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A Study of the Awareness of Wearable Medical Devices in India: A Potential Market Perspective

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Abstract

A Medical Wearable Device provides vital sign monitoring. Therefore, it involves monitoring of one or more of the following or any other physiological vital that has application in fitness monitoring and medical diagnostic such as; blood glucose level; blood pressure; pulse rate; electrocardiograph (ECG) patterns; respiration rate; respiration effectiveness (e.g., blood oxygen saturation). Hence the Medical Wearable Devices are extremely useful precautionary gadgets. A number of such devices are available in market these days. Despite of their usefulness they are not very popular in India. This may be due to low level of awareness. As Metropolitan cities is primary market for such gadgets.

This paper focuses on the awareness level of the medical wearable devices in Delhi-NCR and studies awareness with respect to suitable demographics. Further, this paper identifies the key parameters in role of the education, qualification and purchase power parity for adoption of this device. The insights drawn from the vast health literature helps to develop the behavioral conceptual framework which becomes the basis to gather the primary data.

Keywords

Internet of things, integrated health care model, adoption, consumer awareness, challenges

1. Introduction

According to Section (h) of the Food, Drug & Cosmetic Act, a medical device is "intended for use in diagnosis of disease or other conditions or in the cure, mitigation, treatment, or prevention of disease, in man or other animals". Wearable health tracking devices are being launched every year. These inventions include tracking bands smart watches, contact lenses, glasses, derma patches, clothing's and consumable pills for continuous monitoring to name a few. The popular devices in the present market are used for fitness monitoring but the new innovation aims to monitor/alert physiological parameters critical in cure, mitigation, treatment or prevention of chronic diseases in India. According to the Medcon report (2017), devices used for continuous monitoring of chronic diseases have a unique value proposition because their sensors are capable of monitoring multiple biomarkers, including those associated with diabetes (e.g., trace ketones to signal low insulin), hypertension, and certain lung conditions like breast health, skin health, cardiovascular health, asthma monitoring, nicotine levels, blood glucose levels, bed sore and ulcer prevention due to inactivity during hospitalization. Another domain being explored is in treatment and management of neurological disorders to modify behavior

and treat anxiety, depression; monitor and prevent seizure, stroke, etc. These devices with blue tooth capabilities collect real time data received through biosensors. Proliferation of these technologies has been relatively higher in developed nations and has only very recently taken off in India. The more commercially available devices in India are limited to smart watches, fitness bands and applications integrated with mobile applications. However, India is poised to become one of the largest markets for wearable medical device technologies in the near future. Some of the most recognizable brands are Fitbit, Garmin, Omron, Apple, Zephyr, Xiomi, but a modest number of Indian startups have also emerged like Cardea Labs. Amongst the vivid pool of wearable health solutions lies a healthcare segment of Wearable Monitoring Systems. WPM systems are a potential solution for addressing some of these challenges by enabling advanced sensors, wearable technology, and secure and effective communication platforms between the clinicians and patients (Baig, 2017). The Internet of Things (IoT) is widely used to interconnect the available medical resources like wearable monitoring systems and offer reliable, smart, and effective healthcare services. Health monitoring is one of the paradigms that can use the IoT advantages to improve preventive care and remote diagnostic. Architecture of IoT for healthcare applications collects the data and sends it to the cloud where it is analyzed and processed. Actions based on the analyzed data are sent back to the user by the physician. According to Abdelgawad, Yelamarthi, and Khattab (2017), remote healthcare has become a vital service with the growing rate of senior citizens. Health monitoring, rehabilitation, and assisted living for the elderly and medically challenged humans is an emerging challenge because they require seamless networking between people, medical instruments, and medical and social service providers. This motivates the need for affordable, low-power, reliable, and wearable devices that will improve the quality of life for many elderlies and physically challenged people. According to Yin, Zeng, Chen, and Fan (2016) et al., the Internet of Things (IoT) platform offers a promising technology to achieve the aforementioned healthcare services, and can further improve the medical service systems. As per Sullivan, Sahasrabudhe (2017) et al., IoT wearable platforms can be used to collect the needed information of the user and its ambient environment and communicate such information wirelessly, where it is processed or stored for tracking the history of the user. Such a connectivity with external devices and services will allow for taking preventive measure (e.g., upon foreseeing an upcoming heart stroke) or providing immediate care (e.g., when a user falls down and needs help).

