Exploratory study of the implications of research on the use of smart connected devices for prevention: a scoping review

Audrey Petit\textsuperscript{1,2,*} and Linda Cambon\textsuperscript{1}

Abstract

Background: Smart devices and mobile applications are now an integral part of all aspects of everyday life. They are particularly numerous in the field of health, contributing to the movement called ehealth. What is the potential role of these devices as prevention supports? The purpose of this article is to provide an exploratory analysis of the use, efficacy and contribution to conventional prevention strategies.

Methods: To address this issue, we conducted a scoping-review on the basis of 105 publications from the fields of medicine and human sciences.

Results: Three dimensions of the use of smart devices in the field of health were identified: 1/a quantification tool allowing the users to measure their activities; 2/a tool of self-positioning in the community; 3/an interface between the medical world and the population, modifying the hierarchy of knowledge. However, few published studies have investigated the determinants of the efficacy of these devices and their impact on individual behaviours and professional health practices.

Conclusion: Based on the hypothesis of possible integration of these devices in prevention policies, it would be interesting to investigate two research issues: how and under what psycho-socio-environmental conditions can smart devices contribute to the adoption of positive health behaviours? To what degree does the use of smart devices modify the health care professional-patient relationship? Finding answers to these questions could help to define the real place of these devices in prevention strategies by determining their complementarity with respect to other prevention strategies, and the conditions of their efficacy on behaviours and inequalities.

Keywords: Smart devices, ehealth, Quantified self, Prevention, Health care relationship
“ehealth” movement [6–8] that was initiated at the end of the 1990s. This movement is defined as the use of emerging mobile communications in public health [5, 9–12] designed to change health behaviours and health care. It has been defined as an ally of medicine and biomedical research [13]. About 100,000 applications are now available in the health sector, 70 % of which are related to the well-being segment, concerning almost 5 million people in France [14]. The development of these devices in the health care sector, governed in France by Article L.6316 of the French public health code, is also intensive and diversified: rating scale for chemotherapy sessions and associated adverse effects, textual interpretation of arterial blood gases, management of diabetic patients by a web-based telemonitoring platform [15], teleradiology-based management of neuroradiology emergencies [16], telemedicine applied to muscle rehabilitation [17], telemonitoring in patients with heart failure [18], etc.

Consequently, in the field of health, also marked by increasing life expectancy, an increasing number of chronic diseases and the growth of outpatient management [19, 20], these devices will inevitably occupy an increasingly important place alongside conventional curative and preventive health policies and management. However, few data are available, especially in the field of prevention. What is the real value of these devices as a support for prevention behaviours [21, 22]? What questions are currently raised in the literature concerning their use, their efficacy or their contribution to conventional strategies. This article is designed to address these various issues based on a review of the literature.

Method

In order to address these issues, we conducted a scoping review [23], which can be defined as “exploratory projects that systematically map the literature available on a topic, identifying key concepts, theories, sources of evidence and gaps in the research. They are often preliminary to full syntheses, undertaken when feasibility is a concern - either because the potentially relevant literature is thought to be especially vast and diverse... or there is a suspicion that not enough literature exists” [24]. We applied the PRISMA guidelines [25] (relevant items: eligibility criteria, information sources, search, study selection).

We performed a literature search using the following key words: prevention OR education AND e-health OR m-health OR health education AND coaching OR prevention on the Web of Science database. This database was selected because it is a multidisciplinary database that includes the best scientific journals, including in the field of human sciences. We searched for all original and methodological articles indexed between 2000 and 1st December 2015, in English or in French, and selected relevant articles on the basis of their abstracts according to the following criteria: articles concerning the use of smart devices and/or health applications, articles in the field of prevention (in the health system and in other settings), articles concerning modalities of use and/or impact on users, articles on general public interventions. Articles on the curative use of smart devices were excluded. The articles identified were selected by double reading using Covidence software [26]. Certain articles not meeting our selection criteria and not initially selected, but cited in selected articles and likely to be interesting to assess the scope of the subject, were then identified and were added to the selection (doctorate theses, dissertations, didactic articles, methodological articles, scientific articles including human sciences but not in the field of prevention).

We then analysed the selected articles, on the basis of the complete text, according to two questions: What are the objectives of using smart devices in prevention? What questions are raised by the use of smart devices in relation to the conventional prevention strategy? Finally, several other articles, listed in the references of the selected articles, were also progressively included in the analysis, especially human science articles or articles on ehealth, but not concerning the field of prevention.

Results

Of the 388 articles selected by the search algorithm, 44 were selected on the basis of the inclusion criteria. Excluded articles were mainly excluded because they concerned information technology techniques or curative use (especially telemedicine). Another 61 articles were added to this first selection. A total of 105 publications were finally included in the analysis (see Table 2 in the Appendix) (Fig. 1).
The articles were analysed and classified according to two questions. In the first question concerning the purpose of using a smart device, three dimensions were identified: for the purposes of quantification, for the purposes of socialization, for modification of the doctor-patient relationship. This classification is presented in Table 1 below.

