Attitudes Toward Microchip Implant in Groups Pro and Con its Insertion for Healthcare Purposes

Anja Žnidaršič[1], Alenka Baggia[1] & Borut Werber[1]

[1] University of Maribor, Faculty of organizational sciences, Kranj, Slovenia, e-mail: anja.znidarsic@um.si, alenka.baggia@um.si, borut.werber@um.si

Abstract The perception of new technologies and medical interventions in the human body changes over time. Attitudes towards new technologies, health issues and approaches differ according to the gender, age, education, place of residence and background of the individual. Our research on the adoption of microchip implants for healthcare purposes has identified two main groups of people: those who would be willing to use microchip implants for healthcare purposes and those who reject this option without considering its use. This study examines the differences in the general opinion on microchip implants between respondents for and against their use for healthcare purposes. An online survey was conducted in four European countries. More than half of the respondents were inclined to use a microchip implant for healthcare purposes. Statistically significant differences in general attitudes towards microchip implants exist between the groups of respondents who are for and against the use of a microchip implant for healthcare purposes. The most significant difference is in perceived usefulness, which shows that respondents who are inclined to use microchip implants for healthcare purposes consider the technology more useful than those who are against it. All respondents disregarding their willingness to use microchip implants showed privacy concerns.

Keywords: healthcare, microchip, implant, international, comparison.

University of Maribor Press

DOI https://doi.org/10.18690/978-961-286-362-3.42
ISBN 978-961-286-362-3

1 Introduction

New technologies used by and in society are transforming society to the next level of digitalization. One of the main areas in this process of transformation is the healthcare system, which has to become proactive (Bauer, 2007) to efficiently follow and exploit the novel technologies and trends (e.g. Lazzi, Lee, & Nikita, (2019; Virkki, Wei, Liu, Ukkonen, & Björninen, (2017)). RFID microchip implants are an example of novel technology, which can provide vital patient information (i.e., blood type, age, etc.) and can be used as an identifying device (Gillenson, Zhang, Muthitacharoen, & Prasarnphanich, 2019).

Microchip implants (MIs) have been used in healthcare for prosthetic, monitoring, and enhancement medical devices (Basham, 2014; Madrid, Korsvold, Rochat, & Abarca, 2012; Sachs & Gabel, 2004; Soares dos Santos et al., 2013). Implanted devices for therapeutic purposes to combat illnesses such as epilepsy, Parkinson's disease, and severe depression have also proved to be effective (Michael & Michael, 2013; Perakslis & Michael, 2012). Besides, MIs can affect cancer cells (Lai, Chan, & Singh, 2016). MIs can also minimize mistakes in personal medical information such as blood type, allergies, current medications, and medical history (Mohamed, 2020).

Similar to any other foreign object in the body, MIs could pose health risks (e.g. rejection, allergic reaction). For example, Albrecht (2010) identified the causal link between microchips and cancers in rodents and dogs. Therefore, we have to consider whether the benefits of implants are worth the potential health risks. The perception of MIs as secure technology differs according to the country of residence and generational factors (Perakslis & Michael, 2012). Although there are plenty of perceived reasons to reject MIs for employee identification (Michael, Aloudat, Michael, & Perakslis, 2017), MIs have been adopted by healthy people for various non-therapeutic purposes (Fram, Rivlin, & Beredjiklian, 2020).

Putting aside the privacy and security issues (Juels, 2006; Rodriguez, 2019), the advantages that MIs can bring to healthcare management in general and individual health issues are not negligible. Nevertheless, not much research was conducted to identify MI acceptance for healthcare purposes. In prior research (Werber, Baggia, & Žnidaršič, 2018), we have identified the differences between individuals who

would be willing to adopt a MI for health purposes and those, who reject the idea disregarding the purpose.

In this paper, we aim to present the differences that exist between people who are willing to implant a MI for healthcare purposes and those who reject the MIs for healthcare purposes. This research focuses on Near Field Communication (NFC) microchips that can be read at the distance up to 16 cm using a 12 x 2,2 mm microchip in a glass tube (in special conditions up to 0,6 m) (Meyer, Chansue, & Monticelli, 2006). The discussed microchips cannot be tracked by GPS or other satellite networks as well as other RFID networks that track active RFID devices.

