Evaluation of the effectiveness of personal electronic health assistants in monitoring patients with chronic diseases

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Abstract

Introduction: Chronic diseases pose significant challenges in healthcare, which has driven the development of electronic health solutions. The effectiveness of these solutions in the management of diseases such as hypertension has generated interest, but further in-depth, evidence-based evaluation is required.

Objective: The study aims to comprehensively evaluate how a customizable web platform, called "HyperVigilance", influences blood pressure control in hypertensive patients, considering additional variables such as patient satisfaction, quality of life and costs associated with treatment. In addition, the aim is to explore possible demographic factors that could moderate the results.

Methodology: The study was conducted with a quasi-experimental research design that included an intervention group using the "HyperVigilance" platform and a control group receiving standard medical care. Statistical tests were applied and demographic factors such as age, gender and socioeconomic status were considered.

Results: The use of the "HyperVigilance" platform resulted in a significant reduction in blood pressure, increased patient satisfaction and a marked improvement in quality of life, as well as a reduction in the costs associated with the treatment of hypertension.

Conclusions: The study concludes that the "HyperVigilance" platform is effective in controlling blood pressure and improving quality of life in patients with hypertension. The results support the growing role of digital interventions in chronic disease management, but highlight the need for long-term studies and exploration of different populations for a more complete understanding of their impact.

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1. Introduction

Chronic diseases represent one of the most pressing challenges to global health today [1-8]. These conditions, which include diseases such as diabetes, hypertension, and cardiovascular disease, require continuous monitoring and effective management to prevent serious complications and improve patients' quality of life [9-13]. However, traditional monitoring of chronic diseases often has limitations in terms of accessibility, efficacy and cost [14-19], which has prompted the search for innovative approaches to improve patient care and self-care [20-24].

In this context, electronic health tools, or eHealth, have emerged as a promising solution for addressing the challenges associated with chronic disease [25-27]. These tools, which include mobile applications, customizable web platforms, and electronic personal health assistants [28-30], have the potential to overcome traditional barriers by providing more accessible support, real-time information [31-34] and personalized follow-up tools [35-38]. As technology continues to advance, the question arises as to whether these digital solutions can really make a difference in the lives of patients with chronic diseases [39-42].

While research in eHealth has yielded promising results in terms of improvements in treatment adherence and management of diseases such as diabetes [43-45], there is still a critical need for rigorous, evidence-based evaluations [46-49]. The evidence on the actual impact of eHealth tools on concrete clinical outcomes, such as blood pressure control in hypertensive patients, is mixed [50-53] and requires further investigation.

The fundamental objective of this study is to address this knowledge gap by comprehensively assessing how the use of a customizable web-based platform, called "HyperVigilance," influences blood pressure control in patients diagnosed with hypertension. In addition to blood pressure control, this study will analyze additional variables, such as satisfaction with care received, perceived quality of life, and costs associated with treatment. Demographic factors, such as age, gender, educational level, and socioeconomic status, will also be explored to better understand how these aspects may influence the effectiveness of eHealth interventions.

This original study has the potential to shed light on the impact of digital tools in chronic disease management, which could revolutionize the way patients and healthcare professionals approach these conditions. The results can not only inform clinical decision-making and the design of more effective care strategies, but also contribute to the growing field of eHealth and its role in improving healthcare and quality of life for patients.

2. Methods

Research Design

A quasi-experimental research design with comparative groups was used to evaluate the effects of the intervention on blood pressure control and other variables of interest. This design allowed consideration of demographic factors by stratifying the sample.

Population and Sample
The target population of the study consisted of hypertensive patients attending the East Primary Care Center. The inclusion criteria for participants were as follows: being aged between 18 and 65 years, having been diagnosed with hypertension for more than 6 months and not presenting. other diseases that could affect the results of the study. The sample size was calculated using the difference of proportions formula, considering 80% power and a confidence level of 95%.

Recruitment and consent
Potential participants who met the inclusion criteria were contacted and provided with a detailed explanation of the study. Subsequently, their informed consent or approval to participate in the study was requested, ensuring that they were fully informed and voluntarily consented to participate in the research.

Sampling
Stratified random sampling was carried out considering the factors of sex and age (under 50 years and 50 years or older). Then, each stratum was randomly assigned to one of two groups: the intervention group or the control group.

Intervention
The experimental group had access to the "HyperVigilance" platform for a period of 6 months. This web platform designed for the study allowed participants the following:

- Register and log in using a personal username and password.
- Monitor your blood pressure on a weekly basis using a Bluetooth digital blood pressure monitor connected to your account.
- Daily record of antidiabetic and antihypertensive medication consumed.
- Access informative content on lifestyle modifications recommended for hypertensive patients.
- Receive weekly email reminders about the importance of adherence to treatment.
- Redeem points accumulated through monitoring and registration for vouchers for healthy eating courses.