### Purposes of smart device use

Three dimensions of the use of smart devices in prevention were identified.

#### Quantified self devices: objective monitoring of health and health behaviours

The first dimension considered in the literature concerns quantification of health-related activities or constants [27, 28], corresponding to the socio-technological “quantified self” movement, also called self-quantifying, self-surveillance, or self-tracking, developed in the United States at the initiative of two *Wired* magazine journalists, Gary Wolf and Kevin Kelly. This movement has grown considerably over the last 10 years, with the publication of a number of books devoted to its philosophy, quantified self guides [7, 29, 30] and the creation of a quantified self collective [30]. This movement promotes self-knowledge based on figures provided by connected body sensors on scales, blood pressure monitors or pedometers that send information to a smartphone (m.health [31]). One of the aims of this movement is to quantify all activities or all subjects [32] by means of algorithms [33], even subjective variables such as pain or mood [28].

More specifically, especially in the field of prevention, these devices are designed to collect, measure and compare various biological, physical, behavioural and environmental parameters concerning lifestyle activities such as sleeping, eating and physical exercise, in order to improve well-being and maintain or improve the subject’s state of health [34], but also to measure the subject’s consumptions (for example smoking, alcohol, calories) or activities (work time, leisure activities, physical exercise, etc.). Some of these data (e.g.: blood pressure, pulse) were conventionally recorded and analysed in the specific setting of the doctor-patient relationship in the context of a specific risk [35]. The quantified self therefore modifies the frontiers between the fields of well-being, health and health care, which now constitute a continuum between normal and pathological rather than a break-point [10, 36] The objective for users is to collect data in order to acquire knowledge about themselves and their health in the form of graphic representations reflecting the time-course of selected variables [28]. Self-quantification induces a perception of the body that is modelled in an essentially
technical relationship determined by quantitative data.

Self-quantification is therefore a way for individuals to objectively visualize their behaviours [37], as part of a strategy of self-knowledge and self-construction [38], although these strategies are not always maintained in the long term [32, 35, 39].

**Smart devices as a means of socialization: a source of social valorization**

The second dimension studied in the literature concerns sharing of the data collected and analysed by users of smart devices. Users of these technologies generally belong to internet-connected communities with a double objective of valorization of their efforts and encouraging reassurance according to various configurations. These devices are therefore part of the social interaction economy [40] that highlights the fact that behavioural dynamics are linked to the dynamics of social relationships, whose existence depends on the effects of influence exerted within social groups.

As an example, Lab Orange researchers [32] have defined three types of modalities of use of these measurements. The first consists of surveillance, corresponding to measurement of a risk, in which the concept of threshold plays a central role and is usually defined by external, often medical, norms. This is the case, for example, of body mass index (BMI). This modality does not focus on action, but on self-surveillance. Consequently, the results of this self-surveillance can sometimes be a source of anxiety and may therefore not lead to data sharing. According to this modality, advice is then generally shared on social networks according to a logic of mutual aid and support. The second modality concerns what is known as routinization or regularity, which is designed to replace a bad habit by a more favourable health behaviour, for example smoking cessation or adoption of lifestyle and dietary measures. In contrast with the first modality, this modality comprises an action or a change in which the central element is regularity driven by motivation. In this case, publication of the individual's measurements on social networks is designed to arouse encouragement, but the subject may also prefer to avoid other peoples' opinions. Finally, the third modality refers to performance and the various measurements become self-determined objectives. The objective of this modality is to enhance motivation and improve performance. Social networking allows both sharing of experiences as well as competition and the norms derived from the challenge.

In all three cases, these sharing practices constitute tools of technological mediatization and social mediation [37] allowing renewed forms of self-exposure [41] or self-narration [42]. However, networking does not appear to constitute "a standardization of private activities. Although they are driven by the promoters of these tools and the supporters of the quantified self, discussions between users are rare and alignments of practices between the various users does not appear to constitute a dominant expectation" [32]. Moreover, these measuring practices tend to decline with time [32, 35], as more than one-third of users stop using their smart device in less than 6 months [5] due to a phenomenon described by the law of attrition [39]. Sharing of measurements recorded by smart devices corresponds to a socialization practice, in which the measurement provides an opportunity to communicate according to new codes [43, 44].

**Smart devices in the health care relationship: a mediator of participative medicine**

The third dimension identified by this review concerns the medical setting and involves transformations of health care practices related to the emergence and the potential place of these devices in preventive medicine practices [28, 45].

