Accepted author's manuscript. International Journal of Medical Informatics.
Publisher DOI: https://doi.org/10.1016/j.ijmedinf.2019.08.010

# READINESS TO ACCEPT HEALTH INFORMATION AND COMMUNICATION TECHNOLOGIES: A POPULATION-BASED SURVEY OF COMMUNITY-DWELLING OLDER ADULTS

Nazanin Abolhassani[1]; Brigitte Santos-Eggimann[1]; Arnaud Chiolero[2,3]; Valérie Santschi[4;] Yves Henchoz[1]

[1] Center for Primary Care and Public Health (Unisanté), University of Lausanne, Lausanne, Switzerland; [2] Institute of Primary Health Care (BIHAM), University of Bern, Bern, Switzerland; [3] Department of Epidemiology, Biostastitics, and Occupational Health, McGill University, Montreal, Canada; [4] La Source, School of Nursing Sciences; University of Applied Sciences Western Switzerland, Lausanne, Switzerland

**Authors' emails:**

Nazanin Abolhassani: Nazanin.Abolhassani@chuv.ch
Brigitte Santos-Eggimann: Brigitte.Santos-Eggimann@chuv.ch
Arnaud Chiolero arnaud.chiolero@biham.unibe.ch
Valérie Santschi: v.santschi@ecolelasource.ch
Yves Henchoz: Yves.Henchoz@chuv.ch

**Address for correspondence and reprints**

Nazanin Abolhassani
Center for Primary Care and Public Health (Unisanté), University of Lausanne, Lausanne, Switzerland
Biopôle 2, SV-A
Bio2–00–161
Route de la Corniche 10,
1010 Lausanne, Switzerland
Phone: +41 (0)21 314 88 13
Email: Nazanin.Abolhassani@chuv.ch

**Abstract word count: 285**

**Manuscript word count: 3195**

Accepted author's manuscript. International Journal of Medical Informatics.
Publisher DOI: https://doi.org/10.1016/j.ijmedinf.2019.08.010

# READINESS TO ACCEPT HEALTH INFORMATION AND COMMUNICATION TECHNOLOGIES: A POPULATION-BASED SURVEY OF COMMUNITY-DWELLING OLDER ADULTS

## Abstract

**Introduction:** The development of health information and communication technologies (HICTs) could modify the quality and cost of healthcare services delivered to an aging population. However, the acceptance of HICTs — a prerequisite for users to benefit from them — remains a challenge. This population-based study aimed to 1) explore the acceptance of HICTs by community-dwelling older adults as well as the factors associated to the overall acceptance/refusal of HICTs; 2) identify the factors associated with confidentiality (i.e., access to data allowed to physicians only versus to all caregivers) in the subgroup of older adults willing to accept HICTs.

**Methods:** A total of 3,195 community-dwelling 69-83 year-old members of the Lausanne cohort 65+ were included. In 2017, participants filled out a 9-item questionnaire to assess their acceptance of HICTs ("yes without reluctance"; "yes but with reluctance"; "no"). A bivariate analysis was conducted to examine gender and age differences in the acceptance of HICTs. A multivariable logistic regression was performed to model 1) accepting all or rejecting all HICTs items; 2) willing to share HICTs items with physicians only versus all caregivers.

**Results:** The answer "acceptance without reluctance" ranged from 26.4% to 70.4% across HICTs and was the most frequent answer to six out of nine HICT items. For every HICT item, the acceptance rate decreased across age categories in women. Overall, 20.2% accepted all the HICTs without reluctance and 9.9% rejected them all. Older age and a lower level of education were significantly associated with both accepting all HICTs without reluctance (OR=0.78 and OR=0.65, respectively) and rejecting all HICTs (OR=1.54 and OR=2.89, respectively). Women and participants with health vulnerability (depressive symptoms, difficulty in activities of daily living (ADLs)) were less likely to accept data accessibility to non-physicians.

Accepted author's manuscript. International Journal of Medical Informatics.
Publisher DOI: https://doi.org/10.1016/j.ijmedinf.2019.08.010

**Conclusion:** Acceptance of HICTs was relatively high. To deploy HICTs in the older population, demographic, socioeconomic and health profiles, alongside confidentiality concerns, should be considered.

**Keywords:** Health information and communication technologies; Acceptance; Community-dwelling older adults.

## INTRODUCTION

The demographic shift towards an aging population with a higher prevalence of chronic diseases not only increases the demand for elder care in both the quality and variety of health services; it also puts pressure on healthcare systems. The development and use of information and communication technologies (HICTs) could help reduce costs and improve the quality of care and thereby rise up to the challenge of satisfying the increasing demand for healthcare in an aging population [1-5].

HICTs include various types and functionalities that can be categorized into assistive information technology, electronic health records, telecare, decision support systems and web-based packages [6]. They present opportunities for healthcare systems to improve the care and management of chronic diseases through the home monitoring of clinical signs and symptoms, mobility and behaviours [7, 8]. They also may help older individuals to live independently at home [2] as well as benefit from an improved quality of life and care [6, 9]. However, the adoption of such technologies remains a challenge [10]. Indeed, users may be reluctant to utilize such technologies [11] because of ethical concerns for their personal privacy and security related to the exchange of electronic health information (data confidentiality) [12], their lack of trust and confidence in the reliability of technology [13], their lack of familiarity with technology [14], as well as the risk of dehumanization and losing their intimacy [15].

The behavioural intention to use (acceptance of) HICTs is a prerequisite to benefit from the potential solutions provided through the deployment of them; the reluctance to accept HICTs may increase the risk of rejection and lead to implementation failure [11]. Several studies on HICTs mostly used qualitative methods [5] and applied various analysis models and theories to assess the acceptance of HICTs [4], exploring barriers and facilitators of their adoption [12] and systematically reviewing the application and use of health technologies [6, 13] among older adults. A population-based approach to older populations' readiness to accept HICTs in their home is crucial for public health policy

development in the current demographic context. Using population-based data, our first aim was to explore community-dwelling older adults' behavioural intention to use (or hereafter acceptance of) HICTs and to detect factors related to their overall acceptance and overall refusal. A second aim was to identify the characteristics related to participants' concerns about confidentiality in the subgroup of older adults willing to accept communication technologies.

## METHODS

### *Study population and data collection*

Data was drawn from the Lausanne cohort 65+ (Lc65+), a population-based observational cohort study launched in 2004 to investigate aging and the development of frailty from the age of 65 years in the general population living in Lausanne, Switzerland. Three representative samples of the community-dwelling population of Lausanne city enrolled at the age of 65 to 70 years were randomly selected in 2004, 2009, and 2014, resulting in a cohort of 4,731 persons. Detailed descriptions of the study design have been reported elsewhere [14]. The current study targeted surviving, non-institutionalized participants still living in Lausanne on January 1, 2017. **Supplementary Figure 1** illustrates the selection process. On January 4, 2017, overall, 3,366 eligible 69 to 83 year-old subjects received a self-completion postal questionnaire focusing on care and 3,195 (94.9%) responded. The participants' viewpoints on HICTs were assessed as part of the postal survey on care. The data collected in this survey was integrated to the 2004-2016 Lc65+ database that provides data about participants' characteristics, i.e., sociodemographic and health-related data that were collected in the Lc65+ baseline (education) and 2016 follow-up (other variables) postal questionnaires. The study protocol was approved by the Ethics Committee of the Faculty of Biology and Medicine of the University of Lausanne (Protocol No. 19/04).