1.1 Present Market Need and Analysis

According to a Report by FICCI presented by Deloitte on "Indian Medical Electronics Industry Outlook 2020" the Indian Demographic Factors offer opportunity for tremendous growth in Medical Electronics due to general demand for healthcare. Ageing Population—The proportion of aged population is increasing in India. The number of people in the 60-plus age group in India in 2009 was 89 million and is expected to increase to 316 million by 2050. Health Ministry has rolled out the National Program for the Health Care of the Elderly (NPHCE) in India and a provision of INR 288 Crores (around USD 60 million) has been made during 2010-2025. Change in Disease Profile—Non-Communicable Diseases (NCDs) have emerged as a major public health problem in India and is the leading cause of death in India accounting for over 42% of all deaths. 3 Sedentary lifestyle, pollution, high stress levels, etc. have led to increase in lifestyle/non-communicable diseases such as diabetes, cancer, cardiovascular diseases, etc. Lifestyle diseases such as cardiovascular diseases, obesity and diabetes are also projected to become more pervasive. The Government of India has initiated National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS). Under this program a provision of INR 1230 Crores (around USD 270 million)

has been made during 2011-2012. 4 District Hospitals will be upgraded by setting up NCD Clinic, District cancer facility and Cardiac care units and Tertiary cancer centers are planned to be set up to provide comprehensive treatment to common cancer.

Increase in Income—The per capita disposable income and healthcare expenditure has increased 3 times over the past decade. The trend is not only expected to sustain, but is expected to grow at a higher rate in future. Key drivers are rising income base, growing awareness (information availability), reduced accessibility barriers and changing disease profile.

Growth India ranks amongst the fastest growing countries of the world in terms of GDP growth and is expected to have significant growth for the next 10 years. The growth is fueled by increased globalization, rising work-force productivity and per capita income, intensifying information exchange fueling awareness, and positive attitude of government to develop the general health of the population. Devices worn on or close to the body are expected to produce the most groundbreaking innovation. There is increasing evidence of the value of continuous physiological data in managing chronic diseases and monitoring patients post hospitalization. As a result a growing number of medical devices are becoming wearables in India, including glucose monitors, ECG monitors, pulse oximeters and blood pressure monitors. Whereas in the developed nations, technologies such as preventice's Body Guardian remote monitoring system or Avery Dennison's Metria wearable Technology are setting the stage to seamlessly deliver patients data to doctors. Bluetooth is key in systems such as 9 soulutions IPCS, which uses it to track elderly patient's movement and send health measurement to caregivers. Body Tel uses Bluetooth to allow patients to wirelessly send body measurements to their doctors.

Similarly in a country like India where diabetic patients are high, Continuous Glucose Monitors (CGM) have a wide scope to not only monitor the glucose level in human bodies but also help sustain at desired level by injecting insulin time to time.

An example already exists in the developed nation, C8 Medisensor, a wearable product that conducts non-invasive optical glucose monitoring by transmitting a pulse of light through the skin and constantly updates the data to a Smartphone via Bluetooth.

1.2 Review of Literature

Ian Ferguson (2016) in his address in "Mobile health: the power of wearable's, sensors and app to transform clinical trials" reviewed that according to International Diabetes Federation estimates in Nov 2013, the number of diabetes sufferers will increase 50% with a cost to the health care industry estimated to be $630 billion. Ferguson further stated that Smartphone initially used to simply make and receive phone calls, is expected to become a gateway that channels a rich set of personal information to and fro from a cloud structure such as server. Topol (2010) in the "Consumer movement in Health care" and Kish and Topol (2015) in "Unpatients-why patients should own their medical data" explained that many owners of smart phones and wearable sensors are using their devices to automatically track measure their own health, including sleep, vitals, and exercise but soon most routine lab test will likely be obtainable by consumers with Smartphone kits, this will shift the data ownership from healthcare providers to patients. Seram and Dhramakeerthi (2016) in "Wearable Technology Products: Awareness in Sri Lankan Market" explained the knowledge gap between the customers and Wearable Technology Market where their reduced awareness is dependent on the factors like lack of product experience, low trust level, minimal market influence, low customer motivation and insufficient influence from marketers are also the reasons. Kotler and Armstrong (2005) in his book "Marketing: an Introduction" explained the Innovation Adoption Model. However, steps in Innovation Adoption model state that pushing the customers from "Awareness" to "Evaluation" can be achieved through the use of

