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A Case Study On Empowering A Non-Profit Organization To Better Help People With Disabilities Through M-Health

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A CASE STUDY ON EMPOWERING A NON-PROFIT ORGANIZATION TO BETTER HELP PEOPLE WITH DISABILITIES THROUGH M-HEALTH

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ABSTRACT

Local non-profit organizations are constrained in developing efficient methods for helping people with disabilities confined at their own homes. The cost of labor of physically serving such people is a continued issue at the organizations. This case study explores an entrepreneurial focus on best-in-class applications of m-Health devices for improving methods of home medication support furnished by a leading metropolitan non-profit organization. This study explores further the potential of hosted infrastructure-as-a-service (IaaS) m-Health remote monitoring systems technology. The findings of this study can benefit non-profit organizations considering economic entrepreneurial innovation in interactive managed care technology.

Keywords: Applied Cognitive Devices, Entrepreneurship, Individual Residential Services, m-Health Apps, People with Disabilities, Remote Monitoring, Tele-Care, Tele-Health, Telemedicine

BACKGROUND OF PAPER

The domain of applied cognitive devices for people with disabilities is expanding with generic increased investment in health care technology (Stock, Davies, & Gillespie, 2013). Budgets in the health care industry increased 3.6%, as the industry led in information technology investment in 2012 (Eddy, 2014i). Estimates for applications (apps) of m-Health devices are forecasted to be increasing from $5.7 billion in 2013 to $12.6 billion in 2018 (Eddy, 2014f). Estimates for fitness and health devices, or "digital helpers" as an example from the literature, are indicated to be increasing from 40 million in 2013 to 70 million in 2018 - an evolution in health care in the country, forecasted to be a 142% increase in innovation in personal m-Health products, sensor services and technologies by 2018 (The Economist, 2014a). The domain is highlighted in investments of $564 million out of $2.2 billion in 2013 in entrepreneurial organizations by venture capitalists in the country that focus on the health care industry (The Economist, 2014a). The field of home health care mobile technology is increasing efficient methods for non-profit

organizations in helping people with disabilities if not in helping in the independence of these people. The more functional of m-Health technology is indicated in the monitoring of people with disabilities (Ebling, & Kannry, 2012, and Kahn, 2013), especially in mediation monitoring. The growth in this technology may contribute to a difference in the care management methods of non-profit organizations and importantly in the quality of life of the population served by them.

The applications (apps) of m-Health devices deployed for helping people with disabilities, and even people without disabilities, may be defined in this paper as fitness, health, medication, nutrition, and weight. Examples of best-in-class app devices found in the literature of practitioner publications (e.g., *eWeek Heathcare* and *IEEE Computing Now)* dated February – July 2014 are detailed below:

Table 1: Applications (Apps) of m-Health on Device Tools	
Fitness	**Generic Health**
Body Guardian BodyMedia Fit Fitbit Flex Wireless Activity + Sleep Wristband Hundred Pushups IntelliMat Jawbone Performance Stretchy 5K Runner Wahoo Tickr Rate Monitor	Alivecor Bean Brush Cardiac Rhythm Management (CRM) Care Partner Epocrates Heart Rate Earphone PerformTrek Pulse Oximeter Smart Diapers

Life Monitoring / Medication Monitoring	
DoseCast (Medication Reminder) Glow Cap (Simplified Medication Recording) iPharmacy (Medication Reminder) LifeLabs (Medication Spoon Taking by People with Tremors) MedicineCabine Timeline (Medication Recording) MedCoach Medicine Reminder (Medication Reminder) MedMinder (Medication Reminder) Medisafe Project (Medication Reminder System) MedsLog (Medication Reminder) Medsy (Medication Reminder) MotionPHR Health Record Manager (Medication Recording) Propeller (Medication Recording by People with Respiratory Trouble) Reminder Rosie (Medication Reminder)	

Nutrition	Weight
Diet Dot My Meal Mate Prep Pad	Calorie Counter & Diet Tracker Cardiocam Hapi Fork