*Sociodemographic and health related measures*

Socio-demographic data included gender; age groups in 2017 (69–73, 74–78 and 79–83 years old); educational level (at the time of enrolment) categorized according to the International Standard Classification of Education (ISCED) [15] as low (obligatory school or ISCED 0-2), medium (apprenticeship or ISCED 3), or high (college, university degree or equivalent or ISCED 4-8); and living arrangement (alone vs. not alone). Health-related data included medical diagnoses, difficulties in activities of daily living (ADLs), depressive symptoms and mental impairments. For medical diagnoses, participants were asked whether they suffered from or received treatment for any of the twelve following selected health conditions or diseases, diagnosed by a physician, over the last 12 months: hypertension, myocardial ischemia, other heart disease, stroke, diabetes, chronic lung disease, asthma, osteoporosis, arthrosis or arthritis, malignant neoplasm, ulcer and Parkinson's disease. The number of reported medical diagnoses was categorized into three groups ('zero', 'one', 'two or more'). Difficulties in basic ADLs (feeding, bathing, dressing, using the toilet, and getting up from bed or lying on a bed) were defined as current difficulties or help received in at least one of Katz' activities [16]. Difficulties in instrumental ADLs (housework, shopping, preparing meals, using a phone, preparing drugs and managing money) were defined as current difficulties or help received in at least one of Lawton's activities [17]. Difficulty in daily living activities was further categorized into three groups, i.e., 'no difficulty in ADLs', 'difficulties only in instrumental ADLs' and 'difficulties in basic ADLs'. Regarding depressive symptoms, participants were asked the following questions of the Primary Care Evaluation of Mental Disorders Procedure: "During the past month, have you often been bothered by 1) feeling down, depressed, or hopeless?; 2) having little interest or pleasure in doing things?" A positive answer to any of these two questions or to both was interpreted as the sign of depressive symptoms [18]. For mental impairments, participants were asked whether they had been disturbed for at least 6 months by "1) any memory gap that affect your daily life; 2) any difficulty in concentrating; and 3) any difficulty

in making decisions in your daily life". Presence of mental impairments was defined as a positive answer to any of the three questions [19].

### *Acceptance of health related technology*

From the five main categories of HICTs, i.e., 'assistive information technology', 'electronic health records', 'telecare', 'decision support systems', and 'web-based packages', we selected examples of the first three categories: a remote alarm and a position sensor for assistive information technology; an electronic health card for electronic health records; and an electronic scale, a blood pressure measurement device and blood analysis device for telecare, respectively. The two last categories were not considered because the category "decision support systems" is mainly related to healthcare professionals and the category "web-based packages" is very broad in terms of audiences and applications. Moreover, because an HICT may be accepted in various ways depending on modalities (i.e., the visibility of the device, the accessibility of HICT data, or the necessity of a self-aggressive act), we further differentiated examples: a remote alarm activated by a bracelet versus by a key in the pocket for considering the visibility of devices; an electronic health card and a blood pressure measurement device with data available to the physician versus to other healthcare providers for considering the accessibility of data; a blood pressure measurement device versus a blood test device implying a self-puncture for considering self-aggressive acts within telecare.

The assessment of participants' viewpoints on HICTs started with an introductory text: "Technology can extend home support for frail people or facilitate the monitoring of chronic diseases. However, it raises questions about their acceptability (risks related to intimacy, data confidentiality, dehumanization, etc.)". The assessment was followed by a close-ended question, i.e., "would you accept the following technologies in your home if they were offered to you due to your health conditions?" in 9 HICT items: 1) A remote alarm that you activate with a bracelet; 2) A remote alarm

that you activate with a key in your pocket; 3) Position sensors integrated into walls or floors, automatically triggering an alarm in the event of a fall; 4) An electronic health card storing the results of your examinations and treatments, protected by a code accessible to your physician; 5) An electronic health card storing the results of your examinations and treatments, protected by a code accessible to all your caregivers; 6) An electronic scale that automatically communicates your weight to the home care professionals; 7) A device for measuring your blood pressure, which automatically communicates results to your physician; 8) A device for measuring your blood pressure, which automatically communicates results to home care professionals; and 9) A device for pricking your fingertip and analysing the blood, which automatically sends results to your physician. For each item, participants were asked to select one of the three response choices: "yes, without reluctance", "yes, but with reluctance" and "no".

*Statistical analysis*

Descriptive statistics (frequencies) were used to present participants' characteristics and their declared acceptance of HICTs. Results were expressed as the number and percentage of participants. A bivariate analysis was performed using chi square tests to examine gender and age differences in participants' acceptance of HICTs. Two logistic regression models were defined for multivariable analyses of participants' overall acceptance and overall refusal of HICTs. The first model (overall acceptance) contrasted those who answered "yes, without reluctance" to the principle of 'remote alarm', 'position sensor', 'electronic health card' and 'telecare' (modalities such as the type of device or the recipients of data collected by HICTs were not taken into account in this case) from all the other participants. The second model (overall refusal) contrasted those who answered "no" to the four types of technologies from all the other participants. Independent variables included gender, age group, educational level category, living arrangement, medical diagnoses, difficulty in ADLs, depressive symptoms and mental impairments. Further multivariable logistic regressions were conducted in two subgroups of

participants: 1) those accepting the electronic health card technology with data accessible to their physicians. They contrasted participants who accepted an access to data recorded on their card limited to their physician from those who accepted the access to both their physician and other caregivers; 2) those accepting an access to blood pressure data limited to their physician. They contrasted participants who accepted an access to data recorded on their blood pressure device to their physician from those who accepted the access to the home care professionals. Statistical significance was considered for a two-side test with $p<0.05$. As sensitivity analyses, all the bivariate logistic regression models were fitted once again using each medical diagnosis separately (instead of grouping them) as independent variables. All statistical analyses were performed using Stata software version 15.0 (Stata Corp, College Station, TX, USA).

## RESULTS

### *Characteristics of participants*

The majority of participants were women; most of them were aged between 69-73 years with high education and cohabiting **(Table 1)**. Regarding health-related characteristics, the majority of participants had one or more medical diagnoses, but reported no difficulties in ADLs. While about a quarter of participants had depressive symptoms, they mainly reported no mental impairments.

### *Acceptance of the health-related technologies*

"Acceptance without reluctance" was the most frequent answer to all HICT items, except for the "position sensors" and "electronic scale" which were rejected by most participants (**Table 2)**. Whereas most participants accepted the device to measure blood pressure with automatic

communication of results to their physician, most of them rejected such communication to the home care professionals. "Acceptance with reluctance" was the least frequent answer for all the items.

### *Gender and age differences in acceptance of HICTs*

Significant gender differences were observed only in the acceptance of a "remote alarm activated by a bracelet" (higher acceptance in women, P<0.001), an "electronic scale" (higher acceptance in men, P<0.001), an "electronic health card accessible to all caregivers" (higher acceptance in men, P<0.001), and a "device to measure blood pressure with communication to the home care professionals") (higher acceptance in men, P=0.008).