The literature on this aspect emphasizes the empowerment potential [46, 47] of patients with respect to health care professionals resulting from the use of these devices, allowing them to become active partners of their own health [48]. The use of smart devices in the preventive or curative health care relationship introduces a form of "media medicine" [49] or apomediation [46] meaning remote mediation between the patient and his/her body detached from the doctor, which results in a new doctor/patient relationship articulated around scientific and lay knowledge [19] leading to the emergence of new health care models [28, 50]. The patient becomes patient-expert and the doctor accompanies the patient in his/her life trajectory [14], by replacing a repair strategy by a lifelong support strategy [51] of an empowered and networking patient [52–54], corresponding to an ascending approach to medicine, which could result in a knowledge competition between health care professionals and their patients [55]. This competition is increasing in parallel with the growth of a large on-line community [13, 28, 56–61] and information sharing, concerning both disease and healthy lifestyles, which redefine the hierarchy of knowledge [19]. In France, for example, more than one half of the population and 61% of subjects with a chronic disease search the internet.
for health-related information [50]. Patient communities describe diseases in terms of personal experience [52, 62] by means of peer training, information sharing and networking to more effectively manage their health [52, 53]. These patient networks can constitute a new partner in the health care ecosystem [28]. In contrast, few studies have investigated how patients use this information in a context in which the quality of on-line information is not always reliable [57, 63]. Furthermore, sharing of personal information, previously exclusively confided to doctors, raises ethical issues concerning their use and their confidentiality [64, 65]. Studies examining health care professionals’ perception and integration of these devices in preventive medicine practices also highlight the obstacles to their use [66–71] and the need to train both users [72, 73] and health care professionals [74–80] or even the creation of new medical specialties at the interface between information technology and medicine [81, 82]. Finally, these technologies can also impact on relationships between professionals themselves [82] and consequently on the distribution of tasks concerning the patient and his/her care pathway [82–84], leading to more mutualization and less autonomy of professionals.

The use of these devices in the preventive or curative health care relationship is accompanied by new alliances and conflicts between health care professionals and a different sharing of decisions between patients and professionals [52, 55, 85–87]. These changing relations impact on both the nature of the therapeutic alliance, redefining the balance of knowledge between the patient and the health care professional, and the modalities of elaboration of the therapeutic alliance, redefining sharing of skills of the various professionals participating in the patient’s care pathway.

These three modalities of use suggest that these devices could possibly contribute to new prevention models.

**Smart devices as a support for behaviour change: marker of a new prevention model**

In the light of this review of the literature, these three dimensions of the use of smart devices raise the question of their possible effects on health-related behaviour. The underlying hypothesis is that objective demonstration of behaviours (quantified self) may contribute to transformation of the subject’s relationship to his/her body and health by adoption and consequently normalization of certain behaviours [88] that could be targeted in prevention policies. Other authors have emphasized the effect of these devices but on the basis of other factors. These devices would therefore contribute to behaviour change [72] and the emergence of a new representation of the body and health by promoting empowerment, which cannot be achieved by the biomedicine model [89]. Empowerment is “an individual’s capacity to take decisions when faced with a specific situation or problem, either alone or by group participation, in order to adapt to this situation and take control of their personal life” [14]. In other words, by means of objective measurement of their health and behaviour, individuals would be more able to make more favourable adaptive choices. Several studies [90–92] have corroborated this hypothesis in the clinical practice setting, by showing that the “patient’s implication in management of his or her treatment has beneficial effects [...]. It improves treatment adherence in many diseases and doctors are currently trying to develop tools that can enhance this implication” [52]. The efficacy of eHealth, in the broad sense of the term, has therefore been demonstrated in many fields such as overweight and obesity [93, 94], HIV [95–97], cancer [98–100] and diabetes [92, 101]. Nevertheless, few studies have demonstrated the efficacy and use of these smart devices with respect to conventional strategies. The question of their universal accessibility and consequently the social inequalities that can be induced by the use of these devices [102, 103], also needs to be investigated, as there is a risk that the digital divide [53, 104] may further accentuate the health divide between users with access to this technology and those without access to this technology [46].

The use of these devices as a support for health behaviour changes, and therefore as a specific prevention tool, needs to be further investigated both in terms of the way in which these devices act (empowerment versus normalization), and their efficacy and contribution to the problems of social and regional health inequalities.

**Discussion**

Although not as comprehensive as a systematic review of the literature, this scoping review provides a fairly precise overview of the research issues present in the literature concerning the use of smart devices in prevention strategies, either outside of the medical field (health and well-being) or in the context of clinical prevention practices (health and prevention of diseases or their complications). We have limited our research to the field of prevention and we have
excluded the very abundant literature on curative aspects and have also included publications derived from the fields of human and social sciences. We consequently observed that a large number of articles were excluded and many articles not meeting our inclusion criteria also had to be added \( (n = 61) \). These screening failures could be explained by two hypotheses. Firstly, our search algorithm was too broad: in particular, the word “coaching” refers to support, especially therapeutic support, but not necessarily associated with a smart device or an application. The use of this search term selected a large number of irrelevant articles. The second hypothesis concerns the salience of this innovative subject, especially in the so-called grey literature (not referenced in scientific databases) and in fields not related to health.