2 Methodology

The MI acceptance study was conducted in 2016 and 2017 in four countries: Poland, Croatia, the Czech Republic, and Slovenia. For this research, we updated the pre-developed questionnaire (Werber, Baggia, & Žnidaršič, 2018) that was translated into the local language. Respondents were invited to participate in the survey via various channels, from social networks to media posts. The participants were of different ages and gender.

Items were measured on a 5-point Likert scale of agreement ("strongly disagree" to "strongly agree") or acceptability ("very bad idea" to "very good idea"). Based on our prior research (Werber et al., 2018), we have identified the differences in the attitude towards RFID MIs for healthcare purposes. Therefore, we have formulated the following research question:

RQ: Are there differences in 27 questionnaire items on attitudes toward MIs adoption between two groups according to the willingness to adopt MIs for healthcare purposes?

To answer the RQ we performed 27 Independent Samples t-tests. In the Results section, first, the sample structure and the descriptive statistics of the questionnaire items are presented.

3 Results

We received a total of 1058 partially fulfilled valid responses. Comparing samples from different countries we can see that the smallest sample (146) comes from Croatia and the largest (356) from the Czech Republic, while from Slovenia and Poland we received 288 and 268 respondents, respectively.

Among the respondents, 510 (51.1 %) would adopt a MI for healthcare purposes, and 489 (48.9%) would not (7 persons did not provide that answer). The sample structure according to the willingness to insert a MI for healthcare purposes is presented in Table 1.

Table 1: Sample structure according to the willingness to insert microchips implant for healthcare purposes

		Would you insert a MI for healthcare purposes (identification, storage of medical data, information on organ donation, etc.)?			
		No		**Yes**	
		n	**%**	**n**	**%**
Country	Poland	120	51.1%	115	48.9%
	Croatia	59	43.1%	78	56.9%
	Czech Republic	173	49.0%	180	51.0%
	Slovenia	158	57.7%	116	42.3%
Gender	Man	231	46.8%	263	53.2%
	Women	276	55.0%	226	45.0%
Status	Pupil or student	102	37.8%	168	62.2%
	Employed	339	55.2%	275	44.8%
	Unemployed	23	59.0%	16	41.0%
	Pensioner	43	60.6%	28	39.4%

Comparing the status of respondents, we can see that most respondents with a positive attitude for MI insertion for healthcare purposes come from pupil and student group (62.2%) while the lowest from elderly respondents (39.4%).

Descriptive statistics for 27 questionnaire items on Attitudes toward MIs are presented in Table 2. To answer the research question, the Independent Samples t-tests were performed (Table 3). For 25 questionnaire items, results show that there exist statistically significant differences in mean values of questionnaire items according to two groups of willingness to insert a MI at a 5 % significance level.

In the previous research (Werber, Baggia, & Žnidaršič, 2018), constructs composing of questionnaire items were defined. The same constructs are used in this research, to provide a concise representation of the results. Constructs (as presented in Table 2) are defined as follows: Painful procedure (PP), Health Concerns (HC), Safety and Control Issues (SCI), Perceived Usefulness (PU), Perceived Trust (PT), Perceived Ease of Use (EU), Perceived Threat (PTh) and Privacy Right (PR).

Table 2: Descriptive statistics for 27 questionnaire items according to two groups of interested and non-interested persons for inserting MIs for healthcare purposes

	Would you insert **MI** for healthcare purposes?					
	No			**Yes**		
Questionnaire item	**N**	**M**	**SD**	**N**	**M**	**SD**
Implanting MI is a painful procedure. (PP1)	509	2.97	1.082	487	2.72	0.982
MIs can be threatening to my health because of the possibility of movement in my body. (HC1)	507	3.20	1.129	485	2.74	1.000
MIs may affect my emotional behaviour.(HC2)	506	3.14	1.222	485	2.34	1.074
MIs can be threatening to my health because of possible allergies. (HC3)	505	3.52	1.091	480	3.01	1.052
MIs can be threatening to my health because of their impact on the nervous system. (HC4)	504	3.42	1.100	483	2.79	1.057
MI can be remotely controlled (e.g. switching off or changing settings) by an unauthorized person. (SCI1)	509	3.65	1.057	486	3.21	1.037
MIs enables higher level of control. (SCI2)	509	3.58	1.214	487	3.22	1.194
MIs technology is safe enough to be used in humans. (SCI3)	507	2.36	1.040	486	2.95	0.914
MIs could be used for:						
- monitoring health of the user. (PU1)	506	3.29	1.098	488	4.13	0.793
- warnings about potential health problems or complications. (PU2)	505	3.44	1.080	486	4.21	0.791