Analyses stratified by gender, presented in **Figure 1**, indicated significant age group differences in women's acceptance of every technology, with a decreasing trend over age. For men, there were significant declining age trends in acceptance of a "remote alarm activated by a key" (P=0.017), an "electronic health card accessible to the physician" (P<0.001) and a "Blood analysis device" (P=0.009) only.

### *Determinants of acceptance or refusal of all HICTs*

The frequencies and determinants of participants' acceptance as well as rejection of all the proposed health-related technologies are presented in **Table 3.** Overall, 20.2% accepted all the HICTs without reluctance and 9.9% rejected all of them. Women were less likely than men to accept all HICTs without reluctance (OR=0.82; P=0.046) as well as to refuse all (OR=0.52; P<0.001) technologies. The overall acceptance rate was significantly lower in participants who were older, with

low education and with difficulties in ADLs. Reversely, those who were older, had low and middle education and had difficulties in basic ADLs were more likely to reject all the proposed technologies.

### *Determinants of acceptance of the accessibility of results to the physician and other caregivers*

Among 1,329 participants who accepted an electronic health card accessible to their physician, 150 (11.3%) refused the access to results by all caregivers. Out of 1,266 participants who accepted a blood pressure device with physician's access to results, 181 (14.3%) refused the transmission of results to the home care professionals. The determinants of the participants' acceptance of the accessibility of results to non-physicians (all caregivers/home care professionals), identified in multivariable analyses, are presented in **Table 4.** Women and those participants reporting depressive symptoms were less likely to accept the accessibility of data recorded on an electronic health card to all caregivers. Women and those having difficulties in any kind of ADLs (basic or instrumental) were less likely to accept that blood pressure measurements be sent to home care professionals.

### *Sensitivity analyses*

The sensitivity analysis considering each medical diagnosis separately indicated no significant association between any diagnosis and accepting all technologies, and only those with diabetes diagnosis were significantly more likely to reject all proposed technologies (OR=1.95; P<0.001) (**Supplementary table 1**). The sensitivity analysis considering each medical diagnosis separately showed no association between any diagnosis and the acceptance of accessibility of results to all caregivers versus only to physicians **(Supplementary table 2).**

## DISCUSSION

This population-based study explored the acceptance of several HICTs by community-dwelling Swiss older adults aged 69 to 83 years. 'Acceptance without reluctance' ranged from 26.4% to 70.4% and it was the most frequent answer to six out of nine HICT items. This study portrayed the acceptance as well as the refusal of specific HICTs across age and gender categories in the general population. The decreasing acceptance of each of the proposed technologies across age groups in the whole population might be interpreted as "generational differences" [13] and "age-related digital divide". In other words, despite all the potential advantages that HICTs may have, older adults are less likely to use information technology in general [20]. We observed significant age group differences that were consistent in all analyses among women. However, the more consistent statistical significance of age effects among women could be due to the larger sample size of women compared to men in this study.

In addition, those with low education and any difficulty in ADLs were less likely to accept all HICTs, whereas those with low and middle education and difficulty in basic ADLs were more likely to reject all HICTs. Regarding education, people with different levels of education may not understand the survey question in the same way. Alternatively, they may understand the benefits of the proposed technologies differently. The effect of attaining higher levels of education on the acceptance of technologies was consistent with findings in other studies [21]. Having difficulties in ADLs was also found to be negatively associated with the acceptance of all the technologies. Social factors such as stigma, shame and the fear of being perceived as dependent may play a role [22, 23]. The fear of social isolation may also induce a reluctance to accept HICTs; older persons may be concerned that technologies may replace human interactions [22]. Several studies further showed different results regarding medical diagnoses or symptoms and technology acceptance. The number of self-reported chronic diseases positively influenced the acceptance of a vital signs monitoring system, but not the acceptance of a motion monitoring system [24]. Also, the number of self-reported symptoms

influenced the acceptance of an electronic safety device [25] and the number of drug prescriptions was a predictor of the willingness to use an electronic device [21].

Different patterns emerged from the analyses and highlighted the importance of the type and functionalities of each technology. For the first category of HICTs (i.e., assistive information technology), we proposed three types of technology: 'remote alarm as a bracelet', 'remote alarm as a key' and 'position sensor'. A comparison of the first two types (both portable) showed that the acceptance rate of a remote alarm was higher when it was presented as a bracelet than when it was presented as a key. This finding may have different explanations such as ease of use (convenient), design, and risk of loss. A key is less visible than a bracelet, as the user can hide it in a pocket (in case of fear of stigma), but it is also more likely to be lost, particularly in case of cognitive decline. Other studies mentioned the necessity to address older adults' potential limitations such as cognitive impairments in designing health technologies [26-28]. Furthermore, the acceptance rate of both portable remote alarms was higher than the 'position sensor' which either is fixed or environmental (integrated into the walls or the floors). Older adults may perceive environmental position sensors as more intrusive into their personal life and as being more likely to set off the alarms unnecessarily, since recordings are not triggered by the user. This may also imply the necessity of considering the "ease of use" as well as the operational limitation of sensors fixed to the places where the sensors have been deployed [29, 30]. Indeed, results of qualitative research support the hypothesis that differential acceptance according to alternative types of HICT designed to fit the same need may be related to beliefs about usefulness, ease of use and the perceived reliability of the equipment [10, 31].

Regarding the second category of HICTs (i.e., electronic health records), an 'electronic health card' with two modes of accessibility of results (i.e., to the physician versus to all caregivers) was

proposed. The acceptance rate was higher if access to the results was limited to the physician. This preference for allowing only the physician to access results was confirmed by the observation of the third category of HICTs (i.e., telecare), where a 'blood pressure measurement device' was proposed with two modes of accessibility of results (to the physician versus to home care professionals). Similarly, the acceptance rate of an 'electronic scale' that would automatically communicate weight results to home care professionals (no other option proposed) was low. This may be due to the obesity stigma and perceived provider discrimination [32].

The better acceptance recorded for the accessibility of results to physicians exclusively suggests confidentiality and privacy concerns that have been reported in other studies; such concerns are, in turn, affected by the device type [22, 33]. In this regard, data access restricted to physicians was associated with female gender, difficulty in basic ADLs and depressive symptoms for the 'electronic health card', and with female gender and difficulty in ADLs for 'blood pressure measurement device'. These findings may indicate that women are more concerned about confidentiality issues than men. Furthermore, they may convey same concerns emphasizing fear of stigma related to depression and dependency due to the difficulty in ADLs [22, 23, 34].

### *Strengths and limitations*

This study took advantage of exploring community-dwelling older adults' perspective on the acceptance of various types and functionalities of HICTs. The main limitation of this study is merely to address the "theoretical" acceptance that may differ from the final acceptance; indeed such theoretical acceptance may change in practice when the decision must be taken because of realized needs. Moreover, future research should consider and explore exogenous factors that might influence responses. Exogenous factors could include 'situational' or 'environmental' factors such as facilitating conditions and 'previous experiences'. Finally, we observed that participants' acceptance of proposed

technologies varied according to the designs and functionalities of devices. However, our data did not allow us to explore the reasons behind this variation; therefore, qualitative research on these reasons is needed.

