



# Towards an Automated Management of Well-Being Goals in Nursing Homes

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**Abstract.** Nursing home culture change movement advocates for care that is less hospital-like, and more patient-centered. Despite being a step towards the good direction in providing a proper service for elderly people, considering their well-being is not easy due to a number of factors as: specific treatments with a high price; the number of involved stakeholders (e.g. patient, doctors, relatives, nursing home clerks, funding organisations, etc); or the difficulties to gather an accurate measure for the patients well-being. In current position paper we devise some potential challenges that arise in this context and we provide our insights on potential techniques to solve them by means of a framework to automate the management of well-being goals in nursing homes.

**Keywords:** Well-being · Nursing-homes · IoT · Analysis

## 1 Introduction

The Nursing Home (NH) culture change movement is a grassroots effort that began around the turn of the century and advocates for care that is less-institutional, less hospital-like, and more patient-centered [1]. Despite the efforts and the best intentions, focusing the well-being of NH residents and their families remains a challenge for many reasons, including the need for coordinating a large number of people with different formal and informal roles (e.g. patient, doctors, relatives, NH clerks, etc), the lack of staff and resources in most NHs, the difficult medical conditions of the residents and the high costs involved in their care.

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As an example, the monthly increase in price for residents with Alzheimer or other types of dementia ranges in the US from \$3,165 (in Idaho) to \$5,800 (in Maine) [2]. Such costs cover the many additional care activities such as: memory care at nights (e.g. calming down when they are affected by the sleep dysrhythmia), sensory stimulation (e.g. watching or listening to preferred films or songs, respectively), as well as any other evening activities helping to reduce the sleep problems like walking outdoor through green areas.

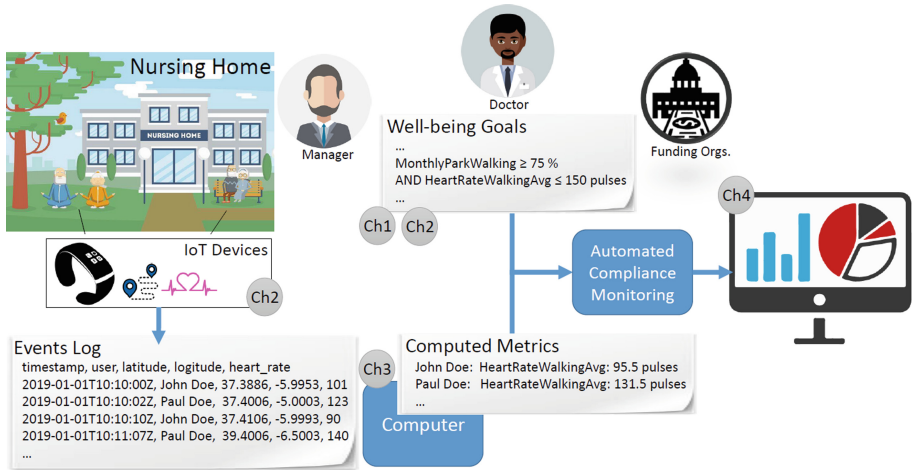
In such a scenario, NHs face many challenges in managing and ensuring the well-being of elder patients: (i) how to establish the proper services considering the different actors and their responsibilities? (Ch1); (ii) how to keep costs to a level that is sustainable for institutions and families? (Ch2); (iii) how to measure the residents well-being accurately and ensure that the data collected are accurate? (Ch3); and how to control the evolution of patients well-being? (Ch4). In order to face these challenges, in this position paper we propose the notion of Well-being Goals (WG) that are established by involved participants (nursing homes, patients, doctors and relatives) as first-class citizen that would formally state the explicit actions and metrics for a given patients in order to ensure its medical and well-being needs.

As potential benefit, WG would represent an appropriate framework to have a tailored set of services depending on each patient: for example, if a patient does not require assistance during meals then they may be entitled to a discounted rate. In addition, governmental or private organizations may establish specific goals within the WG in order to provide funds.