- storing a user's medical info to be used in an emergency. (PU3)	507	3.37	1.093	487	4.21	0.765
- personalized health info. (PU4)	506	2.95	1.145	487	3.89	0.894
- storing information about organ donation. (PU5)	500	3.00	1.143	487	3.93	0.894
- lower the health insurance premiums. (PU6)	504	2.42	1.160	488	3.60	1.091
- saving life (e.g. unconsciousness, cardiac pacemaker, sugar detector, insulin dispenser, etc.). (PU7)	507	3.44	1.064	488	4.23	0.794
The state will ensure the security and the protection of human rights (security of identity documents, passport, identity theft, tracking via GPS, no records should be archived without the consent of the person observed). (PT1)	508	2.14	1.143	486	2.95	1.188
Banks will provide security (payment, discretion of operation, transactions, etc.). (PT2)	508	2.29	1.135	485	3.12	1.151
The healthcare system will provide security (personal data**,** medical data**.** information on treatments, organ donation, etc.). (PT3)	508	2.51	1.169	486	3.58	1.073
MIs are always available. (PEU1)	509	3.31	1.044	488	3.68	0.943
MIs cannot be lost. (PEU2)	507	3.59	1.022	488	3.93	0.866
MIs cannot be stolen (high-security protection). (PEU3)	508	2.88	1.186	488	3.32	1.133
MIs can integrate multiple functions at the same time. (PEU4)	507	3.80	0.898	486	4.15	0.711
Organizations and agencies ask you for too much personal information. (PTh1)	509	4.07	0.901	487	3.81	0.982
The present use of computers is an actual threat to personal privacy in the country. (PTh2)	509	3.81	0.973	486	3.56	1.033
I am concerned about threats to my privacy in the country today. (PTh3)	509	3.67	1.104	485	3.31	1.103
No one should be able to gather or disclose your personal information without your consent. (PR1)	507	4.51	0.830	487	4.47	0.810
People should have the right to control their personal information. (PR2)	507	4.54	0.772	487	4.49	0.714

Table 3: The independent samples t-test.

	Levene's Test for Equality of Variances		t-test for Equality of Means		
Item	**F**	**p**	**t**	**df**	**p**
PP1	0.020	0.887	3.842	994	0.000
HC1	7.733	0.006	6.751	984.2	0.000
HC2	10.196	0.001	11.040	981.7	0.000
HC3	6.827	0.009	7.386	982.8	0.000
HC4	3.678	0.055	9.138	985	0.000
SCI1	0.552	0.458	6.693	993	0.000
SCI2	1.714	0.191	4.760	991	0.000
SCI3	35.889	0.000	-9.443	986.8	0.000
PU1	90.726	0.000	-13.740	919.7	0.000
PU2	66.527	0.000	-12.771	923.9	0.000
PU3	84.687	0.000	-14.059	908.1	0.000
PU4	58.359	0.000	-14.333	951.1	0.000
PU5	49.229	0.000	-14.290	941.5	0.000
PU6	8.095	0.005	-16.450	989.2	0.000
PU7	54.928	0.000	-13.366	935.7	0.000
PT1	1.153	0.283	-10.942	992	0.000
PT2	0.415	0.520	-11.437	991	0.000
PT3	15.408	0.000	-15.049	990.3	0.000
PEU1	6.270	0.012	-5.910	991.6	0.000
PEU2	37.396	0.000	-5.642	977.4	0.000
PEU3	1.239	0.266	-5.976	994	0.000
PEU4	8.967	0.003	-6.816	957.5	0.000
PTh1	6.607	0.010	4.309	977.6	0.000
PTh2	10.684	0.001	4.015	982.0	0.000
PTh3	0.319	0.572	5.065	992	0.000
PR1	*0.209*	*0.648*	*0.782*	*992*	*0.435*
PR2	*0.001*	*0.979*	*0.965*	*992*	*0.335*