On the other hand, the control group continued to receive the usual medical care at the clinic following local protocols for the treatment of hypertension.

Variables and Measurements
The main variables measured in this study include:

Blood Pressure: Blood pressure readings were recorded before and after the intervention, as well as at 3 months after the intervention.

Satisfaction: Participants' satisfaction with the medical care received was assessed using a validated Likert scale.

Quality of Life: The validated health-related quality of life (HRQoL) questionnaire was used to assess the impact of hypertension and the intervention on perceived quality of life.

Costs: Data were collected on the direct and indirect costs associated with the treatment of hypertension.

Instruments
Validated digital blood pressure monitors were used to measure blood pressure, and validated Likert and HRQoL questionnaires were applied to assess satisfaction and quality of life, respectively.

Statistical Analysis

To analyze the data, analysis of variance (ANOVA), nonparametric tests (such as the Wilcoxon test) and moderation analysis (using logistic regression) were performed. These analyses were performed using SPSS 29.0 statistical software.

Ethical Considerations:
The study received approval from the University ethics committee and informed consent was obtained from all participants prior to their participation in the study.

3. Results

Effect of the HyperVigilance Platform on the Control of Blood Pressure.
To assess the impact of the HyperVigilance platform on blood pressure control, blood pressure readings were recorded at three different time points: before the intervention, after the intervention, and at 3 months post-intervention. The results are summarized in Table 1.

Table 1. Changes in Blood Pressure Over Time

Variable	Mean (SD)	Median	IQ Range
PA pre-intervention			
Intervention (N=50)	140.25 mmHg (7.12)	140 (10)	8
Control (N=50)	140.50 mmHg (6.98)	141 (10)	7
PA post-intervention			
Intervention (N=50)	130.75 mmHg (6.34)	130 (7)	7
Control (N=50)	139.75 mmHg (7.21)	140 (8)	9
PA 3 months later			
Intervention (N=50)	138.25 mmHg (5.86)	138 (6)	6
Control (N=50)	139.00 mmHg (7.50)	139 (7)	7.5

Table 1 presents a clear summary of the changes in participants' blood pressure throughout the study. At baseline, no significant differences in blood pressure readings were found between the Intervention group (140.25 mmHg) and the Control group (140.50 mmHg). However, after the intervention, the Intervention group showed a considerable reduction in blood pressure, with a mean of 130.75 mmHg, compared to the Control group, which maintained a mean of 139.75 mmHg. This positive trend in the Intervention group was maintained at 3 months later, with a mean of 138.25 mmHg. These results suggest that the HyperVigilance intervention had a significant impact on blood pressure reduction, supporting the efficacy of this intervention in the management of arterial hypertension.

Table 2. Results of Wilcoxon tests for blood pressure.

Variable	Group	Wilcoxon statistic (W)	p-value
PA pre-intervention	Intervention vs Control	1240	0.872
PA post-intervention	Intervention vs Control	190	0.001
PA at 3 months	Intervention vs Control	420	0.042

In Table 2, Wilcoxon tests comparing blood pressure (BP) at different time points of the study between the Intervention and Control groups are summarized. In pre-intervention BP, no significant differences were observed between groups (p>0.05), suggesting initial comparability. However, post-intervention, significant differences were found, with a p-value of 0.001 (p<0.01), supporting the effectiveness of the intervention in reducing BP. At 3 months post-intervention, although the differences are smaller, they persist, with a p-value of 0.042 (p<0.05). These results indicate that the intervention had a sustained positive impact on BP over time.

Participant Satisfaction and Quality of Life

Participants' satisfaction with the care received was assessed using a validated Likert scale. The results are presented in Table 3.

Satisfaction and quality of life

Variable	Mean (SD)	Median
Satisfaction		
- Intervention	4.8 (0.6)	5
- Control	3.2 (1.1)	3
Wilcoxon W statistic	90	p = 0.01

This table 3 presents the results of the Wilcoxon test to evaluate satisfaction between the Intervention and Control groups. The data reveal a statistically significant difference in satisfaction between these groups. The Intervention group obtained a mean score of 4.8, with a median of 5, indicating a relatively high level of satisfaction. In contrast, the Control group obtained a mean score of 3.2, with a median of 3, reflecting a lower level of satisfaction. The Wilcoxon W statistic was 90, with a p-value of 0.01, confirming the significant difference in satisfaction between the groups. These findings suggest that the intervention had a positive impact on the satisfaction of participants in the Intervention group compared to the Control group.

Regarding quality of life, the validated health-related quality of life questionnaire (HRQoL) was used. The results are presented in Table 4.

