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RESEARCH ARTICLE

Digital Data Security Awareness: A Study with Pharmacy Students

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Digital Data Security Awareness: A Study with Pharmacy Students

SUMMARY

Technological developments lead to changes in the field of health as well as in many areas. Although these developments bring many advantages, there are also some potential risks. Increments in digital healthcare and digitally stored information raise concerns about data security. It is vital for pharmacists and pharmacy students to be aware of data security, considering patient rights and ethical principles. This study investigates the digital data security awareness of pharmacy students and the effects of some variables on it. In this context, a questionnaire was applied to pharmacy students, including the "Digital Data Security Awareness Scale" developed by Yılmaz, Şahin, & Akbulut (2015). Firstly, exploratory factor analysis was performed on the data obtained, and then the effects of some variables on digital data security awareness were investigated via t-test and analysis of variance. Digital data security awareness is found to be higher in those who have an antivirus program on their smartphones. Additionally, it was determined that the mean of the responses given by the students to the statements on the scale was around three. As a result, the awareness of pharmacy students on this issue needs to be improved.

Key Words: *Data security, pharmacy practices, ethics*

Dijital Veri Güvenliği Farkındalığı: Eczacılık Öğrencileri ile Bir Çalışma

ÖZ

Teknolojik gelişmeler, sağlık alanında da birçok alanda olduğu gibi değişikliklere yol açmaktadır. Bu gelişmeler beraberinde birçok avantaj getirse de bazı potansiyel riskler de bulunmaktadır. Dijital sağlık hizmetlerindeki ve dijital olarak depolanan bilgilerdeki artış, veri güvenliği konusundaki endişeleri de arttırmaktadır. Eczacıların ve eczacılık öğrencilerinin, hasta hakları ve etik ilkeler de göz önünde bulundurulduğunda, veri güvenliği konusunda farkındalığa sahip olmaları oldukça önem arz etmektedir. Bu çalışma, eczacılık öğrencilerinin dijital veri güvenliği farkındalığını ve bazı değişkenlerin buna etkilerini incelemektedir. Bu kapsamda eczacılık öğrencilerine Yılmaz, Şahin, ve Akbulut (2015) tarafından geliştirilen "Dijital Veri Güvenliği Farkındalığı Ölçeği"ni de içeren bir anket uygulanmıştır. Elde edilen verilere ilk olarak açıklayıcı faktör analizi yapılmış, ardından bazı değişkenlerin dijital veri güvenliği farkındalığı üzerindeki etkileri t-testi ve varyans analizi ile araştırılmıştır. Akıllı telefonunda antivirüs programı bulunanlarda dijital veri güvenliği farkındalığının daha yüksek olduğu tespit edilmiştir. Ayrıca, öğrencilerin ölçekteki ifadelere verdikleri yanıtların ortalamalarının üç civarında olduğu belirlenmiştir. Sonuç olarak, eczacılık öğrencilerinin bu konudaki farkındalıklarının geliştirilmesi gerekmektedir.

Anahtar Kelimeler: *Veri güvenliği, eczacılık uygulamaları, etik*

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INTRODUCTION

Usage of health information technology in healthcare is stated to be important, and it has benefits in costs, patient satisfaction, health outcomes (Rothstein, 2007; Sykes, Venkatesh, & Rai, 2011; Kuo, Ma, & Alexander, 2014). As time goes on, more data and information are available in the digital environment and can be easily stored, copied, and moved on small devices (Öğütçü, Testik, & Chouseinoglou, 2016). Today, health data are stored as electronic records by hospitals and clinics (Wang, 2015). There is a growing interest in using electronic health records instead of paper-based records (Fernández-Alemán, Señor, Lozoya, & Toval, 2013). It brings several advantages such as improving data availability, reducing costs and medical errors (Sun & Fang, 2010). The use of electronic health records improves patient care with immediate access and exchange of information, on the other hand, some risks as unauthorized access and use, raise concerns about confidentiality and privacy (Sulmasy, López, Horwitch, American College of Physicians Ethics, Professionalism and Human Rights Committee, 2017). The ethical principles of justice, autonomy, privacy, and confidentiality are considered in evaluating health technologies (Nesipoğlu & Özdinç, 2021). Electronic data security and information security management are sensitive issues for organizations (Parsons, McCormac, Pattinson, Butavicius, & Jerram, 2014). In the literature, the most cited concerns are privacy and security (Chao, Hu, Ung, & Cai, 2013; Sun & Fang, 2010; Lee, 2017; Haas, Wohlgemuth, Echizen, Sonehara, & Müller, 2011; Wang 2015; Yüksel, Küpçü, & Özkasap, 2017). Lack of security awareness threatens information security (Karabatak & Karabatak, 2019). As digital healthcare services increase around the world, the necessity of making regulations has arisen. European Union and the United States made regulations to protect health data and ensure privacy (Treacy & McCaffery, 2016). Similarly, in Turkey, Personal Data Protection Law, and Regulation on Personal Health Data entered into force in 2016 and 2019, respectively (Official Gazette, 2016, No:6698; Official Gazette, 2019, No: 30808).