## CONCLUSION

HICTs are well accepted by older people and may improve the delivery of healthcare services to an aging population while bringing benefits at individual level. Nevertheless, several issues require consideration. First, the population's profile (e.g. low education level, difficulty in ADLs, suffering from depression symptoms) that seems to be influential in shaping the overall attitude to HICTs should be taken into account. Second, raising older population's awareness of the potential benefits of proposed technologies and reassuring targeted population about data confidentiality can be seen as strategies to improve HICTs acceptance. Finally, the deployment of HICTs requires design and functionality considerations for an aging population, as well as the recognition of confidentiality concerns.

### CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

### FUNDING

This study was supported by the Swiss National Foundation for Scientific Research (grant 407440-167459/1 National Research Program 74 Smarter Health Care). The Lc65+ study has been supported by the University of Lausanne Hospital Centre; University of Lausanne Department of Ambulatory Care and Community Medicine; Canton de Vaud Department of Public Health; City of Lausanne; Loterie Romande [research grants 2006-2008 & 2018-2019]; Lausanne University Faculty of Biology and Medicine [multidisciplinary research grant 2006]; Swiss National Foundation for Scientific Research

[grant 3247B0-120795/1]; and Fondation Médecine Sociale et Préventive, Lausanne. The sponsors had no role in the design, execution, analysis and interpretation of data, or writing of the study.

**REFERENCES**

1. Damiani, G., et al., *Patterns of Long Term Care in 29 European countries: evidence from an exploratory study.* BMC Health Serv Res, 2011. **11**: p. 316.
2. Steele, R., et al., *Elderly persons' perception and acceptance of using wireless sensor networks to assist healthcare.* Int J Med Inform, 2009. **78**(12): p. 788-801.
3. Damiani, G., et al., *An ecological study on the relationship between supply of beds in long-term care institutions in Italy and potential care needs for the elderly.* BMC Health Serv Res, 2009. **9**: p. 174.
4. Quaosar, G.A.A., M.R. Hoque, and Y. Bao, *Investigating Factors Affecting Elderly's Intention to Use m-Health Services: An Empirical Study.* Telemedicine and e-Health, 2018. **24**(4): p. 309-314.
5. Money, A.G., et al., *Using the Technology Acceptance Model to explore community dwelling older adults' perceptions of a 3D interior design application to facilitate pre-discharge home adaptations.* BMC Med Inform Decis Mak, 2015. **15**: p. 73.
6. Vedel, I., et al., *Health information technologies in geriatrics and gerontology: a mixed systematic review.* Journal of the American Medical Informatics Association, 2013. **20**(6): p. 1109-1119.
7. Kitsiou, S., G. Paré, and M. Jaana, *Effects of home telemonitoring interventions on patients with chronic heart failure: an overview of systematic reviews.* Journal of medical Internet research, 2015. **17**(3).
8. Czaja, S.J., *Long-term care services and support systems for older adults: The role of technology.* American Psychologist, 2016. **71**(4): p. 294.
9. Miskelly, F.G., *Assistive technology in elderly care.* Age and ageing, 2001. **30**(6): p. 455-458.
10. Middlemass, J.B., J. Vos, and A.N. Siriwardena, *Perceptions on use of home telemonitoring in patients with long term conditions - concordance with the Health Information Technology Acceptance Model: a qualitative collective case study.* BMC Med Inform Decis Mak, 2017. **17**(1): p. 89.
11. Miltgen, C.L., A. Popovič, and T. Oliveira, *Determinants of end-user acceptance of biometrics: Integrating the "Big 3" of technology acceptance with privacy context.* Decision Support Systems, 2013. **56**: p. 103-114.
12. Logue, M.D. and J.A. Effken, *An exploratory study of the personal health records adoption model in the older adult with chronic illness.* Journal of Innovation in Health Informatics, 2013. **20**(3): p. 151-169.
13. Fischer, S.H., et al., *Acceptance and use of health information technology by community-dwelling elders.* International journal of medical informatics, 2014. **83**(9): p. 624-635.
14. Santos-Eggimann, B., et al., *The Lausanne cohort Lc65+: a population-based prospective study of the manifestations, determinants and outcomes of frailty.* BMC geriatrics, 2008. **8**(1): p. 20.
15. UNESCO. 2011 27 Aug 2018]; Available from: http://www.uis.unesco.org/Education/Pages/international-standard-classification-of-education.aspx.
16. Katz, S., et al., *Studies of illness in the aged: recovery after fracture of the hip.* Journal of gerontology, 1964. **19**(3): p. 285-293.
17. Lawton, M.P. and E.M. Brody, *Assessment of older people: self-maintaining and instrumental activities of daily living.* Gerontologist, 1969. **9**(3): p. 179-86.
18. Whooley, M.A., et al., *Case-finding instruments for depression. Two questions are as good as many.* J Gen Intern Med, 1997. **12**(7): p. 439-45.
19. Henchoz, Y., et al., *Chronic symptoms in a representative sample of community-dwelling older people: a cross-sectional study in Switzerland.* BMJ open, 2017. **7**(1): p. e014485.

20. Niehaves, B. and R. Plattfaut, *Internet adoption by the elderly: employing IS technology acceptance theories for understanding the age-related digital divide.* European Journal of Information Systems, 2014. **23**(6): p. 708-726.
21. Cohen-Mansfield, J., et al., *Electronic memory aids for community-dwelling elderly persons: Attitudes, preferences, and potential utilization.* Journal of Applied Gerontology, 2005. **24**(1): p. 3-20.
22. Kang, H.G., et al., *In situ monitoring of health in older adults: technologies and issues.* Journal of the American Geriatrics Society, 2010. **58**(8): p. 1579-1586.
23. Melenhorst, A.-S. and W.A. Rogers, *When Will Technology in the Home Improve the Quality of Life.* New dynamics in old age: Individual, environmental and societal perspectives, 2017: p. 253.
24. Lai, C.K., et al., *A survey of older Hong Kong people's perceptions of telecommunication technologies and telecare devices.* Journal of telemedicine and telecare, 2010. **16**(8): p. 441-446.
25. Chappell, N.L. and Z. Zimmer, *Receptivity to new technology among older adults.* Disability and rehabilitation, 1999. **21**(5-6): p. 222-230.
26. Lorenz, A. and R. Oppermann, *Mobile health monitoring for the elderly: Designing for diversity.* Pervasive and Mobile Computing, 2009. **5**(5): p. 478-495.
27. Demiris, G., *Home based e-health applications*. Stud Health Technol Inform. Vol. 106. 2004. 15-24.
28. Demiris, G. and H. Thompson, *Smart Homes and Ambient Assisted Living Applications: From Data to KnowledgeEmpowering or Overwhelming Older Adults?* Yearbook of medical informatics, 2011. **20**(01): p. 51-57.
29. Igual, R., C. Medrano, and I. Plaza, *Challenges, issues and trends in fall detection systems.* Biomedical engineering online, 2013. **12**(1): p. 66.
30. Rougier, C., et al., *Robust video surveillance for fall detection based on human shape deformation.* IEEE Transactions on circuits and systems for video Technology, 2011. **21**(5): p. 611-622.
31. Kim, J. and H.-A. Park, *Development of a health information technology acceptance model using consumers' health behavior intention.* Journal of medical Internet research, 2012. **14**(5).
32. Fruh, S.M., et al., *Obesity Stigma and Bias.* J Nurse Pract, 2016. **12**(7): p. 425-432.
33. Caine, K.E., A.D. Fisk, and W.A. Rogers. *Benefits and privacy concerns of a home equipped with a visual sensing system: A perspective from older adults*. in *Proceedings of the human factors and ergonomics society annual meeting*. 2006. Sage Publications Sage CA: Los Angeles, CA.
34. de Mendonca Lima, C.A., et al., *Stigma and discrimination against older people with mental disorders in Europe.* Int J Geriatr Psychiatry, 2003. **18**(8): p. 679-82.