Table 4. Quality of Life Changes

Variable	Intervention Group (N=50)	Control Group (N=50)
Initial Quality of Life	60.2 ± 5.3	61.0 ± 5.1
Final Quality of Life	74.8 ± 6.2	62.2 ± 5.8
Change in Quality of Life	14.6 ± 4.1	1.2 ± 2.3
Cohen's d	3.15	0.26
Student's t statistic (p)	12.53 (0.001)	1.67 (0.12)

The findings in Table 4 reveal a significant improvement in the quality of life of the intervention group compared to the control group. An initial difference between the groups will be observed, with the intervention group showing a mean score of 60.2 ± 5.3 and the control group with 61.0 ± 5.1. After the intervention, the intervention group experienced a considerable change in quality of life, with an average final score of 74.8 ± 6.2, while the control group showed minimal change, with an average final score of 62.2 ± 5.8. Furthermore, the change in quality of life was significantly greater in the intervention group (14.6 ± 4.1) compared to the control group (1.2 ± 2.3). Both the "Cohen's d" value (3.15 for the intervention group and 0.26 for the control group) and the Student's t-test analysis (p<0.001) support the idea that the HyperVigilance intervention had a positive and significant impact on the quality of life of the participants in the intervention group.

Costs Associated with the Treatment of Hypertension
Data were collected on the direct and indirect costs associated with the treatment of hypertension in both groups. The results are presented in Table 5.

Table 5. Costs Associated with Hypertension Treatment

Type of Cost	Intervention Group (N=50)	Control Group (N=50)
Direct costs (medication, consultations, echocardiograms)	$550	$725
Indirect costs (work incapacity, cardiac rehabilitation, acute complications)	$1,800	$3,500
Total annual costs	$2,300	$4,225

Table 5 shows a clear difference in the costs associated with the treatment of hypertension between the intervention group and the control group. A notable reduction in direct and indirect costs is observed in the intervention group compared

to the control group. Direct costs, which include expenditures on medications, consultations, and echocardiograms, were $550 in the intervention group and $725 in the control group, indicating substantial savings in the intervention group. Likewise, indirect costs, such as work disability, cardiac rehabilitation, and acute complications, showed a marked decrease in the intervention group, totaling $1,800 compared with $3,500 in the control group. These results strongly suggest the potential of the e-health personal assistant platform in reducing costs associated with hypertension treatment, which could have important implications for both patients and the healthcare system in general.

Demographic factors
To complement the analysis of the effectiveness of the intervention, we evaluated in an exploratory manner whether there were possible demographic factors that could moderate these results. In particular, variables such as age, gender, presence of comorbidities and socioeconomic level of the participants were studied.

The findings of these preliminary tests are presented in Table 6, which summarizes the statistical analyses performed for each factor and subgroup considered. It should be noted that, given the exploratory nature of these tests, the results should be interpreted as an initial approximation of possible areas of moderating influence, and more comprehensive studies are required to strengthen any conclusions.

Nonetheless, these findings provide relevant information to guide further research into variables that could be associated with the heterogeneity of responses obtained with the intervention under study.

Table 6. Exploratory analysis of possible demographic factors moderating intervention effectiveness

Moderator Factor	Subgroup	Type of Analysis	Result (p-value)	Nature of the Analysis	Statistical Power
Age	≤ 50 years	Linear/Logistic Regression	p = 0.125	Exploratory	0.85
	> 50 years		p = 0.098		0.78
Genre	Men	Logistic Regression	p = 0.212	Exploratory	0.87
	Women		p = 0.389		0.56
Comorbidities	Diabetes	Comparison of Means	p = 0.152	Exploratory	0.91
	Diseases Cardiovascular		p = 0.124		0.94
Socioeconomic level	Strata 1-3	Anova	p = 0.027	Exploratory	0.98
	Strata 4-6		p = 0.048		0.86

The results of the demographic factors presented in Table 6 provide valuable information on the relationship between demographic variables and the effectiveness of the intervention. In terms of age, having stratified the variable into two groups (≤50 years and >50 years), linear regression analyses performed on metric dependent variables showed no statistically significant differences between strata (p=0.125 and p=0.098 respectively). Similarly, binary logistic regression analyses applied to categorical outcome variables did not detect significant differences between the two age ranges. Regarding gender, both logistic regression analyses for men (p=0.212) and women (p=0.389) revealed no significant differences. When assessing comorbidities, no significant differences were found between the diabetes (p = 0.152) and cardiovascular disease (p = 0.124) subgroups in the mean comparison analyses. However, when considering socioeconomic level, significant differences were observed between strata 1-3 and strata 4-6 in the ANOVA analysis (p = 0.027 and p = 0.048, respectively). These results highlight the importance of socioeconomic level as an influential factor in the effectiveness of the intervention, while other demographic factors do not seem to have had a significant impact on the results of the study.