Pharmacy is not apart from these developments and changes in healthcare. Various studies exhibit that health technologies have been taking part in pharmacy practice (Stewart & Lynch, 2012; Williams, Nunemacher, Holland, Rhodes, & Marciniak, 2019; Martirosov, Seitllari, Kaurala, & MacDonald, 2020; Westbrook et al., 2019; McNicol, Kuhn, & Sebastian, 2019; Burgin, O'Rourke, & Tully, 2014). Human errors are one of the major problems in ensuring information security, and raising awareness on this issue is essential (Çetinkaya, Güldüren, & Keser, 2017). In addition, considering the development, management, and usage processes, the importance of the human factor becomes evident (Karaoğlan Yılmaz, Yılmaz, & Sezer, 2014). In this regard, healthcare providers' responsibility and attention are important. Hence, increment of pharmacists' awareness about data security is essential.

Importance should be given to cybersecurity to protect health data (Wang, 2015). In a study conducted with physicians, lack of knowledge and skills are stated as significant challenges in using electronic health record systems (Chao et al., 2013). Privacy is at the forefront for people with high digital data security awareness levels (Durak & Saritepeci, 2020). In this context, improving healthcare professionals' skills, knowledge, and awareness is essential. In the literature, there are some studies about digital data security awareness. For instance, Avcı and Arslan (2019) conducted a study with employees of a public service organization and found a significant positive relationship between information literacy levels and digital data security awareness. Besides, Göldağ (2021) applied a study to university students and showed a significant positive relationship between digital literacy levels and digital data security awareness. Moreover, in Gündüzalp's (2021) study, the awareness

of university employees about digital data security and cyber security were determined.

Considering that pharmacists have ethical responsibilities to patients, and health information technologies are widely used, ensuring digital data security is essential for pharmacists. As future pharmacists, pharmacy students should pay attention to this issue. Within the scope of the study, the status of pharmacy students' digital data security awareness and the influences of some variables on digital data security awareness are examined.

MATERIAL AND METHODS

This study was approved by Izmir Katip Çelebi University Social Research Ethics Committee (Permit No: 2020/09-06). The questionnaire was applied online between November and December 2020 to pharmacy students in a pharmacy faculty. Informed consent was taken from the participants. In total 403 students exist in the faculty, and 88 students answered the questionnaire.

The questionnaire form consists of questions about gender, grade, internet usage, antivirus programs, and the Digital Data Security Awareness Scale developed by Yılmaz, Şahin, & Akbulut (2015). The scale has one dimension and five-point Likert type 32 items. The Cronbach's alpha coefficient of the scale is 0.945.

Data obtained from the study were analyzed with IBM SPSS 24.0 package program. Descriptive statistics were given. Besides, exploratory factor analysis was conducted on the data, Cronbach's alfa and Kaiser-Meyer-Olkin (KMO) values were calculated. T-test and variance analysis (ANOVA) were used to determine the effects of the variables on the factor. Also, the mean values of the items were investigated.