Three main dimensions were identified. Each dimension situates the smart device in the context of a specific objective and a specific use. The first dimension positions the device as a tool for quantification of activity, allowing users to measure their activities, assess their progress and project themselves towards a target. It consequently constitutes a self-construction tool providing an objective measure of self-control, assuming that the self can be defined by these variables. The second dimension concerns self-positioning in the community. As a vector of collective socialization, the device provides an opportunity to seek advice and encouragements. The third dimension is that of a mediator between an environment considered up until now to be a source of knowledge, the medical environment, and the population. This mediation breaks down the barriers of knowledge, redefining the relationship between patients and health care professionals and between professionals concerning curative or preventive management, which is consequently transformed in terms of its scientific basis and its methods. In view of these elements, smart devices can be considered to be tools that could be integrated into the conventional prevention arsenal, and therefore subject to the same fundamental questions: what is the final objective (empowerment versus normalization)? And what is the impact on social and regional health inequalities [105]?

In reality, these findings highlight a blind spot in the literature: explanation of the mechanisms of efficacy of these devices and their impact on health practices and professional practices, as few studies have investigated the mechanisms mobilized by the use of these devices in favour of health behaviours. In fact, beyond the question of the quality and reliability of the data and algorithms integrated into these devices, their objectives and the scope of their use in prevention need to be precisely defined: What are the psychosocial mechanisms underlying the use of these devices for the purposes of health? What are the objectives of these devices: to monitor, improve performance, accompany behaviour changes, develop empowerment, etc.? In what types of populations are they relevant (age, gender, socioeconomic category, medical history)? In what way do they compensate or complete conventional strategies? What socio-environmental factors potentiate or limit the effects of these devices on behaviour change? The data derived from the literature also fail to provide any details on the absolute efficacy or the efficacy according to social gradient of these devices in the field of prevention nor the conditions of this efficacy.

Finally, very few data are available in the literature to explain the transformations of practices induced by the use of smart devices in the health care relationship and the impact of this transformation on the health system and its capacity to provide an egalitarian response to the population’s needs, as it is unclear from this scoping review whether these changes apply to all fields of prevention and health care and all types of patients. How do health care professionals adapt to these new practices? More broadly, how is the health system preparing for this transformation and what changes will be required in the training of health care professionals?

**Conclusion**

To conclude, this scoping review identified three different dimensions concerning the use of smart devices in prevention. Based on the hypothesis of integration of these devices into prevention policies, this review emphasizes the importance of investigating two questions that have been poorly studied to date, although they represent a real research challenge in this field: how and under what psycho-socio-environmental conditions can eHealth smart devices contribute to the adoption of positive health behaviour? To what degree and how does the use of smart devices positively or negatively modify the doctor-patient relationship?

Finding answers to these questions could help to define and confirm the real place of these devices in prevention strategies by clearly demonstrating their added value and complementarity with respect to other prevention strategies, and by defining the conditions of their efficacy on behaviours, especially by taking into account the question of social and regional inequalities of access to health care.
## Appendix