Accepted author's manuscript. International Journal of Medical Informatics.
Publisher DOI: https://doi.org/10.1016/j.ijmedinf.2019.08.010

**Table 1**: Characteristics of the 3195 included participants

| | **Number (%)** |
|---|---|
| **Gender** | |
| **Men** | 1301 (40.7) |
| **Women** | 1894 (59.3) |
| **Age (years)** | |
| **69-73** | 1304 (40.8) |
| **74-78** | 1035 (32.4) |
| **79-83** | 856 (26.8) |
| **Education** | |
| **High** | 1421 (44.5) |
| **Middle** | 1244 (39.0) |
| **Low** | 527 (16.5) |
| **Living arrangement** | |
| **Not alone** | 1831 (57.5) |
| **Alone** | 1355 (42.5) |
| **Medical diagnoses** | |
| **0** | 1070 (33.6) |
| **1** | 1138 (35.7) |
| **2 or more** | 979 (30.7) |
| **Difficulty in ADLs** | |
| **Not in basic nor in instrumental** | 1638 (51.5) |
| **Only in instrumental** | 1044 (32.9) |
| **In basic with/without in instrumental** | 496 (15.6) |
| **Depressive symptoms** | |
| **No** | 2403 (75.5) |
| **Yes** | 781 (24.5) |
| **Mental impairments** | |
| **No** | 2680 (84.2) |
| **Yes** | 504 (15.8) |

Accepted author's manuscript. International Journal of Medical Informatics.
Publisher DOI: https://doi.org/10.1016/j.ijmedinf.2019.08.010

**Table 2**: Acceptance of health-related technologies (number (%))

| Items | Acceptance | | |
|---|---|---|---|
| | **Yes without reluctance** | **Yes, but with reluctance** | **No** |
| **Remote alarm as a bracelet** | 2167 (70.4) | 411 (13.4) | 500 (16.2) |
| **Remote alarm as a key** | 1372 (47.0) | 442 (15.1) | 1108 (37.9) |
| **Position sensor** | 1145 (38.5) | 573 (19.3) | 1256 (42.2) |
| **Electronic health card (accessibility of results to physician)** | 1698 (56.4) | 483 (16.0) | 831 (27.6) |
| **Electronic health card (accessibility of results to all caregivers)** | 1229 (40.9) | 704 (23.4) | 1074 (35.7) |
| **Electronic scale** | 788 (26.4) | 390 (13.1) | 1807 (60.5) |
| **Blood pressure device (accessibility of results to physician)** | 1534 (50.8) | 468 (15.5) | 1019 (33.7) |
| **Blood pressure device (accessibility of results to home care professionals)** | 1111 (37.1) | 581 (19.4) | 1302 (43.5) |
| **Blood analysis device** | 1379 (45.6) | 509 (16.8) | 1139 (37.6) |

Accepted author's manuscript. International Journal of Medical Informatics.
Publisher DOI: https://doi.org/10.1016/j.ijmedinf.2019.08.010

**Table 3 - Determinants of accepting all and rejecting all the proposed health technologies**

| | Overall acceptance (N=3017) | | Overall rejection (N=3121) | |
|---|---|---|---|---|
| | Accepted all[§] N (%) | OR (95% CI) | Rejected all[§§] N (%) | OR (95% CI) |
| **Total** | 608 (20.2) | | 310 (9.9) | |
| **Gender** | | | | |
| **Man** | 295 (23.5) | 1 (ref.) | 162 (12.6) | 1 (ref.) |
| **Woman** | 313 (17.8) | 0.82 (0.67 – 1.00)* | 148 (8.1) | 0.52 (0.40 - 0.68)*** |
| **Age group** | | | | |
| **69-73** | 283 (22.7) | 1 (ref.) | 104 (8.1) | 1 (ref.) |
| **74-78** | 195 (19.9) | 0.90 (0.73 - 1.11) | 100 (9.9) | 1.25 (0.93 - 1.68) |
| **79-83** | 130 (16.5) | 0.78 (0.61 - 0.99)* | 106 (12.7) | 1.54 (1.14 - 2.09)** |
| **Education** | | | | |
| **High** | 315 (23.0) | 1 (ref.) | 95 (6.8) | 1 (ref.) |
| **Middle** | 223 (19.1) | 0.83 (0.69 - 1.01) | 132 (10.9) | 1.71 (1.29 - 2.27)*** |
| **Low** | 70 (14.7) | 0.65 (0.48 - 0.86)** | 82 (16.2) | 2.89 (2.07 - 4.02)*** |
| **Living arrangement** | | | | |
| **Not alone** | 382 (21.9) | 1 (ref.) | 187 (10.5) | 1 (ref.) |
| **Alone** | 225 (17.7) | 0.89 (0.73 - 1.08) | 120 (9.0) | 0.93 (0.72 - 1.21) |
| **Medical diagnoses** | | | | |
| **0** | 217 (21.4) | 1 (ref.) | 100 (9.6) | 1 (ref.) |
| **1** | 232 (21.6) | 1.11 (0.89 - 1.37) | 120 (10.8) | 1.12 (0.84 - 1.49) |
| **2 or more** | 158 (17.1) | 0.94 (0.74 - 1.19) | 87 (9.1) | 0.82 (0.60 - 1.14) |
| **Difficulty in ADLs** | | | | |
| **Not in basic nor in instrumental** | 374 (23.8) | 1 (ref.) | 150 (9.3) | 1 (ref.) |
| **Only in instrumental** | 169 (17.4) | 0.77 (0.62 - 0.96)* | 91 (9.0) | 1.01 (0.75 - 1.36) |
| **In basic with/without in instrumental** | 64 (13.9) | 0.62 (0.45 - 0.84)** | 65 (13.4) | 1.44 (1.02 - 2.04)* |
| **Depressive symptoms** | | | | |
| **No** | 488 (21.5) | 1 (ref.) | 232 (9.9) | 1 (ref.) |
| **Yes** | 118 (16.1) | 0.86 (0.68 - 1.10) | 75 (9.8) | 0.9 (0.66 - 1.23) |
| **Mental impairments** | | | | |
| **No** | 523 (20.7) | 1 (ref.) | 249 (9.5) | 1 (ref.) |
| **Yes** | 84 (17.7) | 1.06 (0.80 - 1.39) | 57 (11.5) | 1.14 (0.82 - 1.59) |

Results are expressed as number (%); multivariate-adjusted odds ratio (OR) and 95% confidence intervals (95% CI). Statistical analysis using logistic regression considering the group "accepting of all proposed technologies" as reference and using all variables in the table as covariates. The same analysis was done for the group "rejecting all the proposed technologies".