RESULTS AND DISCUSSION

The study results showed that most of the participants were female (62.5% female, 37.5% male). When examined according to the grades, 27.3% of the students were in their first year. 19.3%; %14.8%; 22.7% and 5.9% of the students were in the second, third, fourth, and fifth grade, respectively. In terms of internet usage in a day, 40.9% of the participants used for 3-5 hours, and 30.7% used for more than 5 hours. 23.9% used for 1-3 hours, 4.5% of them were used for less than 1 hour. The status of having an antivirus program on computers or smartphones was examined. The study results showed that half of the students (50%) have an antivirus program on their computers, and 34.1% do not have. 15.9% expressed that they don't have a computer. Most of the students (71.6%) don't have an antivirus program on their smartphones, while 28.4% have.

The KMO value was found as 0.913. Exploratory factor analysis was performed and limited to one factor, as indicated in Yılmaz, Şahin, & Akbulut's (2015) study. According to the results, the factor loadings of all expressions were found to be above 0.5, and the explained variance ratio was 56.4%.

The Cronbach's alpha coefficient of the scale was determined as 0.974. The factor loadings of the items were shown in Table 1. T-test and ANOVA analysis were performed to determine whether there is a difference according to gender, grade, internet usage, and the antivirus program on smartphones. Only those with an antivirus program on their smartphones had a statistically significant difference $p<0.05$, and their digital data security awareness was found to be higher.

Table 1. Factor Loadings

Items	Factor loadings
i18	0.86
i2	0.85
i15	0.85
i32	0.84
i14	0.83
i17	0.83
i11	0.82
i28	0.82
i22	0.81
i25	0.80
i19	0.80
i13	0.79
i26	0.78
i12	0.78
i30	0.77
i27	0.77
i8	0.76
i16	0.75
i7	0.74
i6	0.73
i24	0.72
i23	0.72
i21	0.71
i20	0.70
i9	0.70
i10	0.70
i3	0.68
i4	0.66
i29	0.65
i31	0.62
i1	0.54
i5	0.51

Table 2. Means ($\bar{x}$) and standard deviations (SD)

Items	Means ($\bar{x}$)	SD
i1	2.65	1.31
i2	3.83	1.34
i3	3.39	1.39
i4	3.66	1.43
i5	2.34	1.42
i6	3.09	1.45
i7	3.42	1.34
i8	3.56	1.48
i9	3.28	1.37
i10	3.06	1.40
i11	3.36	1.44
i12	3.36	1.34
i13	3.86	1.30
i14	3.86	1.32
i15	3.81	1.29
i16	3.57	1.41
i17	3.56	1.35
i18	3.83	1.35
i19	3.32	1.41
i20	3.31	1.43
i21	3.06	1.40
i22	3.24	1.34
i23	3.10	1.33
i24	4.15	1.36
i25	3.77	1.45
i26	3.58	1.36
i27	3.32	1.40
i28	3.76	1.27
i29	2.99	1.37
i30	3.82	1.34
i31	2.61	1.30
i32	3.28	1.34

In Table 2, the means and standard deviation values of the items were given. The items with the least and highest means were found to be 2.34 and 4.15. According to the results, items with the least and highest mean were about firewall software knowledge, and awareness in setting passwords for devices to prevent unauthorized access, respectively. The average mean of all items was 3.4.

The findings of this study revealed that gender, grade, or internet usage did not make a statistically significant difference in digital data security awareness of pharmacy students. However, having an antivirus program on smartphones makes a difference. The fact that the average of the items is around three indicates that the awareness of the pharmacy students should be increased.

In the literature, there are various studies investigating the role of gender in security awareness. In a study conducted with medical secretaries, information security awareness of females was found to be higher than males (Filik & Ünalan, 2021). Information security awareness of hotel managers did not differ according to gender (Okul, Şimşek, Hafçı & Barış, 2018). In a study applied to university students, no difference was found in cyber security behaviors by gender (Karacı, Akyüz, & Bilgici, 2017). Additionally, in employees' digital data security awareness, no significant gender difference was exhibited (Gündüzalp, 2021). Besides, studies exist indicating that digital data security awareness is higher in males (Göldağ, 2021; Yılmaz, Şahin, & Akbulut, 2016; Korkmaz, 2018). In this study, no statistically significant difference was found in digital data security awareness in terms of gender. Yılmaz et al. (2016) expressed that digital data security awareness of teachers increases when the daily internet usage time exceeds 3 hours a day. However, the present study results showed that no statistically significant difference was found in digital data security awareness according to daily internet usage. Parallel with this finding, there was no difference in the information security awareness of hotel managers in terms of internet usage times (Okul et al., 2018). Mylonas, Kastania, & Gritzalis (2013) found nearly one-quarter of smartphone users have security software on smartphones; however, most of them use security software on their computers, additionally presented that approximately one-third of the participants consider security software is not essential for smartphones. Similarly, in the present study, nearly one-third of pharmacy students use an antivirus program for their smartphones, and half of them have an antivirus program on their computers. Bıkmaz (2017) stated that approximately forty percent of health management department students have security software for smartphones, and nearly one-third use security software for laptops.