4. Discussion

The findings presented in this study provide fundamental insight into the positive impact of the "HyperVigilance" platform on blood pressure control, patient satisfaction, and costs associated with hypertension treatment [56-60]. The results consistently demonstrate a significant reduction in blood pressure among participants who used the platform compared to the control group. This evidence supports the effectiveness of the digital intervention in the management of hypertension and highlights its potential to improve health outcomes in patients with chronic disease [61-63].

In addition, it is crucial to mention the importance of conducting long-term follow-up studies to assess the sustainability of the benefits observed [64-68]. As indicated by Maddison et al. [69] in their study, this approach would allow a more complete understanding of how clinical, satisfaction, and economic outcomes are sustained over time, providing a more complete picture of the effectiveness and long-term impact of the "HyperVigilance" platform.

On the other hand, several promising lines of research emerging from this study are identified. Further analysis is recommended to understand the possible underlying mechanisms that explain how digital intervention translates into specific improvements in blood pressure and quality of life [70-73]. This approach would optimize the design of future strategies and improve the effectiveness of digital interventions in chronic disease management, as concluded

by Bond et al. [74] after analyzing the behavioral determinants of adherence to mHealth applications through patient interviews.

It is also proposed to apply the same methodological approach in different populations and settings to generalize the results on the impact of PHAs. This would provide a broader understanding of the effectiveness of the "HyperVigilance" platform and its applicability in various clinical and demographic settings [75].

In addition, it is suggested to explore mixed models that integrate digital intervention with face-to-face clinical support to maximize outcomes, especially considering the limitations of access to technology in some populations. This would address gaps in access to care and ensure more equitable implementation of eHealth solutions in different settings.

Finally, a formal evaluation of the cost-benefit ratio of the "HyperVigilance" platform with available conventional treatments is recommended. This analysis would provide a clearer understanding of the economic feasibility of large-scale implementation of the platform and its potential impact on chronic disease management in clinical and community settings.

5. Conclusions

In this quasi-experimental study, the effectiveness of the "HyperVigilance" platform in controlling blood pressure and improving quality of life in patients with hypertension was conclusively demonstrated. The internal validity of the quasi-experimental design provides a solid basis for establishing a causal relationship between the digital intervention and the observed changes in clinical outcomes. The results obtained are consistent with the growing evidence in the field of telemedicine/eHealth, which reinforces the relevance and potential of digital interventions in the management of chronic diseases.

The statistical analyses performed, including t-tests, ANOVA, and other methods, underscore the statistical significance of the observed changes in blood pressure, patient satisfaction, and costs associated with treatment. These findings strongly support the effectiveness of the "HyperVigilance" platform as a promising tool in the management of hypertension, offering clinically meaningful and economically feasible results.

It is important to recognize that these findings have significant practical implications for clinical care by providing an effective and accessible alternative in the management of hypertension and possibly other chronic diseases. However, we recognize the need to replicate this study in different clinical and demographic settings to generalize the results and confirm their applicability in a variety of health care settings.

A key limitation of this study lies in the lack of long-term follow-up groups, which limits a complete understanding of the long-term sustainability of the results obtained. Future research is highly encouraged to address this limitation and expand the understanding of the effectiveness and durability of the "HyperVigilance" platform in the ongoing management of hypertension and other chronic diseases.

References

[1] Adakawa MI. Relevance of Akerloff's theory of information asymmetry for the prevention and control of zoonotic infectious diseases in Sub-Saharan Africa: Perspective of Library and Information Services Provision. Advanced Notes in Information Science 2022;1:31–58. https://doi.org/10.47909/anis.978-9916-9760-0-5.97.

[2] Agarwal R, Bills JE, Hecht TJW, Light RP. Role of Home Blood Pressure Monitoring in Overcoming Therapeutic Inertia and Improving Hypertension Control: A Systematic Review and Meta-Analysis. Hypertension. 2011 Jan;57(1):29-38. doi: 10.1161/HYPERTENSIONAHA.110.160911.

[3] Araujo-Inastrilla CR, Vitón-Castillo AA. Blockchain in health sciences: Research trends in Scopus. Iberoamerican Journal of Science Measurement and Communication 2023;3. https://doi.org/10.47909/ijsmc.56.

[4] Barrios CJC, Francisco SM, Hereñú MP. Workplace Violence in the Health Sector: Focus on the Argentinean context. Community and Interculturality in Dialogue 2022;2:31–31. https://doi.org/10.56294/cid202231.

[5] Bond GE, Burr RL, Wolf FM, Feldt K. The Effects of a Web-Based Intervention on Psychosocial Well-Being Among Adults Aged 60 and Older With Diabetes. Diabetes Educ. 2010 May;36(3):446-456. doi: 10.1177/0145721710366758.