### Table 2 List of articles selected

| No. | Year | Author      | Language | Type            | Selection | Criteria                                                                 |
|-----|------|-------------|----------|-----------------|-----------|--------------------------------------------------------------------------|
| 1   | 2013 | Benferhat   | French   | Doctorate thesis| Addition  | Smart devices In the health system                                        |
|     |      |             |          |                 |           | Quantified-self                                                           |
| 2   | 2012 | Swan        | English  | Original article| Database  | Health applications Non-health setting                                   |
|     |      |             |          |                 |           | Quantified-self                                                           |
| 3   | 2014 | Lendrevie   | French   | Book            | Addition  | Health applications Non-health setting                                   |
| 4   | 2014 | Bellanger-Trely | French | Vade Mecum      | Addition  | Smart devices Health applications In the health system and other settings |
| 5   | 2015 | IREPS Bretagne | French | Grey literature| Addition  | Smart devices Health applications Modalities of use In the health system |
| 6   | 2011 | Dupagne     | French   | Original article| Database  | Health applications In the health system                                  |
| 7   | 2014 | Robin       | French   | Book            | Addition  | Health applications Modalities of use In the health system               |
| 8   | 2012 | Wiederhold  | English  | Original article| Database  | Smart devices Modalities of use In the health system                      |
| 9   | 2014 | CATEL       | French   | Guidelines      | Addition  | Health applications In the health system                                  |
| 10  | 2015 | CNOM        | French   | Guidelines      | Addition  | Health applications Modalities of use In the health system               |
| 11  | 2001 | Eysenbach   | English  | Original article| Database  | Health applications Modalities of use In the health system               |
| 12  | 2011 | Garel       | French   | Book            | Addition  | Health applications Modalities of use In the health system               |
| 13  | 2008 | Eysenbach   | English  | Original article| Database  | Health applications Impact on users In the health system                 |
| 14  | 2014 | Salmon      | French   | Original article| Database  | Impact on users Prevention strategies In the health system and other settings |
| 15  | 2013 | Benhamou    | French   | Original article| Database  | Health applications Impact on users In the health system                 |
| 16  | 2008 | Hazebroucq  | French   | Original article| Database  | Health applications Impact on users In the health system                 |
| 17  | 2008 | Avraam      | English  | Original article| Database  | Health applications Impact on users In the health system                 |
| 18  | 2012 | Bignolas    | French   | Original article| Addition  | Health applications Impact on users In the health system                 |
| 19  | 2014 | Dubey       | French   | Original article| Database  | Health applications Impact on users In the health system                 |
| ID | Year | Author | Language | Article Type | Source | Subject | Impact | Setting |
|----|------|--------|----------|--------------|--------|---------|--------|---------|
| 20 | 2006 | Giustini | English | Original article | Database | Health applications | Impact on users | In the health system |
| 21 | 2014 | Merloz | French | Original article | Database | Health applications | Impact on users | In the health system |
| 22 | 2014 | Vial | French | Original article | Addition | Health applications | Impact on users | In the health system |
| 23 | 2010 | Levac | English | Methodological article | Database | – | – | – |
| 24 | 2010 | IRSC | French | Grey literature | Addition | – | – | – |
| 25 | 2008 | Mother | English | Methodological article | Addition | – | – | – |
| 26 | 2014 | Babineau | English | Methodological article | Addition | – | – | – |
| 27 | 2014 | Beuchet | English | Original article | Database | Smart devices | Modalities of use | In the health system |
| 28 | 2009 | Swan | English | Original article | Database | Smart devices | Health applications | Modalities of use | Impact on users | In the health system and other settings |
| 29 | 2008 | Cotteret | French | Book | Addition | Smart devices | Modalities of use | – | – |
| 30 | 2012 | Gadenne | French | Book | Addition | Smart devices | Modalities of use | Non-health setting | – |
| 31 | 2015 | Ahmadvand | English | Original article | Database | Smart devices | Modalities of use | In the health system and other settings | – |
| 32 | 2013 | Pharabond | French | Original article | Database | Smart devices | Modalities of use | Non-health setting | – |
| 33 | 1990 | Laguna | English | Original article | Addition | Smart devices | Modalities of use | In the health system | – |
| 34 | 2008 | Reiter | English | Original article | Database | Smart devices | Modalities of use | Non-health setting | – |
| 35 | 2014 | CNIL | French | Grey literature | Addition | Smart devices | Modalities of use | Non-health setting | – |
| 36 | 1966 | Canguilhem | French | Book | Addition | Modalities of use | – | – |
| 37 | 2013 | Arruabarrena | French | Original article | Addition | Smart devices | Modalities of use | Non-health setting | – |
| 38 | 2012 | Mondoux | French | Original article | Addition | Health applications | Modalities of use | – | – |
| 39 | 2005 | Eysenbach | English | | Database | Modalities of use | Non-health setting | – | – |
| 40 | 1993 | Manski | English | Original article | Addition | Modalities of use | – | – |
| 41 | 2010 | Granjon | French | Original article | Addition | Modalities of use | – | – |
| 42 | 2006 | Cardon | French | Original article | Addition | Modalities of use | – | – |
| 43 | 2009 | Aguiton | English | Original article | Addition | Modalities of use | – | – |
| 44 | 2014 | Caldwell | English | Original article | Database | Modalities of use | – | – |
| 45 | 2013 | Delmotte | French | Original article | Addition | Health applications | Impact on users | In the health system | – |
| 46 | 2011 | Casilli | French | Original article | Addition | Modalities of use | Prevention strategies | – | – |
|   | Year | Author       | Language | Article Type       | Addition     | Impact Area                        |