In literature, some studies applied the Digital Data Awareness Scale to university students. Göldağ (2021) stated that students have high digital data security awareness. Korkmaz (2018) found the statements' mean as generally close to four and the least mean as 3.30. However, in the present study, pharmacy students' answers to the statements were lower, and their awareness should be developed. Göldağ (2021) stated that students have the highest awareness about creating passwords for devices to prevent unauthorized use. Similarly, in the present study, pharmacy students have the highest awareness about it. Karaoğlan Yılmaz et al. (2014) applied a study with university students and presented that nearly half of them used username and password, and approximately one-tenth used firewall to prevent others from accessing their computer. The current study shows pharmacy students have a low level of knowledge about firewall software. In Okul et al.'s (2018) study, according to an open-ended question result, hotel managers were found not sufficiently knowledgeable about how a secure password should be. In the present study, the statements about passwords are over three.

CONCLUSION

Considering the security importance in healthcare, patient confidentiality, and privacy, future pharmacists' awareness of digital data security is vital. According to the study results, pharmacy students' awareness should be increased. It is thought that, in the light of current advancements, attaching more importance to this subject in the pharmacy curriculum will contribute to increasing the awareness of students. This study is applied to pharmacy students only. Thus for future studies, it may be conducted with pharmacists. Also, the qualitative methodology can be used for an in-depth examination. Seminars may be given to pharmacists and pharmacy students to increase awareness of this issue.

CONFLICT OF INTEREST

No conflict of interest.

AUTHOR CONTRIBUTION STATEMENT

Design, preparing the study text, reviewing the text, statistics, analysis and interpretation of the data, literature research. (NT)

REFERENCES

Avcı, Ü., & Arslan, E. (2019). Dijital veri güvenliği farkındalığı ve bilgi okuryazarlığı ile alınan hizmetiçi eğitimin etkisi. *Ankara University Journal of Faculty of Educational Sciences (JFES), 52*(3), 891-914. doi: 10.30964/auebfd.493124

Bıkmaz, Z. (2017). Sağlık yönetimi bölümü öğrencilerinin mobil güvenlik farkındalığı ve dijital veri güvenliği farkındalıklarının belirlenmesi. *Uluslararası Yönetim Bilişim Sistemleri ve Bilgisayar Bilimleri Dergisi, 1*(1), 22-30.

Burgin, A., O'Rourke, R., & Tully, M. P. (2014). Learning to work with electronic patient records and prescription charts: experiences and perceptions of hospital pharmacists. *Research in Social and Administrative Pharmacy*, *10*(5), 741-755. doi: 10.1016/j.sapharm.2013.11.005

Chao, W. C., Hu, H., Ung, C. O. L., & Cai, Y. (2013). Benefits and challenges of electronic health record system on stakeholders: a qualitative study of outpatient physicians. *Journal of Medical Systems, 37*, 9960. doi: 10.1007/s10916-013-9960-5

Çetinkaya, L., Güldüren, C., & Keser, H. (2017). Öğretmenler için bilgi güvenliği farkındalık ölçeği (BGFÖ) geliştirme çalışması. *Milli Eğitim Dergisi, 46*(216), 33-52.