These applications are deployed on devices of different hardware platforms (e.g., Android; Apple Store for i-Pad, i-Phone and i-Pod; Blackberry 10; Google; and Microsoft Windows smartphones and tablets) selectively (Horowitz, 2013). To facilitate a best-in-class interconnection of m-Health, established technology firms are differentiating products (e.g., Apple / HealthKit; Google / Health Data Tracking Service; and Samsung) for integration on non-wearables and wearables (e.g., on wrists); and even non-technology firms (e.g., Walgreens / At the Corner of Happy & Healthy) and insurance firms (e.g., UnitedHealthcare) are distinguishing m-Health products (Maisto, 2014a, 2014b and 2014c, The Economist, 2014c, and Weiss, 2014b). Less established technology firms are increasing investment in sensor wearables technologies (e.g., Cardiocom Medtronic / Heart; MC10 / Skin; MobiSante / Ultra Sound System; Proteus Digital Health / Stomach; and Verizon), in which information is real-time synced to smartphones (Sifferlin, 2013) and transmitted to internal non-profit organization systems (The Economist, 2012 and 2014a) or to external hosted infrastructure-as-a-service (IaaS) systems and technology.

Firms are increasing investment moreover in smartphones synced to be "digital first-aid kit" (e.g., CellScope / Otoscope) wearables (The Economist, 2012). Though m-Health sensors' technology may not be fully perfected as tools (Reynolds, 2014), the literature of practitioner publications is indicating positive progress with non-wearables and wearables (Dublon, & Paradiso, 2014, Eddy, 2014a and 2014e, Roggen, Perez, Fukumoto, and Van Laerhoven, 2014), especially with life monitoring / medication monitoring (Eddy, 2014g), as listed in Table 1, in mindful or "smart" houses or residences. The growth of applications of m-Health device technology from technology firms, and the potential progress of people with or without disabilities engaged with it, may contribute a desire for health care non-profit organizations to explore this technology.

The domain of application cognitive prosthetics for people with disabilities is not confined to localized m-Health tools, as the field may be enhanced with hosted infrastructure-as-a-service systems (IaaS) and tele-care technology (O'Hara, 2013) and eventually expanded with future technologies. To help non-profit organizations, technology firms are furnishing infrastructure-as-a-service systems (e.g., AbleLink Technologies / Everyday Skills, Visual Assistant and Visual Impact; AT&T / Cloud Video Patient Monitoring Service; Cisco / Tele Presence; IntelliMat; MediSked and Rest Assured / Remote Monitoring), beyond simplified systems (e.g., Philips / Lifeline) [Apostrophe, 2014b, Horowitz, 2012a and 2012b, and MediSked, LLC, 2013]. Estimates are forecasted for infrastructure-as-a-service remote monitoring technology from $10.6 billion in 2012 to $21.2 billion in 2017 (Bruzek, 2014). Future m-Health technologies (e.g., Google Glass and Google Smart Contact Lens) hold the potential for people with disabilities to

be more proactive about health care and quality of life (Apostrophe, 2014a, and Weiss, 2014a). Incubating technologies, such as electronic sensors on the skin for medication needs (Bennington-Castro, 2014), smart clothing (Velshi, 2013) and smartphone tricorders (Sabar, 2014), are promising for people with disabilities.

The potential of products in "smart" houses or residences (Krasher, & Harding, 2014), hyped in practitioner sources as the "Internet of Things" (McCafferty, 2014), in interoperability with m-Health tools (Vrbicky, 2014) is promising for people with or without disabilities. The potential of robotics (e.g., Jibo [Guizzo, 2014]) is real (Eisenberg, 2014, and The Economist, 2014b) for those with disabilities desiring to be in their own personal residences. To encourage an entrepreneurial focus on this gadgetry maze of m-Health, this paper explores the practical feasibility of m-Health technology for people with disabilities in a project at a leading non-profit organization.