|---|------|--------------|----------|-------------------|-------------|-----------------------------------|
| 47| 2008 | Van Uden-Kraan | English  | Original article  | Addition    | Impact on users                   |
| 48| 1999 | Charles      | English  | Original article  | Addition    | Impact on users                   |
| 49| 2015 | Vallancien   | French   | Book              | Addition    | Impact on users                   |
| 50| 2015 | Wernette     | French   | Original article  | Addition    | Impact on users                   |
| 51| 2014 | Caniart      | French   | Original article  | Addition    | Health applications               |
| 52| 2010 | Jouet        | French   | Review            | Addition    | Prevention strategies             |
| 53| 2015 | Brouard      | French   | Original article  | Database    | Prevention strategies             |
| 54| 2008 | Frost        | English  | Original article  | Addition    | Impact on users                   |
| 55| 2011 | Laubie       | French   | Original article  | Database    | Impact on users                   |
| 56| 2009 | Akrich       | French   | Original article  | Addition    | Impact on users                   |
| 57| 2008 | Mayoh        | English  | Original article  | Database    | Impact on users                   |
| 58| 2015 | Valdez       | English  | Original article  | Addition    | Impact on users                   |
| 59| 2015 | Magnezi      | English  | Original article  | Addition    | Impact on users                   |
| 60| 2014 | Magnezi      | English  | Original article  | Addition    | Impact on users                   |
| 61| 2013 | Medina       | English  | Original article  | Addition    | Impact on users                   |
| 62| 2014 | Delory-Momberger | French | Original article  | Addition    | Impact on users                   |
| 63| 2008 | Mitchell     | English  | Original article  | Database    | Impact on users                   |
| 64| 2014 | Béranger     | French   | Original article  | Database    | Impact on users                   |
| 65| 2009 | Lucas        | French   | Original article  | Database    | Impact on users                   |
| 66| 2012 | Gagnon       | English  | Methodological article | Database | Impact on users                   |
| 67| 2012 | Gund         | English  | Original article  | Database    | Impact on users                   |
| 68| 2008 | Ward         | English  | Methodological article | Database | Impact on users                   |
| 69| 2012 | Dünnebeil    | English  | Original article  | Database    | Impact on users                   |
| 70| 2009 | Eley         | English  | Original article  | Database    | Impact on users                   |
| 71| 2005 | Richards     | English  | Original article  | Database    | Impact on users                   |
| 72| 2010 | Sandrin-Berthon | French | Book              | Addition    | Prevention strategies             |
| 73| 2005 | Eymard       | French   | Original article  | Addition    | Prevention strategies             |
| 74| 2002 | Gros         | French   | Rapport           | Addition    | Prevention strategies             |
| No. | Year | Author       | Language | Article Type   | Date Type    | Key Words                      |
|-----|------|--------------|----------|----------------|--------------|-------------------------------|
| 75  | 2013 | Dattakumar   | English  | Original article | Addition    | Impact on users In the health system |
| 76  | 2013 | Lapao        | English  | Original article | Addition    | Impact on users In the health system |
| 77  | 2012 | Bygholm      | English  | Original article | Addition    | Impact on users In the health system |
| 78  | 2011 | Stellefson   | English  | Methodological article | Addition | Impact on users In the health system |
| 79  | 2009 | Clark        | English  | Original article | Addition    | Impact on users In the health system |
| 80  | 2008 | Zvarova      | English  | Original article | Addition    | Impact on users In the health system |
| 81  | 2003 | Moulin       | French   | Original article | Addition    | Impact on users In the health system |
| 82  | 2013 | Mathieu-Fritz| French   | Original article | Addition    | Impact on users In the health system |
| 83  | 2011 | Esterle      | French   | Original article | Addition    | Impact on users In the health system |
| 84  | 1992 | Strauss      | French   | Book           | Addition    | Impact on users In the health system |
| 85  | 2012 | Andrieu      | French   | Book           | Addition    | Impact on users In the health system |
| 86  | 2009 | Silber       | French   | Original article | Addition    | Impact on users In the health system and other settings |
| 87  | 2009 | Silber       | French   | Original article | Addition    | Impact on users In the health system |
| 88  | 2014 | Martin       | French   | Dissertation   | Addition    | Health applications Prevention strategies Non-health setting |
| 89  | 2015 | Thornquist   | English  | Original article | Database    | Health applications Prevention strategies Non-health setting |
| 90  | 2014 | Shull        | English  | Methodological article | Database | Health applications Prevention strategies In the health system and other settings |
| 91  | 2015 | Van den Bulck| English  | Original article | Database    | Health applications Prevention strategies Non-health setting |
| 92  | 2015 | Goyal        | English  | Original article | Database    | Health applications Prevention strategies Non-health setting |
| 93  | 2015 | Hutchesson   | English  | Methodological article | Database | Health applications Prevention strategies In the health system |
| 94  | 2013 | Tate         | English  | Original article | Database    | Health applications Prevention strategies In the health system |
| 95  | 2014 | Odeny        | English  | Original article | Database    | Health applications Prevention strategies In the health system |
| 96  | 2015 | Muessig      | English  | Original article | Addition    | Health applications Prevention strategies In the health system |
| 97  | 2012 | Noar         | English  | Original article | Database    | Health applications Prevention strategies In the health system |
| 98  | 2013 | Sanchez      | English  | Methodological article | Database | Health applications Prevention strategies In the health system |
| 99  | 2013 | Elliot       | English  | Original article | Database    | Health applications Prevention strategies In the health system |
| 100 | 2015 | Davis        | English  | Original article | Database    | Health applications Prevention strategies In the health system |
Table 2 List of articles selected (Continued)