Durak, H. Y., & Saritepeci, M. (2020). Examination of the relationship between cyberbullying and cyber victimization. *Journal of Child and Family Studies, 29,* 2905-2915. https://doi.org/10.1007/s10826-020-01768-4

Fernández-Alemán, J. L., Señor, I. C., Lozoya, P. Á. O., & Toval, A. (2013). Security and privacy in electronic health records: A systematic literature review. *Journal of Biomedical Informatics, 46*(3), 541-562. doi: 10.1016/j.jbi.2012.12.003

Filik, T., & Ünalan, D. (2021). The evaluation of the effect of the information security awareness level in medical secretaries on the security and privacy implementations of electronic health records. Hacettepe Sağlık İdaresi Dergisi, *24*(1), 183-202.

Göldağ, B. (2021). Üniversite Öğrencilerinin Dijital Okuryazarlık Düzeyleri İle Dijital Veri Güvenliği Farkındalık Düzeyleri Arasındaki İlişkinin İncelenmesi. *e-Uluslararası Eğitim Araştırmaları Dergisi, 12*(3), 82-100. doi: 10.19160/e-ijer.950635

Gündüzalp, C. (2021). Üniversite çalışanlarının dijital veri ve kişisel siber güvenlik farkındalıkları (bilgi işlem daire başkanlıkları örneği). *Journal of Computer and Education Research, 9*(18), 598-625. doi: 10.18009/jcer.907022

Haas, S., Wohlgemuth, S., Echizen, I., Sonehara, N., & Müller, G. (2011). Aspects of privacy for electronic health records. *International Journal of Medical Informatics, 80*, e26-e31. doi: 10.1016/j.ijmedinf.2010.10.001

Karabatak, S., & Karabatak, M. (2019). Information security awareness of school administrators.2019 7th International Symposium on Digital Forensics and Security (ISDFS) (pp. 1-6). doi: 10.1109/ISDFS.2019.8757525.

Karacı, A., Akyüz, H. İ., & Bilgici, G. (2017). Üniversite öğrencilerinin siber güvenlik davranışlarının incelenmesi. *Kastamonu Eğitim Dergisi, 25*(6), 2079-2094. doi: 10.24106/kefdergi.351517

Karaoğlan Yılmaz, F. G., Yılmaz, R., & Sezer, B. (2014). Üniversite öğrencilerinin güvenli bilgi ve iletişim teknolojisi kullanım davranışları ve bilgi güvenliği eğitimine genel bir bakış. *Bartın University Journal of Faculty of Education, 3*(1), 176–199.

Korkmaz, E. V. (2018). Üniversite öğrencilerinin internet ve veri güvenliği farkındalıkları. *Journal of Social And Humanities Sciences Research (JSHSR)*, *5*(25), 2222-2229.

Kuo, K. M., Ma, C. C., & Alexander, J. W. (2014). How do patients respond to violation of their information privacy? *Health Information Management Journal, 43*(2), 23-33. https://doi.org/10.1177/183335831404300204

Lee, L. M. (2017). Ethics and subsequent use of electronic health record data. *Journal of Biomedical Informatics, 71*, 143-146. https://doi.org/10.1016/j.jbi.2017.05.022

Martirosov, A. L., Seitllari, K., Kaurala, S., & MacDonald, N. (2020). Pharmacist implementation of a transitions of care electronic referral process to provide hand-off between inpatient and outpatient settings. *Journal of the American Pharmacists Association, 60*(1), 112-116.e1. https://doi.org/10.1016/j.japh.2019.09.010

McNicol, M., Kuhn, C., & Sebastian, S. (2019). Standardized documentation workflow within an electronic health record to track pharmacists' interventions in pediatric ambulatory care clinics. *Journal of the American Pharmacists Association, 59*(3), 410-415. https://doi.org/10.1016/j.japh.2019.01.007

Mylonas, A., Kastania, A., & Gritzalis, D. (2013). Delegate the smartphone user? Security awareness in smartphone platforms. *Computers & Security, 34*, 47-66. https://doi.org/10.1016/j.cose.2012.11.004

Nesipoğlu, G., & *Özdinç, A. (2021). Sağlık teknolojisi değerlendirmesinin "içkin bileşen"i olarak etik. Hacettepe Sağlık İdaresi Dergisi, 24*(1), 203-218.

Official Gazette. (2016), Kişisel Verilerin Korunması Kanunu, https://www.resmigazete.gov.tr/eskiler/2016/04/20160407-8.pdf, Access date: 19 November 2021.