§ Those who accepted (without reluctance) all the proposed health technologies.

§§ Those who rejected all the proposed health technologies.

* = P<0.05; ** = P<0.01; *** = P<0.001

Accepted author's manuscript. International Journal of Medical Informatics.
Publisher DOI: https://doi.org/10.1016/j.ijmedinf.2019.08.010

**Table 4 - Determinants of accepting accessibility of results to all caregivers/home care professionals versus only to physicians**

| | Accessibility of results of health card to physicians (N=1329) | | Accessibility of results of blood pressure device to physicians (N=1266) | |
|---|---|---|---|---|
| | Accessible to all[§] N (%) | OR (95% CI) | Accessible to all[§§] N (%) | OR (95% CI) |
| **Total** | 1179 (88.7) | | 1085 (85.7) | |
| **Gender** | | | | |
| **Man** | 556 (92.4) | 1 (ref.) | 499 (89.1) | 1 (ref.) |
| **Woman** | 623 (85.7) | 0.51 (0.34 - 0.76)** | 586 (83.0) | 0.67 (0.46 - 0.96)* |
| **Age group** | | | | |
| **69-73** | 535 (87.7) | 1 (ref.) | 500 (87.1) | 1 (ref.) |
| **74-78** | 392 (90.3) | 1.35 (0.90 - 2.04) | 346 (85.2) | 0.92 (0.63 - 1.34) |
| **79-83** | 252 (88.4) | 1.12 (0.71 - 1.78) | 239 (83.6) | 0.94 (0.62 - 1.44) |
| **Education** | | | | |
| **High** | 603 (88.9) | 1 (ref.) | 515 (87.1) | 1 (ref.) |
| **Middle** | 441 (88.2) | 0.98 (0.68 - 1.42) | 426 (84.9) | 0.92 (0.65 - 1.31) |
| **Low** | 135 (89.4) | 1.26 (0.70 - 2.29) | 144 (83.7) | 0.96 (0.59 - 1.57) |
| **Living arrangement** | | | | |
| **Not alone** | 708 (90.1) | 1 (ref.) | 664 (87.1) | 1 (ref.) |
| **Alone** | 470 (86.9) | 0.89 (0.62 - 1.29) | 420 (83.7) | 0.89 (0.63 - 1.26) |
| **Medical diagnoses** | | | | |
| **0** | 428 (88.3) | 1 (ref.) | 383 (88.9) | 1 (ref.) |
| **1** | 415 (89.6) | 1.30 (0.85 - 1.99) | 393 (84.5) | 0.74 (0.49 - 1.11) |
| **2 or more** | 335 (88.2) | 1.17 (0.74 - 1.84) | 308 (83.5) | 0.75 (0.49 - 1.16) |
| **Difficulty in ADLs** | | | | |
| **Not in basic nor in instrumental** | 670 (90.1) | 1 (ref.) | 633 (89.5) | 1 (ref.) |
| **Only in instrumental** | 365 (88.6) | 1.04 (0.68 - 1.59) | 329 (81.8) | 0.65 (0.45 - 0.95)* |
| **In basic with/without in instrumental** | 139 (83.2) | 0.58 (0.34 - 0.98)* | 122 (78.2) | 0.48 (0.29 - 0.78)** |
| **Depressive symptoms** | | | | |
| **No** | 939 (89.9) | 1 (ref.) | 845 (87.0) | 1 (ref.) |
| **Yes** | 236 (84.0) | 0.61 (0.40 - 0.93)* | 238 (81.8) | 0.91 (0.62 - 1.35) |
| **Mental impairments** | | | | |
| **No** | 1018 (88.4) | 1 (ref.) | 924 (86.0) | 1 (ref.) |
| **Yes** | 159 (90.3) | 1.65 (0.92 - 2.94) | 159 (84.1) | 1.08 (0.68 - 1.72) |

Results are expressed as number (%); multivariate-adjusted odds ratio (OR) and 95% confidence intervals (95% CI). Statistical analysis using logistic regression considering the group "accepting accessibility of results to both physician and all caregivers/home care professionals" as reference versus "accepting accessibility of results to physician but not to other caregivers/home care professionals" and using all variables in the table as covariates.

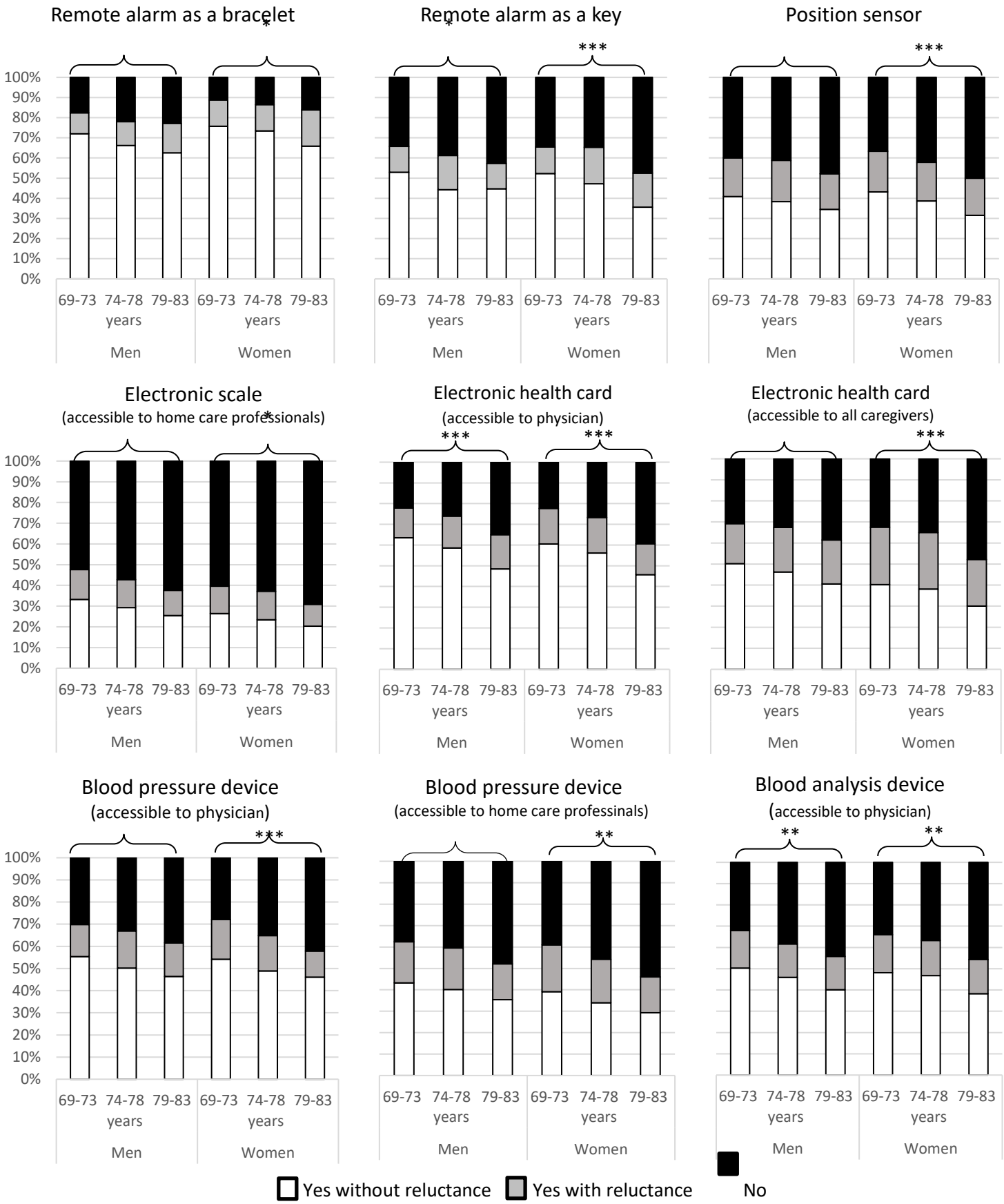
§ Those who accepted accessibility of results to all caregivers in addition to physician.