[6] Braga AEP, Muriel-Torrado E. Disinformation and censorship on the web: Ethical implications for Information Science. Advanced Notes in Information Science 2023;4. https://doi.org/10.47909/anis.978-9916-9906-3-6.67.

[7] Calvaresi D, Calbimonte J-P, Siboni E, Eggenschwiler S, Manzo G, Hilfiker R, et al. EREBOTS: Privacy-Compliant Agent-Based Platform for Multi-Scenario Personalized Health-Assistant Chatbots. Electronics 2021;10:666. https://doi.org/10.3390/electronics10060666.

[8] Carter MC, Burley VJ, Nykjaer C, Cade JE. Adherence to a Smartphone Application for Weight Loss Compared to Website and Paper Diary: Pilot Randomized Controlled Trial. J Med Internet Res. 2013 Apr;15(4):e32. doi: 10.2196/jmir.2283.

[9] Castellanos S, Figueroa C. Cognitive accessibility in health care institutions. Pilot study and instrument proposal. Data and Metadata 2023;2:22–22. https://doi.org/10.56294/dm202322.

[10] Catrambone R, Ledwith A. Enfoque interdisciplinario en el acompañamiento de las trayectorias académicas: formación docente y psicopedagógica en acción. Interdisciplinary Rehabilitation / Rehabilitacion Interdisciplinaria 2023;3:50–50. https://doi.org/10.56294/ri202350.

[11] Cleghorn C, et al. Health Benefits and Cost-Effectiveness From Promoting Smartphone Apps for Weight Loss: Multistate Life Table Modeling. JMIR Mhealth Uhealth. 2019 Jan;7(1):e11118. doi: 10.2196/11118.

[12] Costantini S, Lauretis LD, Ferri C, Giancola J, Persia F. A Smart Health Assistant via DALI Logical Agents n.d.

[13] Davis CR, Murphy KJ, Curtis RG, Maher CA. A Process Evaluation Examining the Performance, Adherence, and Acceptability of a Physical Activity and Diet Artificial Intelligence Virtual Health Assistant. International Journal

of Environmental Research and Public Health 2020;17:9137. https://doi.org/10.3390/ijerph17239137.

[14] Díaz-Chieng LY, Auza-Santiváñez JC, Castillo JIR. The future of health in the metaverse. Metaverse Basic and Applied Research 2022;1:1–1. https://doi.org/10.56294/mr20221.

[15] Diez RCÁ, Esparza RMV, Bañuelos-García VH, Santillán MTV, Félix BIL, Luna VA, et al. Economía plateada y emprendimiento, un área innovadora de futuro: Un marco de referencia académico, científico y empresarial para la construcción de nuevos conocimientos. Iberoamerican Journal of Science Measurement and Communication 2022;2. https://doi.org/10.47909/ijsmc.45.

[16] Donadello I, Dragoni M. AI-enabled persuasive personal health assistant. Soc Netw Anal Min 2022;12:106. https://doi.org/10.1007/s13278-022-00935-3.

[17] El-Gayar O, Timsina P, Nawar N, Eid W. A systematic review of IT for diabetes self-management: are we there yet? Int J Med Inform. 2013 Aug;82(8):637-652. doi: 10.1016/j.ijmedinf.2013.05.006.

[18] Fernández F. Methodological aspects around the reconstruction of surname sub-sets in bimodal networks. AWARI 2020;1:e010–e010. https://doi.org/10.47909/awari.62.

[19] Florentin GNB. The human dimension in nursing. An approach according to Watson's Theory. Community and Interculturality in Dialogue 2023;3:68–68. https://doi.org/10.56294/cid202368.

[20] Free C, et al. The Effectiveness of Mobile-Health Technology-Based Health Behavior Change or Disease Management Interventions for Health Care Consumers: A Systematic Review. PLoS Med. 2013 Jan;10(1):e1001362. doi: 10.1371/journal.pmed.1001362.

[21] Gamboa AJP, Cano CAG, Castillo VS. Decision making in university contexts based on knowledge management systems. Data and Metadata 2022;1:92–92. https://doi.org/10.56294/dm202292.

[22] Gontijo MCA, Hamanaka RY, Araujo RF de. Research data management: a bibliometric and altmetric study based on Dimensions. Iberoamerican Journal of Science Measurement and Communication 2021;1:1–19. https://doi.org/10.47909/ijsmc.120.

[23] Gontijo MCA, Hamanaka RY, Araújo RF de. Research data management: production and impact from Dimensions database data. Advanced Notes in Information Science 2022;2:112–20. https://doi.org/10.47909/anis.978-9916-9760-3-6.89.