| No. | Year | Author(s) | Language | Type of Article | Title |
|-----|------|-----------|----------|----------------|-------|
| 101 | 2012 | Pacaud    | French   | Original article | Addition Health applications Prevention strategies In the health system |
| 102 | 2014 | Steinberg | English  | Original article | Database Health applications Prevention strategies In the health system |
| 103 | 2009 | Atkinson  | English  | Original article | Addition Health applications Prevention strategies In the health system |
| 104 | 2011 | Granjon   | French   | Original article | Addition Prevention strategies In the health system and other settings |
| 105 | 2015 | Zhang     | English  | Original article | Addition Prevention strategies In the health system |

Acknowledgements
There are no acknowledgements.

Funding
No funding.

Availability of data and materials
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Authors’ contributions
AP made substantial contributions to conception and design, acquisition of data, analysis and interpretation of data; drafting and critical review of the manuscript for important intellectual content; she agrees to be accountable for all aspects of the work by ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. LC made substantial contributions to conception and design, acquisition of data, analysis and interpretation of data; drafting and critical review of the manuscript for important intellectual content; she agrees to be accountable for all aspects of the work by ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Both authors read and approved the final manuscript.

Consent for publication
Not applicable.

Ethical approval and consent to participate
Not applicable.

Received: 31 January 2016 Accepted: 24 June 2016
Published online: 11 July 2016

References
1. Benferhat D. Conception d’un système de communication tolérant la connectivité intermittente pour capteurs mobiles biométriques. Application à la supervision médicale de l’activité cardiaque de marathoniens [Thèse de doctorat en informatique]. Université de Bretagne Sud; 2013.
2. Swan M. Sensor mania! The internet of things, wearable computing, objective metrics, and the quantified self 2.0. J Sens Actuator Netw. 2012;1(3):217–53.
3. Lendrevie J, Lévy J, Mercator 11e édition - Tout le marketing à l’ère numérique. Avec e-book. 11th ed. Paris: Dunod; 2014. p. 1040.
4. Bellanger-Trelly M-V, Vade-Mecum des objets connectés. Réalités, tendances et futur proche. APSSIS. APSSIS; 2014.
5. IREPS Bretagne. Santé connectée...que la magie opère! Horiz Plur. 2015;(28).
6. Dupagne D. E-santé. Communications. 2011;98(1):57–65.
7. Robin J-Y. L’urgence numérique. Faire de la France un leader de l’e-santé. L’Harmattan. 2014. p. 214.
8. Wiederhold BK. Self-tracking: better medicine through pattern recognition. Cyberpsychol Behav Soc Netw. 2012;15(5):235–6.
9. CATEL. Préconisations e-santé 2014. Catel; 2014. p. 69
10. Conseil national de l’Ordre des médecins. Santé connectée. De la e-santé à la santé connectée. Le livre blanc du Conseil National de l’Ordre des Médecins. 2015.
11. Eysenbach G. What is e-health? J Med Internet Res [Internet]. 2001;3(2):E20 [cited 2015 Oct 9].
12. Garel P. Systèmes d’information en santé et TIC. E-Santé Etat Lieux Eur. 2011:539:78–80.
13. Eysenbach G. Medecine 2.0: social networking, collaboration, participation, apromediation and openness. J Med Internet Res. 2008;10(3):e22.
14. Salmon FD, Tallec LL. La e-santé: de nouveaux usages pour les technologies individuelles en santé publique. Ann Mines - Réal Ind. 2014/2014(4):70–5.
15. Benhamou P-Y, Muller M, Lablanche S, Debyat I. La télémédecine au service de la prise en charge des patients diabétiques; développements actuels et conditions du succès. Eur Res Telemed Rech Eur En Télémédecine. 2013; 2(1):23–8.
16. Hazebroucq V, Fey-Lemmonier E. Apports de la téléradiologie dans la prise en charge des urgences neuroradiologiques/data/revues/01509861/00310004/334/[Internet]. 2008 [cited 2015 Oct 22].
17. Avraam M, Horodinca M, Letier P, Peumont A. Portable smart wrist rehabilitation device driven by rotational MR-fluid brake actuator for télémédecine applications. In: IEEE/RJS International Conference on Intelligent Robots and Systems, 2008 IROS 2008. 2008. p. 1441–6.
18. Bigolas G. Fileris: un modèle organisationnel des soins. Gerontol Soc 2012; HS 1(5):137–48.
19. Dubey G. Les nouvelles technologies en autonomie et santé : un déplacement des frontières de la connaissance. Ann Mines - Réal Ind. 2014; 482–8.
20. Giustini D. How Web 2.0 is changing medicine. BMJ. 2006;333(7582):1283–4.
21. Merloz P. À quoi servent les nouvelles technologies en médecine et en chirurgie ? Ann Mines - Réal Ind. 2014/2014(4):12–6.
22. Val A. Les technologies s’opposent-elles à la médecine humaniste ? une (fausse) question vieille comme le monde. Ann Mines - Réal Ind. 2014:46–11.
23. Levac D, Colquhoun H, O’Brien K. Scoping studies: advancing the method. Implement Sci. 2015;6:99.
24. Instituts de recherche en santé du Canada. Guide sur la synthèse des connaissances - IRSC [Internet]. 2010 [cited 2015 Nov 12].
25. Mother L, Liberati A, Tetzlaff J, Altman D, The PRISMA Group. Preferred reporting items for systematic reviews meta-analyses: the PRISMA Statement. PLoS Med. 2009;6(7):e1000097.
26. Babineau J. Product review: covidence (Systematic Review Software). J Can Health Libr Assoc. J Assoc Bibl Santé Can. 2014;53(2):68–71.
27. Beauchet O, Lavay CP, Meltzagn C, Kabeshova A, Aminweller C. Quantified self and comprehensive geriatric assessment: older adults are able to evaluate their own health and functional status. Plos One. 2014(9)(6):e100636.
28. Swan M. Emerging patient-driven health care models: an examination of health social networks, consumer personalized medicine and quantified self-tracking. Int J Environ Res Public Health. 2009;6(2):492–525.
29. Cotteret M-A. Mesurez vous de la métrologie à l’autonomie. Ovadia. 2008. 130p.
30. Gadenne E, Devesa F, Wolf M. Guide pratique du Quantifié Self. Mieux gérer sa vie, sa santé, sa productivité. limoges: Editions Fyp; 2012. p. 224.
31. Ahmadvand A, Whittaker R, Lim MSC. Placing prevention in the pockets: the role of mHealth. In: Adibi S, editor. Preventive medical services. Boca Raton: Crc Press-Taylor & Francis Group; 2015.
81. Moulin T, Retel O, Chavot D. Impacts des nouvelles technologies informatiques et de communication (NTIC) sur l’organisation hospitalière et la prise en charge des patients : Réseau d’Aide au Diagnostic et aux Soins des Urgences Neurologiques (RAIDUS). Santé Publique. 2003;vol. 15(4S):191–200.