§§ Those who accepted accessibility of results to home care professionals in addition to physician.

* = P<0.05; ** = P<0.01; *** = P<0.001

Accepted author's manuscript. International Journal of Medical Informatics.
Publisher DOI: https://doi.org/10.1016/j.ijmedinf.2019.08.010

**Figure 1 :** Acceptance of health-related technologies by gender and age

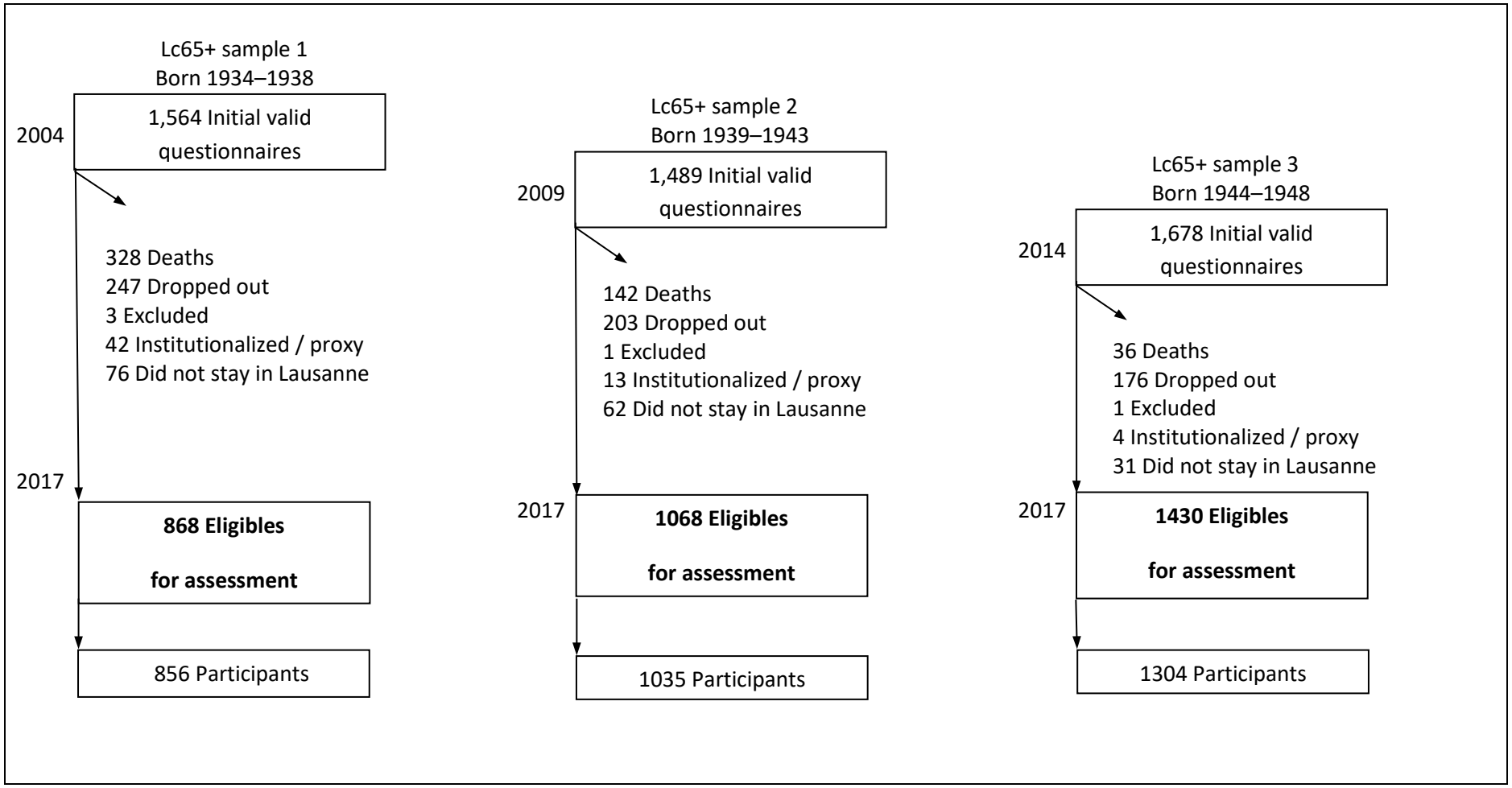


Accepted author's manuscript. International Journal of Medical Informatics.
Publisher DOI: https://doi.org/10.1016/j.ijmedinf.2019.08.010

*P<0.05; ** P<0.01; *** P<0.001 for age trend

Accepted author's manuscript. International Journal of Medical Informatics.
Publisher DOI: https://doi.org/10.1016/j.ijmedinf.2019.08.010

**Supplementary figure 1: selection procedure of participants**



Accepted author's manuscript. International Journal of Medical Informatics.
Publisher DOI: https://doi.org/10.1016/j.ijmedinf.2019.08.010

**Supplementary table 1 - Determinants of accepting all and rejecting all the proposed health technologies by different diagnoses**