From an operational point of view, the price of specialized services affecting the patient well-being is typically high since they involve special care and monitoring (e.g. nurses have to manually perform several actions [4] as: record when a patient has a sleep dysrhythmia; control the heart rate meanwhile an exercise is taking place; or the participation in a social event). However, nowadays there is a plethora of Internet of Things (IoT) devices that may help measuring the elderly medical well-being meanwhile mentioned services take place and many techniques have been proposed [3]. For instance, bracelets tracing geolocalization and hearth rate, glucometers to measure if a proper diet is being applied that is specially interesting for diabetes patients, etc. These connected IoT devices would generate automated events log avoiding manual measures of nurses and therefore reducing the price of these services and thus facing aforementioned second and third challenges (e.g. assuming an average salary of €34k<sup>1</sup> and a reduction of 0.5 h/day; the cost would be reduced in more than €2k/year per worker). Furthermore, having these events logs available the fourth challenge would be faced by both: an automated checking of WG compliance, and developing dashboard with the WG compliance status that would be very appealing for nursing home managers (e.g. to control staff duties), doctors (e.g. to change current treatment when appropriate) and even it may ease sending monthly reports to relatives (e.g. to inform on the patient well-being).

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<sup>1</sup> [https://www.payscale.com/research/IE/Industry=Nursing\\_Home/Salary](https://www.payscale.com/research/IE/Industry=Nursing_Home/Salary).



**Fig. 1.** Outline of our approach to face the challenges

Following our expertise in the automated management of Service Level Agreements (SLA) [5–7], including monitoring, compliance analysis and enforcement, our hypothesis is that WG-IoT-based gerontechnology may not only help assess the evolution of a patient by doctors and nursing home staff, but also to make specialized services cheaper, and possibly even facilitate the involvement of the residents’ family in the care process if they are willing and able to do so.

The paper is structured as follows, Sect. 2 exposes how we propose to measure and compute the required information to monitor the patients welfare (c.f. Sect. 2.1); and how we propose to monitor and show the services compliance (c.f. Sect. 2.2). Finally, we outline the conclusions in Sect. 3.

## 2 A Framework to Automate Well-Being Goals Management

Current section exposes the elements depicted in Fig. 1 proposed to face in further research the aforementioned fourth challenges. Thus, In Sect. 2.1 we face challenges Ch1, Ch2 and Ch3, and Sect. 2.2 faces challenge Ch4.

### 2.1 Well-Being Goals

Our vision of WG goes beyond a simple list of well-being goals for the patients. WG must refer to specific services with three main features facing Ch1 and Ch2: (i) they are specially interesting and important for the patients well-being, from the perspective of their doctors and relatives; (ii) they can be automatically measured with connected IoT devices, and (iii) They must include responsibilities of the involved participants.

A WG could include as one goal the goal included in Fig. 1: “*MonthlyParkWalking*  $\geq 75$  % AND *HeartRateWalkingAvg*  $\leq 150$  pulses” that is defined on both: the percentage of park walkings performed at a month; and the monthly hearth rate average in park walkings. Note that these metrics are related to the health-care aspect of the patients well-being, because it is not easy to find existing IoT devices retrieving information in other aspects of the patients well-being as mood or depression. Nevertheless, there are methods such as “Beck Depression Inventory (BDI)” [10] in which it is indicated how to measure these other aspects of the well-being. Although as far as we know such a method cannot be directly applied with IoT devices, a first step can be the parametrization of mood and depression through smartphones or any other applicable IoT device.

In addition, the multiparty responsibility should be established and this could be solve by using Responsible-Accountable-Support-Consulted-Informed (RASCI) matrix in a similar solution as provided in business processes [8].

Technology can help reduce the cost of monitoring health and well-being indicators, which in turn can help reduce costs (Challenge Ch2). For instance, as Fig. 1 shows, a variety of sensors can collect information about location, heart-rate, blood pressure and more, and relay this information without the NH staff having to enter such information manually. This is a huge advantage for NH staff, both because it saves precious time but also because it prevents errors and omissions - provided of course that sensors are accurate and properly used. Note that we propose reducing at most interactions between elders and IoT devices being the staff member who perform required actions at the end of the day, namely: (1) set them up as required, or (2) charge the batteries, between others. The challenging part here is in identifying those sensors that are easy to maintain and operate, otherwise they became a headache instead of a resource.

Once sensor measures are available, then it also becomes easy to transform data (e.g. filtered by patient and gathering a mean value for computed metrics in Fig. 1) into adherence to goals (Challenge Ch3).