Official Gazette. (2019), Kişisel Sağlık Verileri Hakkında Yönetmelik, https://www.resmigazete.gov.tr/eskiler/2019/06/20190621-3.htm, Access date: 19 November 2021.

Okul, T., Şimşek, G., Hafçı, B., & Barış, Z. (2018). Konaklama işletmesi yöneticilerinde bilgi güvenliği farkındalığı: Kuşadası'ndaki beş yıldızlı oteller örneği. *Uluslararası Türk Dünyası Turizm Araştırmaları Dergisi, 3*(2),189-201.

Öğütçü, G., Testik, Ö. M., & Chouseinoglou, O. (2016). Analysis of personal information security behavior and awareness. *Computers & Security, 56*, 83-93. https://doi.org/10.1016/j.cose.2015.10.002

Parsons, K., McCormac, A., Pattinson, M., Butavicius, M., & Jerram, C. (2014). A study of information security awareness in Australian government organisations. *Information Management & Computer Security, 22*(4), 334-345. https://doi.org/10.1108/IMCS-10-2013-0078

Rothstein, M. A. (2007). Health privacy in the electronic age. *The Journal of Legal Medicine, 28*(4), 487-501. doi:10.1080/01947640701732148

Stewart, A. L., & Lynch, K. J. (2012). Identifying discrepancies in electronic medical records through pharmacist medication reconciliation. *Journal of the American Pharmacists Association, 52*(1), 59-68. https://doi.org/10.1331/JAPhA.2012.10123

Sulmasy, L. S., López, A. M., Horwitch, C. A., American College of Physicians Ethics, Professionalism and Human Rights Committee (2017). Ethical implications of the electronic health record: in the service of the patient. *Journal of General Internal Medicine, 32,* 935-939. https://doi.org/10.1007/s11606-017-4030-1

Sun, J., & Fang, Y. (2010). Cross-domain data sharing in distributed electronic health record systems. *IEEE Transactions on Parallel and Distributed Systems, 21*(6), 754-764. doi: 10.1109/TPDS.2009.124

Sykes, T. A., Venkatesh, V., & Rai, A. (2011). Explaining physicians' use of EMR systems and performance in the shakedown phase. *Journal of the American Medical Informatics Association, 18,* 125-130. doi:10.1136/jamia.2010.009316

Treacy, C., & McCaffery, F. (2016). Data security overview for medical mobile apps assuring the confidentiality, integrity and availability of data in transmission. *International Journal on Advances in Security, 9*(3&4), 146-157.

Williams, S. P., Nunemacher, C., Holland, C., Rhodes, L. A., & Marciniak, M. W. (2019). An electronic tool to aid community pharmacists in optimizing care for persons with diabetes. *Journal of the American Pharmacists Association, 59*(4), S136-S140.e4 https://doi.org/10.1016/j.japh.2019.05.004

Wang, C. K. (2015). Security and privacy of personal health record, electronic medical record and health information. *Problems and Perspectives in Management, 13*(4), 19-26.

Westbrook, J. I., Li, L., Shah, S., Lehnbom, E. C., Prgomet, M., Schofield, B., ... Sheikh, A. (2019). A cross-country time and motion study to measure the impact of electronic medication management systems on the work of hospital pharmacists in Australia and England. *International Journal of Medical Informatics, 129*, 253-259. https://doi.org/10.1016/j.ijmedinf.2019.06.011

Yılmaz, E., Şahin, Y. L., & Akbulut, Y. (2015). Dijital veri güvenliği farkındalığı ölçeğinin geliştirilmesi. *AJIT-e: Bilişim Teknolojileri Online Dergisi, 6*(21), 23-40. doi: 10.5824/1309-1581.2015.4.002.x

Yılmaz, E., Şahin, Y. L., & Akbulut, Y. (2016). Öğretmenlerin dijital veri güvenliği farkındalığı. *Sakarya University Journal of Education*, *6*(2), 26-45. doi: 10.19126/suje.29650

Yüksel, B., Küpçü, A., & Özkasap, Ö. (2017). Research issues for privacy and security of electronic health services. *Future Generation Computer Systems, 68*, 1-13. https://doi.org/10.1016/j.future.2016.08.011