It can be seen from Table 2 that the means of items differ the most in the Perceived Usefulness (PU) construct. There is a significant difference in means for the item considering that users of MIs should have lower insurance premiums. Respondents prone to MIs for HC purposes have a higher level of agreement with this statement $(M = 3.60)$ as respondents contrary to MIs for HC purposes $(M = 2.42)$. Further,

respondents prone to MIs for HC purposes are more convinced that MIs could be used for personalized health information ($M = 3.89$), as respondents contra ($M = 2.95$). A similar difference in opinion is identified in the opinion about using MIs for storing organ donation information, where respondents prone to MIs for HC purposes agree with the statement ($M = 3.93$) significantly more as the respondents contrary ($M = 3.00$). The lowest statistically significant differences were identified in the construct Privacy Threat (PTh), showing that respondents have a quite similar opinion on MI's influence on privacy.

The only construct, where we have not identified statistically significant differences in the Privacy Right construct (PR). Both items PR1 (No one should be able to gather or disclose your personal information without your consent) and PR2 (People should have the right to control their personal information) showed no statistically significant differences. All items with statistically significant differences between the two groups of respondents are presented in Figure 1. Figure 1 presents error bars for each item according to 2 groups, meaning that dots represent mean values, and intervals are +/- one standard deviation around mean.

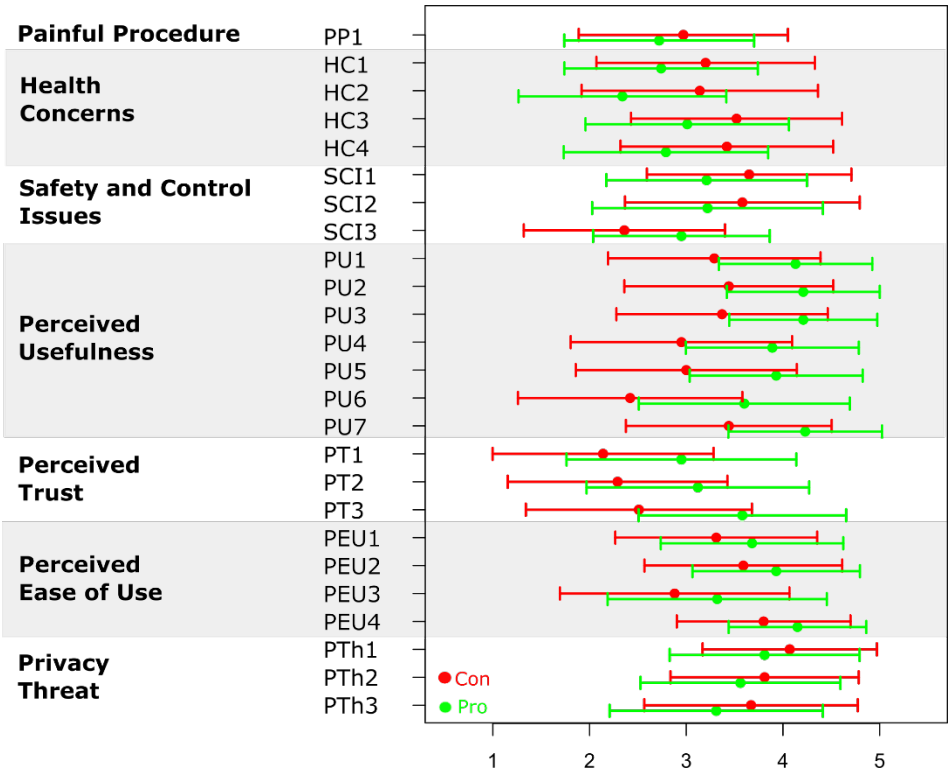

Figure 1: Error bars (mean values (dots) +/- one standard deviation) for attitudes toward MIs in groups pro and con for insertion of microchips for healthcare purposes

4 Conclusions

In the current situation with the Coronavirus COVID-19 pandemic, the popularity of MIs is rising. Due to the conflicting perception of MIs acceptance, various examples, discussions, as well as fake news, appear in the media. It has been reported that MIs were used for disaster victim identification in the tsunami of 2004 (Meyer et al., 2006). Kinkead (2014) reported the development of a contraceptive chip that could be activated using a wireless remote. On the other hand, public figures and their statements are being manipulated. According to Reuters (Reuters, 2020), the fake news of Bill Gates promoting MIs to fight coronavirus has been widely shared in social media. Several sources (Kinkead, 2014; McHugh et al., 2019) have been included in the misleading post about the "human-implantable capsules that have 'digital certificates' which can show who has been tested for the coronavirus".