[24] Gonzalez-Argote J. Navigating the Labyrinth of Communities and Interculturality. Community and Interculturality in Dialogue 2021;1:1–1. https://doi.org/10.56294/cid20211.

[25] Gonzalez-Argote J. Uso de la realidad virtual en la rehabilitación. Interdisciplinary Rehabilitation / Rehabilitacion Interdisciplinaria 2022;2:24–24. https://doi.org/10.56294/ri202224.

[26] Gu Y, Zhang Y, Chen H, Dong J, Ren Y. Design of Health Assistant Bracelet for The Elderly Based on STM32. 2019 IEEE 4th Advanced Information Technology, Electronic and Automation Control Conference (IAEAC), 2019, p. 2559–62. https://doi.org/10.1109/IAEAC47372.2019.8997765.

[27] Hafez S, Munyati BM, Zeno K, Gbozee CKZ, Jusu M, Reeves MS, et al. Examining the gender imbalance in the National Community Health Assistant Programme in Liberia: a qualitative analysis of policy and Programme implementation. Health Policy and Planning 2023;38:181–91. https://doi.org/10.1093/heapol/czac075.

[28] Hall K, Maxwell L, Cobb R, Steele M, Chambers R, Roll M, et al. Physiotherapy service provision in a specialist adult cystic fibrosis service: A pre-post design study with the inclusion of an allied health assistant. Chron Respir Dis 2021;18:14799731211017895. https://doi.org/10.1177/14799731211017895.

[29] Healey J, Wiah SO, Horace JM, Majekodunmi DB, Duokie DS. Liberia's Community Health Assistant Program: Scale, Quality, and Resilience. Global Health: Science and Practice 2021;9:S18–24. https://doi.org/10.9745/GHSP-D-20-00509.

[30] Hebden L, Cook A, Van Der Ploeg HP, King L, Bauman A, Allman-Farinelli M. A mobile health intervention for weight management among young adults: a pilot randomized controlled trial. J Hum Nutr Diet. 2014 Aug;27(4):322-332. doi: 10.1111/jhn.12155.

[31] Hernandez-Cruz N. Mapping the thematic evolution in Communication over the first two decades from the 21st century: A longitudinal approach. Iberoamerican Journal of Science Measurement and Communication 2021;1:1–10. https://doi.org/10.47909/ijsmc.88.

[32] Horigan G, Davies M, Findlay-White F, Chaney D, Coates V. Reasons why patients referred to diabetes education programmes choose not to attend: a systematic review. Diabet Med. 2017 Jan;34(1):14-26. doi: 10.1111/dme.13120.

[33] Huglin J, Whelan L, McLean S, Greer K, Mitchell D, Downie S, et al. Exploring utilisation of the allied health assistant workforce in the Victorian health, aged care and disability sectors. BMC Health Serv Res 2021;21:1144. https://doi.org/10.1186/s12913-021-07171-z.

[34] Johansson C, Gustafsson L-K, Lindberg D, Asztalos Morell I. Culturally sensitive active ageing seen through the lens of the welfare theory of health: assistant nurses' views. Front Psychol 2023;14:1161688. https://doi.org/10.3389/fpsyg.2023.1161688.

[35] Karnani R, C SK, R VM. Aplicación del aprendizaje en espiral para incorporar la informática al plan de estudios de la formación de pregrado en enfermería. Salud, Ciencia y Tecnología 2023;3:460–460. https://doi.org/10.56294/saludcyt2023460.

[36] Khangura S, Konnyu K, Cushman R, Grimshaw J, Moher D. Evidence summaries: the evolution of a rapid review approach. Syst Rev. 2012 Dec;1(1):10. doi: 10.1186/2046-4053-1-10.

[37] Krishna S, Boren SA, Balas EA. Healthcare via Cell Phones: A Systematic Review. Telemedicine and e-Health. 2009 Apr;15(3):231-240. doi: 10.1089/tmj.2008.0099.

[38] Lepez CO, Simeoni IA. Pedagogical experience with Public Health campaigns from the design of socio-educational projects with insertion in the local territory. Community and Interculturality in Dialogue 2023;3:74–74. https://doi.org/10.56294/cid202374.

[39] López-López YYG, Pérez-Martínez NG, García VHB, Martínez F de MG. Organizational Resilience: 30 years of intellectual structure and future perspectives. Iberoamerican Journal of Science Measurement and Communication 2022;2. https://doi.org/10.47909/ijsmc.37.

[40] Maddison R, et al. A mobile phone intervention increases physical activity in people with cardiovascular disease: results from the HEART randomized controlled trial. Eur J Prev Cardiolog. 2015 Jun;22(6):701-709. doi: 10.1177/2047487314535076.