marketing tools and strategies devised by the marketers. Teng, Zhang, Poon and Bonato (2008) in "Wearable medical system for p-health", explained that in Medical WT, all the measured physiological data are collected by a microcontroller based on the processed data the central controller may either generate a warning message to the caregiver or help detect an early disease (James, 2016). "The Baetylus Theorem—The Central Disconnect Driving Consumer Behavior and Investment Returns in Wearable Technologies" explains that. There is a fundamental disconnect in how consumers view wearable sensors and how companies market them; this is called The Baetylus Theorem where people believe (falsely) that by buying a wearable sensor they will receive health benefit; data suggest that this is not the case. This idea is grounded social constructs, psychological theories and marketing approaches. A marketing proposal that fails to recognize The Baetylus Theorem and how it can be integrated into a business offering has not optimized its competitive advantage.

Chen et al. (2016) in "Wrist Eye: Wrist-Wearable Devices and a System for Supporting Elderly Computer Learners" told that Wearable devices, such as wristbands, smart watches, are gaining in popularity. Into such devices can be embedded a variety of sensors which can give birth to a number of diverse functions. Our team wanted to develop an assisted learning system incorporating a wearable device that would be able monitor _rst-time learners' use of mouse and keyboard and provide their instructors with useable feedback.

Gao, Li, Luo, and Yan (2015) in "An empirical study of wearable technology acceptance in healthcare" identifies that Consumer's decision to adopt healthcare wearable technology is affected by factors from technology, health, and privacy perspectives. Specially, fitness device users care more about hedonic motivation, functional congruence, social influence, perceived privacy risk, and perceived vulnerability, but medical device users pay more attention to perceived expectancy, self-efficacy, effort expectancy, and perceived severity. Bloss (2015) in "Wearable sensors bring new benefits to continuous medical monitoring, real time physical activity assessment, baby monitoring and industrial applications" highlighted in practical implications that Doctors will be able to replace one-off tests with continuous monitoring that provides a much better continuous real-time "view" into the patient's conditions. Wearable monitors will help provide much better medical care in the future. Industrial managers and others will be able to monitor and supervise remotely.

He, Kumar and Chen et al. (2015) in "Robust anonymous authentication protocol for health-care applications using wireless medical sensor networks" stated that as an application of the WSN, the Wireless Medical Sensor Network (WMSN) could improve health-care quality and has become important in the modern medical system. In the WMSN, physiological data are collected by sensors deployed in the patient's body and sent to health professionals' mobile devices through wireless communication. Then health professionals could get the status of the patient anywhere and anytime. The data collected by sensors are very sensitive and important. The leakage of them could compromise the patient's privacy and their malicious modification could harm the patient's health. Therefore, both security and privacy are two important issues in WMSNs. Ivaschenko and Minaev (2014) in the conference paper on "Multi-agent Solution for Adaptive Data Analysis in Sensor Networks at the Intelligent Hospital Ward" was based on wireless network of sensors that are used to collect and process medical data describing the current patient state. A multi-agent architecture is provided for a sensor network of medical devices, which is able to adaptively react to various events in real time. To implement this solution it is proposed to partially process the data by autonomous medical devices without transmitting it to the server and adapt the sampling intervals on the basis of the non-equidistant time series analysis. The solution is illustrated by simulation results and clinical deployment.