Despite the abuse of information in media, the research on MIs and its usage for healthcare purposes continues, and advances in its research can be tracked in contemporary research articles. This research aimed to identify the difference in the perception of MIs adoption between groups of respondents pro and con of using MIs for healthcare purposes.

The highest percentage among respondents who showed a positive attitude toward the adoption of MIs was in Croatia and the lowest in Slovenia. Students and pupils were generally most willing to adopt MIs for healthcare purposes. The results show that statistically significant differences exist in 25 questionnaire items according to two groups of willingness to insert MIs. The highest statistically significant difference was identified in the item from the construct of the Perceived Usefulness of MIs. The lowest, although a statistically significant difference was identified in the item of the Privacy Threat construct. The only construct where no statistically significant differences between the two groups in its questionnaire items was the Privacy Right construct.

Based on the results, we can conclude that the general attitude towards the MIs differs between the people who are willing to implant MI for healthcare purposes, and the ones that are against it. Nevertheless, the issues which concern both groups are related to privacy. There are still some differences in the perception of privacy threat, whereas, for privacy rights, individuals have a similar opinion. We can conclude that the concerns of individuals about their privacy do not change even though they would be willing to implant a foreign body to enhance their health conditions. So although people agree with the use of MIs they expect some privacy issues remain.

5 Limitations and Future Research

Despite the large sample size, this research has some limitations. There was a small time gap of a few months between data collection in Slovenia, where the survey was first conducted, and other countries. This could influence the low willingness to adopt MIs in Slovenia. Second, the age diversity of participants in samples was different. In the Croatian sample, the majority of participants were students (56.9 %). This could affect the results, showing that Croatia has the highest percentage of respondents willing to adopt MIs.

In future research, a detailed comparison between countries is needed. We plan to compare the differences between countries based on the extended TAM model, although according to the first results and the abovementioned limitations, we could be forced to omit some data from the research. It is also planned to conduct the second iteration of the study and to compare the results before and after the COVID-19 pandemic, which influenced our daily routines and our perception the health and privacy.

Acknowledgments

This research was supported by the Slovenian Research Agency; Program No. P5-0018 – Decision Support Systems in Digital Business.

References

Albrecht, K. (2010). Microchip-induced tumors in laboratory rodents and dogs: A review of the literature 1990-2006. 2010 IEEE International Symposium on Technology and Society, 337–349. https://doi.org/10.1109/ISTAS.2010.5514622

Basham, R. (2014). Emerging Demographic Needs and Social Implications of RFID Chip Technology Use Surveilling the Elderly : 169–171. https://doi.org/10.4018/978-1-4666-4582-0.ch007

Bauer, K. A. (2007). Wired Patients: Implantable Microchips and Biosensors in Patient Care. Cambridge Quarterly of Healthcare Ethics, 16(03), 281–290. https://doi.org/10.1017/S0963180107070314

Fram, B. R., Rivlin, M., & Beredjiklian, P. K. (2020). On Emerging Technology: What to Know When Your Patient Has a Microchip in His Hand. The Journal of Hand Surgery, 1–5. https://doi.org/10.1016/j.jhsa.2020.01.008

Gillenson, M. L., Zhang, X., Muthitacharoen, A., & Prasarnphanich, P. (2019). I'VE GOT YOU UNDER MY SKIN: THE PAST, PRESENT, AND FUTURE USE OF RFID TECHNOLOGY IN PEOPLE AND ANIMALS. Journal of Information Technology Management, XXX(2), 19–29.

Juels, A. (2006, February). RFID security and privacy: A research survey. IEEE Journal on Selected Areas in Communications, Vol. 24, pp. 381–394. https://doi.org/10.1109/JSAC.2005.861395

Kinkead, G. (2014). A Contraceptive Implant with Remote Control.