| | Overall acceptance (N=3017) | | Overall rejection (N=3121) | |
|---|---|---|---|---|
| | Accepted all§ N (%) | OR (95% CI) | Rejected all§§ N (%) | OR (95% CI) |
| **Medical diagnoses** | | | | |
| **Hypertension** | | | | |
| **No** | 387 (20.0) | 1 (ref.) | 206 (10.2) | 1 (ref.) |
| **Yes** | 220 (20.5) | 1.03 (0.86 - 1.24) | 101 (9.1) | 0.88 (0.68 - 1.12) |
| **Myocardial ischemia** | | | | |
| **No** | 584 (20.2) | 1 (ref.) | 293 (9.8) | 1 (ref.) |
| **Yes** | 23 (19.5) | 0.96 (0.60 - 1.52) | 14 (11.5) | 1.19 (0.68 - 2.11) |
| **Other heart disease** | | | | |
| **No** | 565 (20.1) | 1 (ref.) | 275 (9.5) | 1 (ref.) |
| **Yes** | 42 (20.7) | 1.04 (0.73 - 1.47) | 32 (15.1) | 1.70 (1.14 - 2.52) |
| **Stroke** | | | | |
| **No** | 598 (20.1) | 1 (ref.) | 301 (9.8) | 1 (ref.) |
| **Yes** | 9 (25.0) | 1.32 (0.62 - 2.83) | 6 (15.0) | 1.63 (0.68 - 3.90) |
| **Diabetes** | | | | |
| **No** | 558 (20.6) | 1 (ref.) | 256 (9.1) | 1 (ref.) |
| **Yes** | 49 (16.3) | 0.75 (0.55 - 1.04) | 51 (16.4) | 1.95 (1.41 - 2.71)* |
| **Chronic lung disease** | | | | |
| **No** | 578 (20.4) | 1 (ref.) | 294 (10.0) | 1 (ref.) |
| **Yes** | 29 (17.1) | 0.80 (0.53 - 1.21) | 13 (7.3) | 0.70 (0.39 - 1.25) |
| **Asthma** | | | | |
| **No** | 586 (20.6) | 1 (ref.) | 293 (10.0) | 1 (ref.) |
| **Yes** | 21 (12.4) | 0.55 (0.34 - 0.87) | 14 (8.1) | 0.79 (0.45 - 1.38) |
| **Osteoporosis** | | | | |
| **No** | 560 (20.2) | 1 (ref.) | 284 (9.9) | 1 (ref.) |
| **Yes** | 47 (19.3) | 0.95 (0.68 - 1.32) | 23 (9.2) | 0.92 (0.59 - 1.44) |
| **Arthrosis or arthritis** | | | | |
| **No** | 452 (21.0) | 1 (ref.) | 231 (10.4) | 1 (ref.) |
| **Yes** | 155 (18.1) | 0.83 (0.68 - 1.02) | 76 (8.5) | 0.80 (0.61 - 1.05) |
| **Malignant neoplasm** | | | | |
| **No** | 579 (20.2) | 1 (ref.) | 297 (10.0) | 1 (ref.) |
| **Yes** | 28 (19.4) | 0.95 (0.62 - 1.45) | 10 (6.5) | 0.63 (0.33 - 1.20) |
| **Ulcer** | | | | |
| **No** | 601 (20.2) | 1 (ref.) | 305 (9.9) | 1 (ref.) |
| **Yes** | 6 (16.7) | 0.79 (0.33 - 1.91) | 2 (5.6) | 0.53 (0.13 - 2.24) |
| **Parkinson** | | | | |
| **No** | 604 (20.2) | 1 (ref.) | 305 (9.9) | 1 (ref.) |
| **Yes** | 3 (12.5) | 0.56 (0.17 - 1.89) | 2 (7.4) | 0.73 (0.17 - 3.10) |

Results are expressed as number (%); bivariable odds ratio (OR) and 95% confidence intervals (95% CI).

§ Those who accepted (without reluctance) all the proposed health technologies.

§§ Those who rejected all the proposed health technologies.

* = P<0.005 (Bonferroni adjustment was performed)

Accepted author's manuscript. International Journal of Medical Informatics.
Publisher DOI: https://doi.org/10.1016/j.ijmedinf.2019.08.010

**Supplementary table 2 - Determinants of accepting accessibility of results to all caregivers/home care professionals versus only to physicians by different diagnoses**

| | Accessibility of results of health card to physicians (N=1329) | | Accessibility of results of blood pressure device to physicians (N=1266) | |
|---|---|---|---|---|
| | Accessible to all[§] N (%) | OR (95% CI) | Accessible to all[§§] N (%) | OR (95% CI) |
| **Medical diagnoses** | | | | |
| **Hypertension** | | | | |
| **No** | 758 (88.2) | 1 (ref.) | 688 (87.4) | 1 (ref.) |
| **Yes** | 420 (89.6) | 1.14 (0.80 - 1.64) | 396 (82.9) | 0.69 (0.51 - 0.95) |
| **Myocardial ischemia** | | | | |
| **No** | 1132 (88.4) | 1 (ref.) | 1038 (85.6) | 1 (ref.) |
| **Yes** | 46 (95.8) | 3.01 (0.72 - 12.52) | 46 (88.5) | 1.29 (0.54 - 3.07) |
| **Other heart disease** | | | | |
| **No** | 1103 (88.5) | 1 (ref.) | 1015 (85.7) | 1 (ref.) |
| **Yes** | 75 (91.5) | 1.39 (0.63 - 3.07) | 69 (86.3) | 1.05 (0.54 - 2.03) |
| **Stroke** | | | | |
| **No** | 1160 (88.6) | 1 (ref.) | 1069 (85.7) | 1 (ref.) |
| **Yes** | 18 (94.7) | 2.31 (0.31 - 17.44) | 15 (88.2) | 1.26 (0.28 - 5.54) |
| **Diabetes** | | | | |
| **No** | 1078 (88.5) | 1 (ref.) | 997 (85.9) | 1 (ref.) |
| **Yes** | 100 (90.9) | 1.30 (0.66 - 2.55) | 87 (83.7) | 0.84 (0.49 - 1.45) |
| **Chronic lung disease** | | | | |
| **No** | 1120 (88.8) | 1 (ref.) | 1026 (85.7) | 1 (ref.) |
| **Yes** | 58 (86.6) | 0.81 (0.39 - 1.67) | 58 (85.3) | 0.97 (0.48 - 1.93) |
| **Asthma** | | | | |
| **No** | 1117 (88.9) | 1 (ref.) | 1028 (85.6) | 1 (ref.) |
| **Yes** | 61 (85.9) | 0.76 (0.38 - 1.53) | 56 (87.5) | 1.18 (0.55 - 2.51) |
| **Osteoporosis** | | | | |
| **No** | 1086 (88.7) | 1 (ref.) | 1005 (86.1) | 1 (ref.) |
| **Yes** | 92 (88.5) | 0.97 (0.52 - 1.82) | 79 (80.6) | 0.67 (0.40 - 1.14) |
| **Arthrosis or arthritis** | | | | |
| **No** | 875 (89.8) | 1 (ref.) | 796 (87.2) | 1 (ref.) |
| **Yes** | 303 (85.6) | 0.67 (0.47 - 0.97) | 288 (81.8) | 0.66 (0.47 - 0.92) |
| **Malignant neoplasm** | | | | |
| **No** | 1119 (88.9) | 1 (ref.) | 1034 (85.6) | 1 (ref.) |
| **Yes** | 59 (85.5) | 0.74 (0.37 - 1.48) | 50 (87.7) | 1.20 (0.54 - 2.69) |
| **Ulcer** | | | | |
| **No** | 1167 (88.7) | 1 (ref.) | 1072 (85.6) | 1 (ref.) |
| **Yes** | 11 (91.7) | 1.40 (0.18 - 10.96) | 12 (92.3) | 2.01 (0.26 - 15.59) |
| **Parkinson** | | | | |
| **No** | 1170 (88.7) | 1 (ref.) | 1076 (85.7) | 1 (ref.) |
| **Yes** | 8 (88.9) | 1.02 (0.13 - 8.20) | 8 (80.0) | 0.67 (0.14 - 3.16) |

Results are expressed as number (%); bivariable odds ratio (OR) and 95% confidence intervals (95% CI).

§ Those who accepted accessibility of results to all caregivers in addition to physician.

§§ Those who accepted accessibility of results to home care professionals in addition to physician.

* = P<0.005 (Bonferroni adjustment was performed)