Kuptsov, Nechaev, and Gurtov (2012) in "Securing Medical Sensor Network with HIP" discussed their framework which heavily relies on Host Identify Protocol (HIP) [1,2,3]—a protocol proposed to overcome the problem of using IP addresses both for host identification and routing. HIP defines a new cryptographic Host Identity name space, thereby splitting the double meaning of IP addresses. In HIP, Host Identities (HI) are used instead of IP addresses in the transport protocol headers for establishing connections. Prior to communication over HIP, two hosts must establish a HIP association. This process is known as HIP Base Exchange (BEX) [2] and it consists of four messages transferred between initiator (I) and responder (R). A successful BEX authenticates hosts to each other and generates a Diffie-Hellman shared secret key used in creation of two IPsec Encapsulated Security Payload (ESP) Security Associations (SAs), one for each direction. All subsequent traffic between communicating nodes is encrypted by IPsec. "A system of human vital signs monitoring and activity recognition based on body sensor network" (Wang, Zhao, & Qiu, 2014), develop a health monitoring system that can measure human vital signs and recognize human activity based on Body Sensor Network (BSN). Through the three collection nodes to collect ECG signals, blood oxygen signals and motion signals it was found that the human monitoring system can simultaneously monitor human ECG, heart rate, pulse rate, SpO2 and recognize human activity. A classifier based on Coupled Hidden Markov Model (CHMM) is adopted to recognize human activity. The average recognition accuracy of CHMM classifier is 94.8 percent, which is higher than some existent methods, such as Supported Vector Machine (SVM), C4.5 decision tree and Naive Bayes Classifier (NBC). The monitoring system may be used for falling detection, elderly care, postoperative care, rehabilitation training, sports training and other fields in the future.

2. Method

An Exploratory research has been conducted using different keywords to draw a list of relevant research papers on Google Scholar and several online databases like Springer, IEEE, Elsevier, Emerald, etc. On the basis of both the primary and secondary data a logical framework is established which emphasis on the gap between the present awareness level to adoption. According to the insights from IoT India Congress report, health is not a single event it can be thought as a continuous event. In India people buy healthcare for two factors—perceived severity and perceived susceptibility. Data is collected through a sample of 186 respondents by using mail questionnaire method. Sampling is done by using stratified random sampling method. Snowball technique is used to reach the desired sample size. Reliability of the data is checked by using Chronbach alpha ($\alpha = 0.78$). The scope of this study is Delhi NCR Region.

2.1 Data Analysis

This section presents data analysis of the awareness with respect to various demographics. The following objective and the hypotheses formulated are tested in this study.

Objective 1: To study the awareness level of the customers of Medical wearable technology and devices.

Objective 2: To analyze the relationship between awareness level and age, education level, qualification and the income group.

3. Result

To know the level of awareness of medical wearable device in India, the following questions were analyzed.

Q1. In which field of application do you have awareness of any Wearable Technology/Wearable Device?

Table 1. Awareness of Wearable Devices

		Responses		Percent of Cases
		N (Y)	Percent	
Awareness Field	Medical Wellness	102	42.0%	55.1%
	Sports/ Fitness field	103	42.4%	55.7%
	Cloth and Fashion	33	13.6%	17.8%
	Security	5	2.1%	2.7%
Total		243	100.0%	131.4%

Note. Dichotomy group tabulated at value 1.

When respondents are asked in which field of awareness they have awareness of any wearable technology/wearable device. The awareness remained highest in sports/fitness field while the second largest awareness remained in medical field. The lowest awareness of such devices reflected in security field. Not even a single respondent was aware that there are implantable wearable devices.

Table 2. How Familiar You Are with a Wearable Device

	Gender	N	Mean	Std. Deviation	Std. Error Mean
QH1_1	Female	136	3.59	.954	.082
	Male	50	3.60	1.143	.162

When it comes to familiarity with wearable device it can be clearly seen that males have a higher familiarity with the wearable device comparatively while the standard deviation for males remain higher that shows that there is a higher variability in thought process.

Now in order to check whether the difference of mean is significant or not we formulate following alternate hypothesis.

$\boldsymbol{H_{11}}$: Difference of awareness amongst males and females is different.