INTRODUCTION TO CASE STUDY

The project of the case study commenced at AHRC New York City, a local non-profit organization for helping people with developmental and intellectual disabilities, in metropolitan New York. The non-profit organization engaged the Seidenberg School of Computer Science and Information Systems of Pace University on the project, as the school was already a participant with the organization on different outreach projects engaging people with disabilities with students of the school. The outreach projects engaged the people on diverse applications (apps) of mobile computing technology (e.g., i-Pads, smart tablets and speech tools) that helped them to be more self-advocates, having learned new presentation skills with the tools. The people, and health care professionals on the outreach projects, engaged with the students in the facilities of the school in the full semesters of the university. The existing partnership with AHRC New York City with the Seidenberg School on mobile computing technology was a favorable foundation for the project of m-Health mobile technology at the houses or personal residences of the people with disabilities.

One of the problems learned in the partnership with AHRC New York City was that a larger number of the people with disabilities served by the organization may not be able to manage medication in their own residences. The extent of managing medication (i.e., accurate dosing, administration of insulin, blood management, impacts of medications and refilling of prescriptions) may be beyond an issue in memory for the people, especially people with physical disabilities, and others of them having complex medication needs, complicating medication tasks to have to be done by the health care professional staff. Though a smaller number of the people may depend on family, friends or neighbors to be monitoring if not helping in the medication taking, a larger number of them do not have a community of localized support for this. The problem impacts the desirability of the people for independence in living in their own houses or personal residences, instead of in group residences that necessitate the need for medication taking to be performed by the professional staff; and this problem impacts the desirability of the organization for labor savings if the task was performed by most of the people themselves. The

non-profit organization may be helped in serving the people with disabilities with m-Health applications of medication monitoring on devices that may be non-wearables or wearables synced to monitoring systems of the organization.

The organization may be alternately or concurrently helped in serving these people with infrastructure-as-service (IaaS) remote monitoring systems if not with future incubator m-Health technologies. These people may be helped in increased independence and self-advocacy. The project of the case study is justified by the benefits that may be derived if AHRC New York City and the people with disabilities served by it leverage m-Heath technology.

The project is funded by the Helene & Grant Wilson Center for Social Entrepreneurship of Pace University. The project is further justified by the benefits that may be derived by an entrepreneurial focus on the feasibility of methods that might be engaged by AHRC New York City, in integrating m-Health with a budget constrained for investment in new technology – research is indicating however that non-profit organizations are eager to be more engaged in serving people with intellectual and developmental disabilities (NAAD e-Newsletter, 2014). The technology may be incrementally initiated with best-in-class applications of medication monitoring already initiated by other non-profit organizations (Eddy, 2014d), but with considerations for privacy and sensitivity of the people and for security of the technology. Those involved on the project are honors students of the university with an affinity for community service and m-Health technology and the professional staff of AHRC New York City. This case study furnishes new opportunities for both the staff and the students in interactive managed care technology.

FOCUS OF STUDY

The focus of the study is to explore the generic potential of applications (apps) of m-Health life monitoring / medication monitoring mobile computing technology. The goal of the study is to inquire into the power of this technology, and of infrastructure-as-a-service (IaaS) remote monitoring technology, in order to help people with disabilities in the management of medications in their own houses and residences; and to improve the methods of the non-profit organization in serving this population. The impact of new incubator prototype technologies in the health care industry is a limited objective of the study. This study is apt, as the market for health care mobile computing device technology is forecasted to be 500 million people with or without disabilities in 2015 (Global Services, 2013). This study benefits administrative, direct care and mental health professional staff at non-profit organizations to be current on managed care technology and impacts people with disabilities to be more self-advocates through m-Health and remote monitoring tools.