Lai, H. C., Chan, H. W., & Singh, N. P. (2016). Effects of radiation from a radiofrequency identification (RFID) microchip on human cancer cells. International Journal of Radiation Biology, 92(3), 156–161. https://doi.org/10.3109/09553002.2016.1135264

Lazzi, G., Lee, R., & Nikita, K. S. (2019). Guest editorial for the special issue on wireless real-time health monitoring technology for personalized medicine. IEEE Transactions on Antennas and Propagation, 67(8), 4946–4954. https://doi.org/10.1109/TAP.2019.2931377

Madrid, C., Korsvold, T., Rochat, A., & Abarca, M. (2012). Radio frequency identification (RFID) of dentures in long-term care facilities. The Journal of Prosthetic Dentistry, 107(3), 199–202. https://doi.org/10.1016/S0022-3913(12)60057-2

McHugh, K. J., Jing, L., Severt, S. Y., Cruz, M., Sarmadi, M., Jayawardena, H. S. N., … Jaklenec, A. (2019). Biocompatible near-infrared quantum dots delivered to the skin by microneedle patches record vaccination. Science Translational Medicine, 11(523). https://doi.org/10.1126/scitranslmed.aay7162

Meyer, H. J., Chansue, N., & Monticelli, F. (2006). Implantation of radio frequency identification device (RFID) microchip in disaster victim identification (DVI). 157, 168–171. https://doi.org/10.1016/j.forsciint.2005.10.001

Michael, K., Aloudat, A., Michael, M. G., & Perakslis, C. (2017). 10. Perceptions of radio-frequency identification implants for employee identification in the workplace. IEEE Consumer Electronics Magazine, 6(3 (June)), 111–117.

Michael, K., & Michael, M. G. (2013). The future prospects of embedded microchips in humans as unique identifiers: the risks versus the rewards. Media, Culture & Society, 35(1), 78–86. https://doi.org/10.1177/0163443712464561

Mohamed, M. A. (2020). Modeling of Subcutaneous Implantable Microchip Intention of Use. In T. Ahram, W. Karwowski, A. Vergnano, F. Leali, & R. Taiar (Eds.), Intelligent Human Systems Integration 2020 (pp. 842–847). Cham: Springer International Publishing.

Perakslis, C., & Michael, K. (2012). Indian Millennials: Are microchip implants a more secure technology for identification and access control? Proceedings of the 2012 IEEE Conference on Technology and Society in Asia, T and SA 2012, 1–9. https://doi.org/10.1109/TSAsia.2012.6397977

Reuters. (2020). False claim: Bill Gates planning to use microchip implants to fight coronavirus - Reuters. Reuters Fact Check, p. 1.

Rodriguez, D. A. (2019). Chipping in at work: Privacy concerns related to the use of body microchip ("RFID") implants in the employer-employee context. Iowa Law Review, 104(3), 1581–1611.

Sachs, H., & Gabel, V. (2004). Retinal replacement—the development of microelectronic retinal prostheses—experience with subretinal implants and new aspects. Graefe's Archive for Clinical and Experimental …, 242(8), 717–723. https://doi.org/10.1007/s00417-004-0979-7

Soares dos Santos, M. P., Ferreira, J. a F., Ramos, a, Simões, J. a O., Morais, R., Silva, N. M., … Oliveira, T. (2013). Instrumented hip implants: electric supply systems. Journal of Biomechanics, 46(15), 2561–2571. https://doi.org/10.1016/j.jbiomech.2013.08.002

Virkki, J., Wei, Z., Liu, A., Ukkonen, L., & Björninen, T. (2017). Wearable passive E-textile UHF RFID tag based on a slotted patch antenna with sewn ground and microchip interconnections. International Journal of Antennas and Propagation, 2017, 27–29. https://doi.org/10.1155/2017/3476017

Werber, B., Baggia, A., & Žnidaršič, A. (2018). Factors Affecting the Intentions to Use RFID Subcutaneous Microchip Implants for Healthcare Purposes. Organizacija, 51(2), 121–133. https://doi.org/10.2478/orga-2018-0010