We use independent sample t-test for testing the hypothesis. Following table shows the results.

Table 3. Independent Sample T-test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
QH1_1	Equal variances assumed	2.843	.093	-.071	184	.944	-.012	.167
	Equal variances not assumed			-.065	75.539	.948	-.012	.181

We can observe from Levene's test that the difference of variances is not significant. We can consider the case of equal variances as we can observe that the difference of opinion is not significant and we do not reject the null hypothesis. Thus we conclude that males and females have a similar awareness in general.

Next we measure the impact of age on level of awareness for medical wearable device. Following table compare the means.

Table 4. How Familiar You Are with a Wearable Device

Age	Mean	N	Std. Deviation
15-25	3.89	53	1.266
25-35	3.55	20	1.317
35-45	3.47	19	.841
45-55	3.76	21	.768
55-65	3.17	35	.514
65 and Above	3.55	38	.828
Total	3.59	186	1.005

It is clearly visible that younger generation, 15-25 age group have highest awareness about wearable device, while the least awareness is observed amongst 55-65 age group. Maximum deviation is observed in age group 25-35. Also, the awareness level is gradually increasing between groups 25-35, 35-45 and 45-55. However, it is inconsistent for the above groups as the higher age groups might not be abreast with the latest innovative technology in healthcare.

Now, we observe whether the difference amongst the age group is significant or not. We formulate following alternate hypothesis and use ANOVA to test it.

$\boldsymbol{H_{12}}$: Difference of awareness amongst age groups is significant.

Table 5. Analysis of Variance

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	11.763	5	2.353	2.417	.038
Within Groups	175.183	180	.973		
Total	186.946	185			

We can observe that the difference amongst the opinion of different age groups is significant hence we reject the null hypothesis and conclude that the age group 15-25 has highest awareness of wearable healthcare products.

As our next demographics is education hence we compare the level of awareness with respect to different education levels. Following table discusses the results.

Table 6. How Familiar You Are with a Medical Wearable Device

Education	Mean	N	Std. Deviation
XIIth Standard or Below	3.82	17	1.286
Graduate	3.80	59	1.079
Post Graduate	3.46	92	.857
Above Post Graduate	3.39	18	1.092
Total	3.59	186	1.005

Highest awareness lies with people who are educated XIIth standard or below, while the least awareness is observed amongst post graduate and above. It seems that education doesn't play a role in awareness of wearable healthcare product. That seems logical as well. Since familiarity with innovative health devices is likely to be maximum for the ones who are conscious for their lifestyle and get the maximum opportunities to explore the nascent sports/fitness inventions.

Now we measure whether the difference amongst the means is statistically significant or not. In order to do so, we formulate following alternate hypothesis and perform one-way ANOVA to test it.

$\boldsymbol{H_{13}}$: Difference of awareness amongst different level of educations is significant.

Table 7. Analysis of Variance

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.812	3	1.937	1.947	.124
Within Groups	181.134	182	.995		
Total	186.946	185			

We can see the significance value is above 0.05 hence we do not reject null hypothesis and consider that the difference of awareness is not statistically significant. Hence the difference of opinion is just a matter of chance.

Further we compare the level of awareness with respect to income group. Following table describes the results.

Table 8. How Familiar You Are with a Medical Wearable Device

Monthly Income	Mean	N	Std. Deviation
Less than 30,000	3.84	45	1.261
30,000-50,000	3.77	39	.902
50,000-1 Lac	3.35	77	.823

1 Lac-3 Lac	3.72	18	.826
3 Lac-5 Lac	4.00	3	1.000
5 Lac & Above	2.75	4	1.708
Total	3.59	186	1.005

We can see that the highest level of awareness is amongst 3 Lac-5 Lac group, however the group with less than 30,000 per monthly income is still the second highest familiar group. Which substantially proves that the age group of 15-25 has remarkable familiarity. Highest variation in thoughts is also in highest income level. While the highest consistency is observed group of 50,000-1 lac with lowest standard deviation.

Now we formulate following alternate hypothesis and test it using analysis of variance for testing statistical significance.