METHODOLOGY OF STUDY

The methodology of the project conformed to generic principles of case study of Yin (Yin, 2014). The study consisted of one faculty (first author) member in disability health informatics

of the Seidenberg School of Computer Science and Information Systems of Pace University; two honors undergraduate (second and third authors) students in community service and m-Health technology of the university; five health care managerial (two) and professional (three) staff of AHRC New York City and Learning Journey to Neighbors, Inc., an affiliated organization; and two people with disabilities served by AHRC New York City. The students were educated by the two managerial staff, as to methods of support to people with disabilities with *Wish Fulfilling Justice*: *Creating Individualized Residential Supports with Homebuilders* documentation of AHRC New York City (Mount, Gothelf, & Teich, 2009). The students evaluated m-Health applications (apps) of best-in-class life monitoring / medication monitoring technology, in Table 1, from leading health care and information technology practitioner publications dated February – July 2014 recommended by the first author. They were guided by the first author and by the two managerial staff in the learning process.

The highlight of the study was in independent semi-structured interviews of the two people with disabilities – one in his house and the other in an AHRC New York City location – by the two students. The objective of the interviews was to inquire into the entrepreneurial feasibility of functionality of m-Health medication technology and / or remote monitoring technology to help the two people manage medications in their houses; and to inquire into habits in their lives with or without technologies. A further objective was to learn the motivations of the two people to be independently proficient with new technology. The interview questions were pre-tested from *Innovation Site Inquiry*: *Observational Guide* documentation of AHRC New York City, which was the proven documentation of the organization on investigative techniques with previous population studies. The students learned moreover the role of the direct care staff in supporting the two people. The limited number of two people with disabilities was the maximum number for the funded period of the study from November 2013 – August 2014, but they furnished important input to the students. The two people were selected by the two managerial staff as pioneers in localized technology, in a limited population representation. The students however interviewed the five staff for insight on the people and on the potential of the technology. The students met with the first author and the two managerial staff following the interviews for subsequent insight.

The faculty (first author) member managed the students in the period of the study through interim reporting by the students, often on the discussion board of the Blackboard Academic Suite of the university that was shared with the two managerial staff.

ANALYSIS OF FINDINGS OF STUDY

The analysis from the project disclosed that applications (apps) of m-Health life monitoring / medication monitoring to be comfortably feasible for both of the people with disabilities in the study. Though the objective of the study was on medication monitoring tools, the analysis concurrently disclosed that applications of m-Health fitness, generic health and nutrition tools, in Table 1, and fundamental Internet tools to be comfortably feasible for both of the people. The analysis disclosed that deployment of m-Health tools, as non-wearables or wearables, to

equivalent people with disabilities in the larger population with the motivations and proficiencies of the people in the study may enable an improved quality of care by AHRC New York City and an improved quality of life for the people themselves.

Findings from the study are detailed below:

Findings from AJ (*)

AJ could be empowered by DoseCast, Glow Cap, iPharmacy, Lift Labs, MedCoach Medication Reminder, MedicineCabinet, MedsLog and Propeller, in Table 1. DoseCast could be especially helpful to AJ as a medication reminder, even though medication reminding was not cited by her as a problem. Fitness, generic health and nutrition tools could be further helpful to AJ, as she cited desirability for other m-Heath tools.

Google Glass with Google Maps could be an interesting tool for her, as she commutes in her neighborhood by wheelchair.

AJ could be an enthusiastic prototype for an electronic wheelchair with extended feature functionality that integrated into the wheelchair.

In short, AJ was comfortable with the functionality and intuitive interfaces of m-Health tools and with the functionality and positioning of wearables.

Findings from BT (*)

BT could be empowered by the medication monitoring tools in Table 1 cited by AJ. Glow Cap could be especially helpful to BT in opening caps of prescriptions; and Lift Labs could be especially helpful to him, as he has a tendency to tremor. Apple / Health Kit i-Pad tools could be interesting for him in further mediation reminding – he is an advocate for i-Pad tools.

BT could be an enthusiastic contributor to Skype, as he could interact with friends and heath care professionals through video conferencing in his house.

BT could be an excellent prototype for an electronic wheelchair that integrates tools to inform manufacturers of needed repairs to the wheelchair, as he is in a wheelchair.

In summary, BT was comfortable with the intuitive user interfaces and functionalities of m-Health tools, and with wearables (i.e. on his wrist) as “they would help me be me”, but he was not comfortable with camera-loaded remote monitoring tools, as they might intrude on his privacy.

