorithms have been developed for the follow-up of chronic pathologies such as diabetes, cancer follow-up, hospital discharge, etc.

Intel@Care's goal is to combine AI with TML to enable remote health management for seniors. To achieve it, we develop a clinical research pipeline named Intel@Care to implement a new organization of care for the elderly based on telemedicine and a medical decision support tool (AI) in areas with low medical density.

This project is open to all elderly people living at home or in nursing home. However, initially, we plan to study nursing home residents because this population is particularly vulnerable because of dependence, neuro-cognitive disorders, polypathologies and polymedication, and frequently hospitalized. Secondly, it

seemed easier to propose this organization in nursing home because of the presence of health professionals. A research pipeline was designed to move forward step by step in order to secure future deployment in this area :

1. Faisability study: Intel@Med-Faisa
2. Proof of concept study: Intel@Med-POC
3. Efficiency study: Intel@Med-Efficiency

I- Methods

Digital technologies workpackage (Telemedicine and AI):

Telemedicine solution: telemedicine, defined as synchronous or asynchronous consultation using technology to deliver care at a distance (Parker, 2018) has become a lifeline for older adults to maintain access to essential primary health care and social services as well as chronic disease management (Gray, 2020). Following a call for projects launched by the Regional Health Agency (ARS) in 2018 to support the deployment of the TLM, all Nouvelle Aquitaine's Nursing Homes are equipped. The solution chosen is the one common to the nursing homes selected in the Creuse, Corrèze and Dordogne territories. The tool is a communicating e-health platform. It combines a shared medical file with a liaison book to integrate the person in his or her care pathway and associate all the actors (health professionals, social workers and family). In addition, it has developed a telemedicine module from which it is possible to carry out a teleconsultation from a computer, a tablet or a smartphone while having access to the patient's file. The doctor can write and save a report to which only authorized professionals will have access.

AI solution: The medical decision support chosen is an artificial intelligence system validated in the general population with an accuracy rate of over 85%. It has been developed through 4 modules, encompassing Emergency medicine, General medicine, Prevention and Well-being.

AI is created on an encyclopedia containing 5300 detailed articles explaining symptoms, diseases, further examinations and treatments. It is currently used for triage in hospitals and as well as for prevention within the insurance sector.

The algorithm is able to evaluate the characteristics and severity of clinical symptoms according to the clinical classification of emergencies (CCMU) (Fourestié, 1994). This classification is used in French emergency departments and includes 5 stages of increasing severity: level 1: No immediate severity; level 2: Spontaneous regression, level 3: Regression after symptomatic treatment; level 4 : Hospitalization > 24 h without vital risk and level 5 : Vital risk or death.

Then, the algorithm is able to make diagnosis proposals.

Innovative care organization workpackage:

Intel@Care offers a new way of organizing health care. Whenever a resident has a medical event that requires an AI, the nurse completes the AI assessment and sends the report to the remote physician. For the experiment, the remote physician is a geriatrician to lock in the AI algorithm specifically for the elderly. But at the end of the experiment, the remote physician will be the resident's own general practitioner.

The proposed new organization consists in managing the health of the residents thanks to the nurses who are the sentinels to detect health problems and transmit

the necessary elements to the remote general practitioner. Thanks to the AI report, he can assess the seriousness of the health event. Thus, from his office or from the place where he is (if he is consulting at home), he can either ask the transfer of the resident directly to the emergency service; or thanks to the TLM device, ask the nurse to transmit additional information (heartbeat recording, electrocardiogram tracing, pictures...) and order the appropriate medication or ask for a consultation with a specialist; or finally, indicate that he will carry out a face-to-face consultation within 24 to 48 hours.