82. Mathieu-Fritz A, Esterle L. Les transformations des pratiques professionnelles lors des téléconsultations médicales. Coopération interprofessionnelle et délégation des tâches. Rev Fr Sociol. 2013;54(2):303–29.

83. Esterle L, Mathieu-Fritz A, Espinoza P. L’impact des consultations à distance sur les pratiques médicales : vers un nouveau métier de médecin? Rev Fr Aff Soc. 2011;2:363–79.

84. Straus AL. La trame de la négociation : sociologie qualitative et interactionnisme. Paris: L’Harmattan; 1992.

85. Andrieu B. L’autosanté : Vers une médecine réflexive. Armand Colin; 2012. p. 256.

86. Silber D. Médecine 2.0; les enjeux de la médecine participative. Presse Med. 2009;38(10):1456–62.

87. Silber D. L’Internet et le partage de la décision médicale entre patients et professionnels de santé. Presse Med. 2009;38(10):1491–3.

88. Martin B. La quantification de soi dans les réseaux socionumériques [Mémoire de maîtrise en communication]. [Montréal]: Université du Québec; 2014.

89. Thornquist E, Kirkengen AL. The quantified self : closing the gap between general knowledge and particular case? J Eval Clin Pract. 2015;21(3):398–403.

90. Shull P, Jirattigalachote W, Hunt MA, Cutkosky MR, Delp SL. Quantified self and human movement : a review on the clinical impact of wearable sensing and feedback for gait analysis and intervention. Gait Posture. 2014;40:11–9.

91. Van den Bulck J. Sleep apps and the quantified self : blessing or curse? J Sleep Res. 2015;24(2):121–3.

92. Goyal S, Morita P, Lewis GF, Yu C, Seto E, Cafazzo JA. The systematic design of a behavioural mobile health application for the self-management of type 2 diabetes. Can J Diabetes. 2016;40(1):95–104.

93. Hutchesson MJ, Rollo ME, Krukowski R, Ellis L, Harvey J, Morgan PJ, et al. eHealth interventions for the prevention and treatment of overweight and obesity in adults: a systematic review with meta-analysis. Obes Rev. 2015;16(5):376–92.

94. Tate EB, Spruit-Metz D, O’Reilly G, Jordan-Marsh M, Gotis M, Pentz MA, et al. mHealth approaches to child obesity prevention: successes, unique challenges, and next directions. Transl Behav Med. 2013;3(4):406–15.

95. Odeny TA, Newman M, Bukusi EA, McClelland RS, Cohen CR, Camlin CS. Developing content for a mHealth intervention to promote postpartum retention in prevention of Mother-To-Child HIV transmission programs and early infant diagnosis of HIV: a qualitative study. Plos One. 2014;9(9):e100383.

96. Muesig KE, Bien CH, Wei C, Lo EJ, Yang M, Tucker JD, et al. A mixed-methods study on the acceptability of using eHealth for HIV prevention and sexual health care among men who have sex with men in China. J Med Internet Res. 2015;17(4):e100.

97. Noar SM, Willoughby JF. eHealth interventions for HIV prevention. Aids Care Psychol Socio-Med Asp AidsHiv. 2012;24(8):945–52.

98. Sanchez MA, Rabin BA, Gagliolo B, Henton M, Elzarrad MK, Purcell P, et al. A systematic review of eHealth cancer prevention and control interventions: new technology, same methods and designs? Transl Behav Med. 2013;3(4):392–401.

99. Elliot DL, Lindenmueller SJ, Goldberg L, Stadler DD, Smith J. Health promotion for adolescent childhood leukemia survivors: building on prevention science and eHealth. Pediatr Blood Cancer. 2013;60(6):905–10.

100. Davis SW, O’Keeley-Givan I. mHealth education applications along the cancer continuum. J Cancer Educ Off J Am Assoc Cancer Educ. 2015;30(2):388–94.

101. Pacaud D, Kely H, Downey AM, Chasson M. Successful delivery of diabetes self-care education and follow-up through eHealth media. Can J Diabetes. 2012;36(5):257–62.

102. Steinberg DM, Levine EL, Lane I, Alkew S, Foley PB, Puleo E, et al. Adherence to self-monitoring via interactive voice response technology in an eHealth intervention targeting weight gain prevention among black women: randomized controlled trial. J Med Internet Res. 2014;16(4):105–16.