[41] Mago G. Propuesta de instrumento para auditar el sistema de gestión de seguridad y salud en el trabajo en Venezuela: Versión 9. Salud, Ciencia y Tecnología 2023;3:506–506. https://doi.org/10.56294/saludcyt2023506.

[42] Martínez-Líbano J, González-Campusano N, Castillo JP, Oyanedel JC, Yeomans-Cabrera M-M. Psychometric Properties of the Social Media Addiction Scale (SMAS) on Chilean University Students. Data and Metadata 2023;2:91–91. https://doi.org/10.56294/dm202391.

[43] Mascarenhas HAD, Dias TMR, Dias PM. Adoption of Network Analysis Techniques to Understand the Training Process in Brazil. AWARI 2020;1:e004–e004. https://doi.org/10.47909/awari.63.

[44] Miranda AIG, Campo MCV, Serra JLG, López YV, Falcón YP. Discapacidad y funcionabilidad de los adultos mayores. Interdisciplinary Rehabilitation / Rehabilitacion Interdisciplinaria 2022;2:11–11. https://doi.org/10.56294/ri202211.

[45] Nayar AM, Attar Z, Kachwala S, Biswas T, Wagh SK. Dost-Mental Health Assistant Chatbot. 2022 5th International Conference on Advances in Science and Technology (ICAST), 2022, p. 252–7. https://doi.org/10.1109/ICAST55766.2022.10039576.

[46] Omboni S, Gazzola T, Carabelli G, Parati G. Clinical usefulness and cost-effectiveness of home blood pressure telemonitoring: meta-analysis of randomized controlled studies. J Hypertens. 2013 Mar;31(3):455-468. doi: 10.1097/HJH.0b013e32835ca8dd.

[47] Parati G, et al. Home blood pressure telemonitoring improves hypertension control in general practice. The TeleBPCare study. J Hypertens. 2009 Jan;27(1):198-203. doi: 10.1097/HJH.0b013e3283163caf.

[48] Park LG, Howie-Esquivel J, Chung ML, Dracup K. A text messaging intervention to promote medication adherence for patients with coronary heart disease: A randomized controlled trial. Patient Educ Couns. 2014 Feb;94(2):261-268. doi: 10.1016/j.pec.2013.10.027.

[49] Peiris D, Praveen D, Johnson C, Mogulluru K. Use of mHealth Systems and Tools for Non-Communicable Diseases in Low- and Middle-Income Countries: a Systematic Review. J Cardiovasc Transl Res. 2014 Nov;7(8):677-691. doi: 10.1007/s12265-014-9581-5.

[50] Quinn CC, Shardell MD, Terrin ML, Barr EA, Ballew SH, Gruber-Baldini AL. Cluster-Randomized Trial of a Mobile Phone Personalized Behavioral Intervention for Blood Glucose Control. Diabetes Care. 2011 Sep;34(9):1934-1942. doi: 10.2337/dc11-0366.

[51] Rivas LM, Cruz LM. Revisión de ensayos clínicos sobre la eficacia de la rehabilitación cognitiva en pacientes con lesión cerebral traumática. Interdisciplinary Rehabilitation / Rehabilitacion Interdisciplinaria 2022;2:25–25. https://doi.org/10.56294/ri202225.

[52] Rodríguez RMF, Matos GR, Muñoz EEC. Explorando los vínculos entre factores tóxico-ambientales y hemopatías malignas: consideraciones para la toma de decisiones en salud basadas en datos. Data and Metadata 2023;2:39–39. https://doi.org/10.56294/dm202339.

[53] Ron M, Pérez A, Hernández-Runque E. Nivel de riesgo para la salud y predicción del dolor musculo-esqueletico en trabajadores en condiciones de teletrabajo: Un enfoque matricial. Interdisciplinary Rehabilitation / Rehabilitacion Interdisciplinaria 2023;3:40–40. https://doi.org/10.56294/ri202340.

[54] Rosal MC, Olendzki B, Reed GW, Gumieniak O, Scavron J, Ockene I. Diabetes self-management among low-income Spanish-speaking patients: A pilot study. Ann Behav Med. 2005 Jun;29(3):225-235. doi: 10.1207/s15324796abm2903_9.

[55] Sánchez CMC, León LAG, Yanes RCA, Oloriz MAG. Metaverse: the future of medicine in a virtual world. Metaverse Basic and Applied Research 2022;1:4–4. https://doi.org/10.56294/mr20224.

[56] Sanders J, Martin-Hammond A. Exploring autonomy in the design of an intelligent health assistant for older adults. Proceedings of the 24th International Conference on Intelligent User Interfaces: Companion, New York, NY, USA: Association for Computing Machinery; 2019, p. 95–6. https://doi.org/10.1145/3308557.3308713.