H_{14}: Difference of awareness amongst income groups is significant.

Table 9. Analysis of Variance

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.218	5	2.444	2.517	.031
Within Groups	174.728	180	.971		
Total	186.946	185			

It can be observed that the null hypothesis is rejected and we conclude that the difference of awareness amongst different income groups is statistically significant.

Now we observe the awareness difference between respondents that belong to medical field and that does not belong to medical field.

Following table compiles the result.

Table 10. How Familiar You Are with a Medical Wearable Device

MP	Mean	N	Std. Deviation
No	3.60	161	1.014
Yes	3.52	25	.963
Total	3.59	186	1.005

Surprisingly people that belong to medical field have a lower level of awareness of wearable device. The thoughts of people who belong to medical field is more aligned. Now we observe whether the difference is statistically significant or not. We formulate following alternate hypothesis and use independent sample t-test to test it.

H_{15}: Difference of awareness amongst income groups is significant.

Table 11. Independent Sample T-test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
QH1_1	Equal variances assumed	.404	.526	.381	184	.704	.082	.217
	Equal variances not assumed			.396	32.839	.695	.082	.208

It can be observe that the null hypothesis is not rejected and it can be concluded that the level of awareness is more or less same. The difference of awareness between two classes is just a matter of chance.

4. Discussion

The objective of the study is to identify the awareness level of the medical wearable devices but also to identify the prospective early adopters. In this study it has also been explored that the early adopters might not be the long term customers who intend to use these devices out of need for diagnosis/prognosis to avoid aberrations. Since the most aware age group 15-25 may not be the one who have unwell medical trajectory and are buying it out of perceived usefulness and perceived occurrence of aberration. So, we can identify the gap between the prospective targets customers on a long term and the present awareness level in the market.

In order to increase the awareness and make it affordable the startup's might face the challenge to not only create a suitable offering but make it adaptable to IoT Platforms of various stakeholders (Physicians, Hospitals, pharmacies, R & D/Analytics firms), which as a whole increase the value of the healthcare model.

References

Abdelgawad, A., Yelamarthi, K., & Khattab, A. (2017). IoT-Based Health Monitoring System for Active and Assisted Living. *Smart Objects and Technologies for Social Good*, 11-20. https://doi.org/10.1007/978-3-319-61949-1_2

Baig, M. (2017). A Systematic Review of Wearable Patient Monitoring Systems—Current Challenges and Opportunities for Clinical Adoption. *Journal of Medical Systems*, *41*(7). https://doi.org/10.1007/s10916-017-0760-1

Chen, L. B. et al. (2016). Wrist Eye: Wrist-Wearable Devices and a System for Supporting Elderly Computer Learners. *IEEE Access*, *4*, 1454-1463. https://doi.org/10.1109/ACCESS.2016.2553838

Chi, Y. M., Deiss, S. R., & Cauwenberghs, G. (2009). Noncontact low power EEG/ECG electrode for high density wearable biopotential sensor networks. In *Sixth International Workshop on Wearable and Implantable Body Sensor Networks* (pp. 246-250). https://doi.org/10.1109/BSN.2009.52

Crawford, E. C., & Charles, C. O. (2014). *Strategic Urban Health Communication*. Retrieved from http://www.springer.com/gp/book/9781461493341

Donald, L. (2014). *The Internet of Things and Life & Health Insurance*. Retrieved November 2016, from http://www.celent.com/reports/internet-things-and-life-helath-insurance

Ferguson, I. et al. (2016). *Mobile health: The power of wearable's, sensors and app to transform clinical*

trials (pp. 3-18).

He, D. et al. (2015). Robust anonymous authentication protocol for health-care applications using wireless medical sensor networks. *Multimedia Systems*, *21*(1), 49. https://doi.org/10.1007/s00530-013-0346-9

Hongyang, Z., Shuangquan, W., Gang, Z., & Daqing, Z. (n.d.). Ultigesture: A Wristband-based Platform for Continuous Gesture Control in Healthcare. *Smart Health*. https://doi.org/10.1016/j.smhl.2017.12.003

Hwang, C. (2014). *Consumers' acceptance of wearable technology: Examining solar-powered clothing* (Graduate Theses and Dissertations).