Findings from AJ (*) **and BT** (*)

Both AJ and BT could be definitely helped by applications of m-Health non-wearables and wearables that could enable them to live a more proactive and productive quality of life.

Both were self-advocates for themselves.

Findings for AHRC New York City

AHRC New York City could improve its care of people with disabilities, such as AJ and BT, with entrepreneurial investment in a limited number of m-Health platform tools that could be extended to a larger population. The non-profit organization could initiate investment in best-in-class m-Health life monitoring / medication monitoring tools, already integrated in other organizations helping people with disabilities. The health care professional staff is proficient in the fundamental functionality of the device tools, which is an advantage for the organization in attempting to improve its methods with m-Health technology. An alternate but also concurrent strategy could be in initiating investment in infrastructure-as-service (IaaS) remote monitoring tools with a best-in-class cloud service provider (CSP) that is cognizant of privacy requirements and security. A concurrent strategy could be finally in initiating involvement with m-Health incubator shops on forthcoming tools that may benefit the people with disabilities supported by the organization.

The findings of the study were presented by the authors to the AHRC New York City management staff in the fall 2014 semester for follow-up in an investment in the technology in 2015.

(*) The names of the two people with disabilities on this project are confidentially initialed in order preserve privacy.

IMPLICATIONS OF STUDY

" … [People with or without disabilities] … do not have to be geek[s] to be part of this … (Malloch, 2014)

The benefits of m-Health life monitoring / medication monitoring are not limited to improved independence of people with disabilities served by AHRC New York City. Literature elucidates cost efficiencies from localized m-Health device tools (Eddy, 2014f and 2014i), and in the methods of non-profit organizations that support people in their own residences, such that less professional staff may be required to be supporting them, or less of their time may be required there. The findings of this preliminary study imply that efficiencies from less staff may not be enabled enough, given people with disabilities without motivations and without proficiencies for the tools due to their disabilities, or requiring some support even with the tools. Literature highlights issues of people with intellectual disabilities on mobile tools (Byren, Carey & Friedman, 2007). The implication is that the extent of financial organizational savings is a feasible but not an immediate proposition.

The empowerment of people with disabilities through m-Health technology is essentially irrefutable, but people with disabilities, like the people in the study, have to have the motivations and proficiencies to be proactive with the tools (Eddy, 2014b and 2014g). The profiling of the people as to their habits may be helpful in matching products if not modifying the m-Health tools to their life styles. The proliferation of tools to people with or without disabilities may require planning for improved universal design functionality of the tools (Schauer, & Vanderheiden, 2010) for the population segments of AHRC New York City. Their receptivity to m-Health

training is a further requirement. The implication is that m-Health is hinged on the private requirements of population segments suitable for it and the sensitivity to support them.

Though m-Health technology may be beneficial for people with disabilities at AHRC New York City, the privacy and regulation of sensors in tools are issues for organizations, especially for non-profit organizations. The information on people with disabilities in m-Health individualized sensors and networked sensors in tools may be divulged inadvertently or hacked intrusively (Hong, & Langheinrich, 2014), due to expected flaws of limited manufacturer security (Perez, & Huang, 2014) and also of openness of open source tools (Eddy, 2014h). The integration of m-Health provider remote monitoring technology with the tools may be impacted by issues of privacy and security, cited by one of the people in the study. The integration of household products of the "Internet of Things" (IoT) with m-Health tools may be a future but larger issue in security – "the Internet of New Things to be hacked." (Mitchell, 2014). The implication of this issue is that expanded information management of localized m-Health tools is a prerequisite for AHRC New York City, in order to properly protect the rights of those with disabilities.

Those with disabilities having the motivations and the proficiencies to be empowered with m-Health tools may be helped if not only they but also the health care – direct care - staff supporting them learn the tools. Inasmuch as new products of m-Health technology are frequently introduced on tools that may be more complex in feature functionality but more fruitful to these people (Palmer, Wehmeyer, Davies, & Stock, 2012), the learning of new suggested tools by the staff and them may be increased more at the non-profit organization. The implication is that people with disabilities training and staff training may be an inevitably more prominent program of AHRC New York City, in order to be productively state-of-the-art with the technology.