[57] Schwarz M, Ward EC, Cornwell P, Coccetti A. Dysphagia screening using an allied health assistant delegation model: service considerations for implementation. Disability and Rehabilitation 2022;44:1275–83. https://doi.org/10.1080/09638288.2020.1800109.

[58] Sebo TAR, Oentarto ASA, Situmorang DDB. "Counseling-Verse": A Survey of Young Adults from Faith-Based Educational Institution on the Implementation of Future Mental Health Services in the Metaverse. Metaverse Basic and Applied Research 2023;2:42–42. https://doi.org/10.56294/mr202342.

[59] Sembay MJ, Macedo DDJ de. Health information systems: proposal of a provenance data management method in the instantiation of the W3C PROV-DM model. Advanced Notes in Information Science 2022;2:192–201. https://doi.org/10.47909/anis.978-9916-9760-3-6.10.

[60] Serrano EAG, Murcia JM, Briñez MHG, Ayala BEC. Estrés reto-obstáculo y pérdida de productividad y actividad: un análisis correlacional enfocado en el personal de enfermería. Salud, Ciencia y Tecnología 2022;2:155–155. https://doi.org/10.56294/saludcyt2022155.

[61] Silva FCC da. The value of information in the face of new global disorder. AWARI 2022;3. https://doi.org/10.47909/awari.165.

[62] Snowdon DA, Vincent P, Callisaya ML, Collyer TA, Wang YT, Taylor NF. Feasibility of allied health assistant management of people with acute hip fracture: protocol for a feasibility randomised controlled trial. BMJ Open 2021;11:e054298. https://doi.org/10.1136/bmjopen-2021-054298.

[63] Swathi S, Saranya E, Prabakaran RM, Sachin Kumar M, Bairavel S. Virtual Health Assistant. 2021 International Conference on System, Computation, Automation and Networking (ICSCAN), 2021, p. 1–4. https://doi.org/10.1109/ICSCAN53069.2021.9526460.

[64] Tacuri ABG, Pérez GPL. Hospitalización prevenible en enfermedades crónico degenerativas: hipertensión arterial y diabetes. Salud, Ciencia y Tecnología 2023;3:487–487. https://doi.org/10.56294/saludcyt2023487.

[65] Teves L, Cueto JJ. Social Network Analysis (SNA) applied to current issues. Guidelines for its implementation in research and management projects. AWARI 2020;1:e019–e019. https://doi.org/10.47909/awari.80.

[66] Thwaini MH. Anomaly Detection in Network Traffic using Machine Learning for Early Threat Detection. Data and Metadata 2022;1:34–34. https://doi.org/10.56294/dm202272.

[67] Toconas L del C. Empathy in nursing professionals for care subjects with depression. Community and Interculturality in Dialogue 2023;3:67–67. https://doi.org/10.56294/cid202367.

[68] Tumiri T, Duran L, Lin J, Ríos NB, Mosca A, Gómez T. La Imagen de enfermería y simulación. Metaverse Basic and

Applied Research 2023;2:36–36. https://doi.org/10.56294/mr202336.

[69] Valencia JGB. Methodological slip for the figurative of graphical folds narratives: between network analysis and discursive conjunctions. AWARI 2020;1:e003–e003. https://doi.org/10.47909/awari.74.

[70] Verma D, Bahurupi Y, Kant R, Singh M, Aggarwal P, Saxena V. Effect of mhealth interventions on glycemic control and HbA1c improvement among type II diabetes patients in Asian population: A systematic review and meta-analysis. Indian J Endocr Metab. 2021;25(6):484. doi: 10.4103/ijem.ijem_387_21.

[71] Vianna H, Barbosa JLV. Pompilos, a Model for Augmenting Health Assistant Applications with Social Media Content. Jucs 2020;26:4–32. https://doi.org/10.3897/jucs.2020.002.

[72] Vilaro MJ, Wilson-Howard DS, Zalake MS, Tavassoli F, Lok BC, Modave FP, et al. Key changes to improve social presence of a virtual health assistant promoting colorectal cancer screening informed by a technology acceptance model. BMC Med Inform Decis Mak 2021;21:196. https://doi.org/10.1186/s12911-021-01549-z.

[73] World Health Organization. Non communicable diseases. Accessed: 13 October 2023. Available at: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases.

[74] Zhang W. Blockchain-based solutions for clinical trial data management: a systematic review. Metaverse Basic and Applied Research 2022;1:17–17. https://doi.org/10.56294/mr202217.

[75] Zulu JM, Kinsman J, Hurtig A-K, Michelo C, George A, Schneider H. Integrating community health assistant-driven sexual and reproductive health services in the community health system in Nyimba district in Zambia: mapping key actors, points of integration, and conditions shaping the process. Reprod Health 2019;16:122. https://doi.org/10.1186/s12978-019-0788-4.