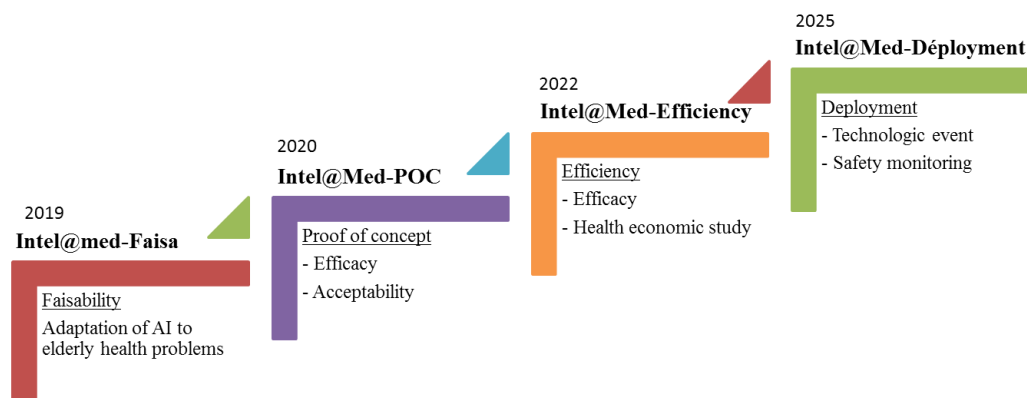
Study design workpackage

Intel@Care research project is performed into 3 different trials according to European clinical research regulations.

Intel@Med-Faisa study is a non-interventional research protocol. MEDVIR was developed by an emergency physician to address the problem of triage of patients (from baby to elderly) admitted to the emergency department. The main goal is to improve AI software algorithms so that they are specifically adapted to the health problems of the elderly. The secondary objectives are to evaluate the severity diagnosis proposed by the AI solution compared to the medical diagnosis performed remotely by the geriatrician and to analyze the perception and appreciation of the AI tool by the users. It is conducted into 2 nursing homes located just near CHU of Limoges. Any residents presenting a health problem that requires the call of his/her attending physician were included prospectively from December 2019 to June 2020. 18 residents were included; 20 additional diagnoses created to adapt the AI algorithm to the clinical characteristics of the elderly and severity classification has been adapted to the geriatrics hospitalization criteria in geriatric department. Publication of the study results is in press.

Intel@Med-POC (Acceptability Assessment of an "Organization of Care Integrating Artificial Intelligence and a Solution of Telemedicine" on Care of the Nursing Home Residents Located in a Medical Desert) is a protocol for interventional research involving the human being (category 2). The ongoing study is a single arm pilot study of feasibility, prospective and multi-centered. 308 residents from the seven nursing homes selected in medical desert location in Nouvelle-Aquitaine Region presenting a health problem that requires the call of his/her attending physician were included from March 2021 to September 2022. The main objective is to measure the accuracy of the IA diagnosis by calculating the sensitivity and specificity of diagnostic for acute disease and emergency for both distant medical doctor and usual care recommendations. At the same time, a socio-environmental study will be conducted as a mixed qualitative/quantitative methodology including observations for professionals, focus groups, semi-structured interviews with nursing home residents and professionals.

Figure 1: AI pipeline research from 2019 to 2025



Source: made by the authors

Intel@Med-Efficiency study will be a protocol for interventional research involving the human being (category 1). It will be a randomized trial of AI-TLM versus usual care for a high level of evidence. A health economic study will be performed to collect health care costing (hospitalization, and resident's quality of life). The protocol is not yet written but will be conducted in European countries in 2023.

II- Discussion

The Intel@Care pipeline research project will give the opportunity to primary practitioner to manage his/her territory. Before imaging the deployment on the territory, it is necessary to secure this new health organization on the validation of the diagnostic relevance of AI, the use of this tool by professionals, identifying the challenges (use; perception; legal, ethical and financial aspects). Each step must be secured before proceeding to the next step.

Intel@Med-Faisa allowed us to verify the feasibility of setting up such an organization in a nursing home. Intel@Med-POC will provide proof the reliability of the diagnosis of this organization as well as the tools for the appropriation of technologies by professionals. Intel@Med-Efficiency will provide a high level of proof of the effectiveness of this organization and will also conclude on the best economic model to remunerate the different actors (French public health system).

This new organization relies on the nurse who is becoming more competent thanks to the AI and allows the general practitioner to come over the nursing home only when necessary. He can manage his own patients more efficiently over a vast territory because thanks to the nursing home professionals add to new technologies. He will prioritize his interventions and refocus on his private practice outside the nursing home.

Intel@Care study could be an answer to the disruption of the care pathway for seniors living in nursing homes or at home in a low medical density area. Future nursing homes could be local referral centers for senior care.

We plan to deploy this new care organization to the elderly in their homes. In this context, the organization will rely on local care professionals: nurses, pharmacists, ambulance drivers.

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