Finally, the non-profit organization may be helped with a best-in-class device management model of m-Health technology. The platform and product sprawl of sensors (Dublon, & Paradiso, 2014, and Mann, 2014) and tools may be managed more prudently with an existing information technology group that, in partnership with the health care managerial staff, recommends the most secure and suitable manufacturer m-Health tools to the organization (Bilton, 2014). Such a group may be responsible for pursuing relationships with incubator shops prototyping new tools (Analytics, 2014, and Eddy, 2014c). The larger role may be in responsibility for the infrastructure interoperability of the m-Health tools with internal systems and / or external provider infrastructure-as-a-service (IaaS) remote monitoring systems – an internal information technology group is the proper integrator of specific tools (Gallant, 2013). This implication is that the issue of management of m-Health mobile computing technology tools will be a more pronounced organizational requirement, in order to have reliable support to the staff and to those with disabilities in their residences.

LIMITATIONS AND OPPORTUNITIES IN RESEARCH

The small number of people with disabilities and professional staff in the paper is a clear limitation of the study, such that the findings may not be generalized without caution. The paper

evaluated the generic potential of m-Health technology, not the specific products of this technology. The paper was not a specific evaluation of the impact of the technology financially or procedurally. However, the paper confirmed anecdotal evidence in the organization and creditable literature in practitioner publications that m-Heart medication monitoring is an enabling technology, on non-wearables or wearables, for people with disabilities having the proficiencies to engage it, a larger likely segment of those with disabilities. The paper justifies a larger study, in order to pursue the benefits of m-Heath technology for both the organization and those supported by it, inasmuch as there are few scholarly studies of the topic.

CONCLUSION OF STUDY

The study explored best-in-class applications (apps) of m-Health technology, focusing on life monitoring / medication monitoring tools. The study found that the medication monitoring tools, and nutrition, generic health and fitness tools, may improve the quality of care by the non-profit organization and may improve the independence and the quality of life for people with disabilities with the motivations and proficiencies for the tools. The study found that innovation in new wearables may further improve the independence and the quality of life for these people. The study highlighted that infrastructure-as-a-service (IaaS) remote monitoring tools may be a feasible improvement in the quality of support, but issues of privacy and regulatory requirements and also security require sensitivity to those with disabilities. The findings of the study indicated entrepreneurial methods to minimally pursue investment in the medical monitoring tools. Though a larger study is needed to pursue the benefits of improved quality of care and quality of life, the people and the professional staff of the study were enthusiastic about the potential of non-wearables and wearables. The students of the study learned more of the power of the tools through practitioner publication research, which they shared with the people and the staff. In conclusion, the findings of this study furnished a foundation for increased managed m-Health care technology at this non-profit organization.

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APPENDIX

Alternate Research Sources for Further Study

Conferences:

Arizona Sonoran University Center for Excellence in Developmental Disabilities (UCEDD) Education, Research and Service – Webinar Series

Coleman National Conference on Cognitive Disability and Technology, University of Colorado.

Seidenberg School of Computer Science and Information Systems Healthcare: Innovation and Information Technology (IT) Lecture Seminar Series, Pace University

Publications:

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McKenna, M. (2013). The New Age of Medical Monitoring. *Scientific American*, March.

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Text:

De Pablos, P.O., et.al., Eds. (2011). Technology Enhanced Learning for People with Disabilities: Approaches and Applications. IGI Global, Hershey, Pennsylvania.

Keyes, J. (2014). BYOD for Healthcare. CRC Press: Taylor & Francis Group, Boca Raton, Florida.

Lazakidou, A., et.al., Eds. (2011). Wireless Technologies for Ambient Assisted Living and Healthcare: Systems and Applications. IGI Global, Hershey, Pennsylvania.

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