Ivaschenko, A., & Minaev, A. (2014). Multi-agent Solution for Adaptive Data Analysis in Sensor Networks at the Intelligent Hospital Ward. In D. Ślęzak, G. Schaefer, S. T. Vuong, & Y. S. Kim (Eds.), *Active Media Technology, AMT 2014*. https://doi.org/10.1007/978-3-319-09912-5_38

James, A. L. (2016). The Baetylus Theorem—The Central Disconnect Driving Consumer Behavior and Investment Returns in Wearable Technologies. *Technology and Investment*, *2016*(7), 59-65.

Kish, L. J., & Topol, E. J. (2015). Unpatients-why patients should own their medical data. *Nat. Biotechnol*, *33*, 921-924. https://doi.org/10.1038/nbt.3340

Kotler, P., & Armstrong, G. (2005). *Marketing: An Introduction*. Pearson Education.

Kuptsov, D., Nechaev, B., & Gurtov, A. (2012). Securing Medical Sensor Network with HIP. In K. S. Nikita, J. C. Lin, D. I. Fotiadis, & W. M. T. Arredondo (Eds.), *Wireless Mobile Communication and Healthcare*. https://doi.org/10.1007/978-3-642-29734-2_21

Misra, V. et al. (2016). *Mobile health: The power of wearable's, sensors and app to transform clinical trials* (pp. 3-18).

Park, E., Kim, K. J., & Kwon, S. J. (2016). Understanding the emergence of wearable devices as next-generation tools for health communication. *Information Technology & People*, *29*(4), 717-732. https://doi.org/10.1108/ITP-04-2015-0096

Ramasamy, S., & Balan, A. (2018). Wearable sensors for ECG measurement: A review. *Sensor Review*. https://doi.org/10.1108/SR-06-2017-0110

Richard, B. (2015). Wearable sensors bring new benefits to continuous medical monitoring, real time physical activity assessment, baby monitoring and industrial applications. *Sensor Review*, *35*(2), 141-145. https://doi.org/10.1108/SR-10-2014-722

Seram, N., & Dhramakeerthi, C. (2016). Wearable Technology Products: Awareness in SriLankan Market. *IJSMMRD*, *6*(3), 49-58.

Sicari, S., Rizzardi, A., Grieco, L., Piro, G., & Coen-Porisini, A. (2017). A policy enforcement framework for Internet of Things applications in the smart health. *Smart Health*, *3-4*, 39-74. https://doi.org/10.1016/j.smhl.2017.06.001

Sullivan, H. T., & Sahasrabudhe, S. (2017). Envisioning inclusive futures: Technology-based assistive sensory and action substitution. *Futures*, *87*, 140-148. https://doi.org/10.1016/j.futures.2016.06.006

Teng, X. F., Zhang, Y. T., Poon, C. C. Y., & Bonato, P. (2008). Wearable medical system for p-health. *IEEE Rev. Biomed. Eng.*, *1*(1), 62-74. https://doi.org/10.1109/RBME.2008.2008248

Topol, E. J. (2010). Consumer movement in Health care. *Pharos Alpha Omega Alpha Honor Med. Soc.*, *73*, 34-35.

Yin, Y., Zeng, Y., Chen, X., & Fan, Y. (2016). The Internet of Things in healthcare: an overview. *J. Ind. Inf. Integr.*, *1*, 3-13. https://doi.org/10.1016/j.jii.2016.03.004

Yiwen, G., He, L., & Yan, L. (2015). An empirical study of wearable technology acceptance in healthcare. *Industrial Management & Data Systems*, *115*(9), 1704-1723. https://doi.org/10.1108/IMDS-03-2015-0087

Zhelong, W., Cong, Z., & Sen, Q. (2014). A system of human vital signs monitoring and activity recognition based on body sensor network. *Sensor Review*, *34*(1), 42-50. https://doi.org/10.1108/SR-12-2012-735