Additionally, in further research we will explore how to ensure the unalterability of the data involved in the NH services that is inputted in the NH information systems by different actors such as doctors or nurses. We devise the potential application of blockchain and smart contracts technologies as performed by Dumas et al. for BPMS in [9]. However, it is an open research question how the smart contracts could include the RASCI matrix and well-being goals.

## 2.2 Well-Being Goals Tooling

Once metrics are computed from the events log, we propose the usage of automated techniques developed in the context of SLAs for iAgree [7] in order to monitor the WG compliance. That compliance provides information regarding the fulfillment of nursing homes with the goals on the welfare services they provide for an specific patient.

In such a context, based on the operational framework of WG Analysis an appropriate tooling can be developed to assist the different stakeholders (Challenge Ch4). As depicted in the mockups of Fig. 2 we can see three different

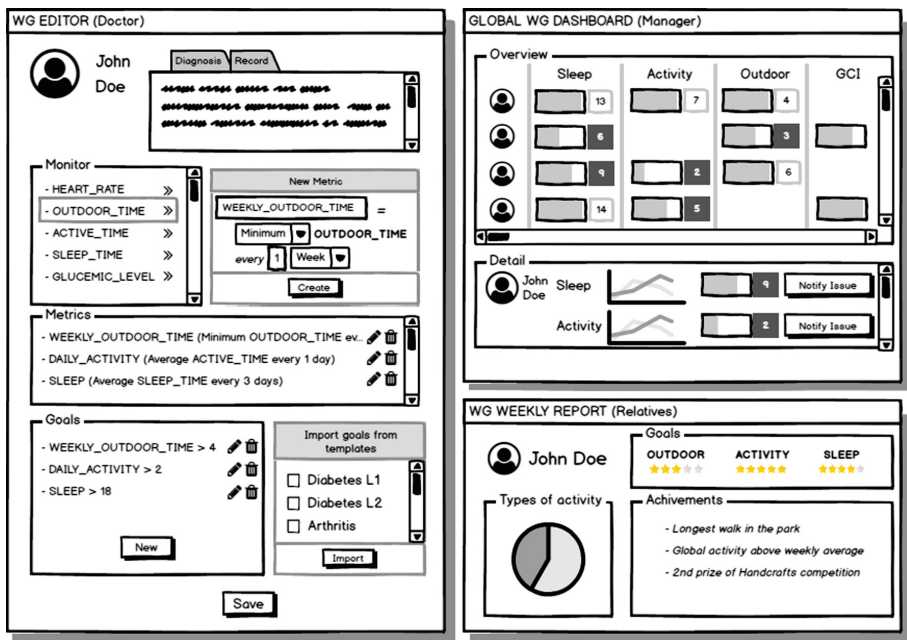


Fig. 2. Mock-up of supporting tooling

views: the doctors would edit the appropriate WG for a given patient (left view at the figure) specifying their tailored metrics and goals or import some standard templates for different conditions; the nursing home manager (top-right view at the figure) could control the different goals of the patients and report problematic situations; finally relatives (bottom-right view at the figure) could have an high-level overview report of the goals and achievements of their elders. In this context, it is important to highlight that this approach also paves the way to additional dashboards for the Public Administrations in a regional level so they can have a detailed information of center operation and subsequently address a better decision-making concerning funds and/or resource allocation.

### 3 Conclusions

Our hypothesis is that using WG-IoT-based gerontechnology as we propose could benefit the health-care related well-being of patients in nursing homes with: (i) Ad-hoc services guaranteed by the nursing homes that improve the patients well-being and ease decreasing cost avoiding to pay for unnecessary services. (ii) Reducing working time of nursing home workers by the use of connected IoT devices that may help reducing the price to pay for the service. (iii) WGs established by all participants, namely doctors, nursing home managers, and even funding organisations. (iv) Dashboards to control the services compliance that

is available and useful for every participants in the patients well-being: doctors, relatives, and nursing home managers. (v) A doctor could adapt the WGs by means of an analysis of how metrics captured by IoT devices are evolving. For instance, if the average of heart rate of a patient is increasing compared with previous months, thus the doctor could adapt the WG by reducing the allowed value for the average heart rate in park walkings.

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