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Usability Evaluation of a Portable Health Information Kiosk Using a SMAART^{TM} Intervention Framework

Ashish Joshi[1], Mohit Arora[1] & Bhavya Malhotra[2]

[1] Graduate school of Public Health and Health Policy, City University of New York, New York, USA

[2]Foundation of Healthcare Technologies Society, New Delhi, India

Correspondence: Ashish Joshi PhD, MBBS, MPH, Associate Dean and Associate Professor, CUNY Graduate school of Public Health and Health Policy, City University of New York, 55 West 125th Street Room 715, New York 10027, USA. Tel: 1-443-570-6018

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Abstract

Empirical literature has shown that interventions to address social determinants of health are limited owing to poor integration of social and clinical data. The objective of this study was to describe a Sustainable, Multisector, Accessible, Affordable, Reimbursable, and Tailored framework (SMAART^{TM}) which was utilized to design and pilot test portable health information kiosk that can facilitate the integration of social determinants of health data with clinical data to enhance population health outcomes in global settings. The SMAART ^{TM} framework was designed using a combined approach of Data, Information Knowledge, Human Centered approach and behavioral humanistic and learning theories, and was applied to develop and evaluate an interactive, bi-lingual computer enabled portable health information kiosk. A convenience sample (recruitment based on accessibility to the researcher) of 149 individuals aged 18 years and above living in urban slum settings of India were enrolled in the year 2013. Subjective and objective data gathering included socio-demographics, clinical history, health behaviors and knowledge, attitude and practices. Weight and blood pressure levels were measured using physiological sensors. Usability assessment of the health information kiosk was also conducted. Results showed an increased burden of chronic non-communicable disease (NCD) risk factors and related knowledge, and lack of healthy lifestyle practices among urban slum individuals. Our study showed that the technology enabled SMAART ^{TM} framework can be utilized to develop an individual risk profile for better disease prevention, monitoring and management of chronic NCDs.

Keywords: framework, non-communicable disease, sustainable development goals, technology

1. Introduction

Health systems include all activities in which the primary purpose is to promote, restore, or maintain health. The rising world population, climate destabilization and scarcities are adding complications to the prospect of sustainable development in all parts of the world (Hennessy et al., 2007). Technological innovations allow individuals unique access to the information and computing power. Internet has become an integral part of the world economy and its ability to facilitate data storage and sharing much faster and more efficiently than before has accelerated diffusion of innovation for sustainable development (Zelenika & Pearce, 2013). Information and Communication Technologies (ICTs) are allowing organizations to share their collective resources and knowledge. These technologies can be presented and accessed in different formats, such as web-based applications, mobile phone and alert systems, or telephone and video conferencing. They have been recognized as effective measures for improving patient skills and knowledge increasing the likelihood of engaging in healthy behavior. ICTs have the potential to offer higher-quality services at lower costs (Lewis, Synowiec, Lagomarsino, & Schweitzer, 2012). However there are still challenges of utilizing ICTs in Low Middle Income Countries (LMICs), including lack of infrastructure and political support, trained health personnel and Internet access (Lewis et al., 2012).

Health and health problems result from a complex interaction of factors notably social determinants. The social determinants of health have gained importance in recent health policy discussions due to their importance in improving the health of populations. Education level, employment, income, family and social support, and community safety are all components of social and economic determinants of health (Braveman & Gottlieb, 2014). Unhealthy behaviors are commonly associated with lower social and economic position of population or

community. Poor education, lack of affordable housing, and insufficient income affect not just the individuals and families who have fewer resources but all the communities in which they live in (Shaw, 2008). Researchers estimate that access to quality medical care may prevent less than 20 percent of avoidable deaths. The remaining 80 percent of avoidable deaths are attributable to genetics (20 percent) and social, behavioral, and environmental determinants of health (60 percent) (Taylor et al., 2016). Improvements in education may have a large effect on health behaviors where knowledge is important (Starfield, 2006). The social determinants of health have linked adverse social, economic, and environmental conditions with poor health (Braveman, & Gottlieb, 2014).

Integration of clinical and non-clinical data sources by combining principles of ICTs to enhance population health outcomes across diverse geographic settings is a growing need. Interventions to address social, behavioral, and environmental determinants of health are less developed. This limitation hinders health policy makers in promoting innovative models of care despite the recognition of non-medical determinants of health. Population health methods and models can be enhanced by linking social and other non-medical information with clinical data (Robert Wood Johnson Foundation, 2016). Several challenges have been identified in the literature that limit the integration of social determinants of health data to facilitate informed decision making for improvement of overall population health. They include: i) limited knowledge of what works best ii) lack of standardization and tools iii) limited knowledge on how to link patient, population and public health data iv) poor understanding of communities by their health systems health systems v) lack of effective multi-sector collaboration, and vi) limited ability to identify and develop the right technologies (Robert Wood Johnson Foundation, 2016). Multi collaboration is therefore pertinent. These collaborations need to address not only who will collect data and how; but the methods by which it will be made available to different stakeholders; actionable steps to be taken by stakeholders; and the process through which the stakeholders can link different programs, policies and interventions (Robert Wood Johnson Foundation, 2016).

ICTs have globally transformed the paradigm of healthcare delivery into patient-centered care. Health education and promotion, remote monitoring and data collection, healthcare workforce training, surveillance and patient support are key ICT applications for LMICs (Lewis et al., 2012). This patient centered point-of-care approach allows healthcare services to be delivered in remote areas especially in isolated communities. However, barriers to health technology adoption persist and are often caused by cost, poor infrastructure such as lack or limited internet, or inadequate trained human resources (Howitt et al., 2012; Ortiz & Clancy, 2003). Three fundamental barriers exist to the greater adoption of technology in healthcare (ibid.). First, the necessary technology is not available. Second, the technology exists, but is not accessible (ibid.). Third, due to high costs, technology is not always used, even when accessible (ibid.). The necessity of offering higher quality services at lower costs makes the use of computer technology essential to support health outcomes (Joshi, Perin, & Arora, 2013; Anwar, Shamim, & Khan, 2011).

A key step to overcoming these barriers is addressing implementation challenges including: the willingness people to use the technology, scale-up of use, and issues of equity. Decisions about the implementation of a technology should combine a range of considerations including: cost per unit, how to encourage uptake, whether a technology can work in a particular setting and the best way to achieve implementation. This presents with an urgent need for low cost, accessible and affordable solutions to meet the demands of the local communities especially those in resource-poor settings (Howitt et al., 2012). Health information programs can be designed with high interactivity and usability levels, and deliver tailored health information according to the specific needs of the users in a community (Joshi, Puricelli Perin, & Arora, 2013).

The primary objective of our study is to describe a Population Health Informatics (PopHI) framework called SMAART^{TM} (Sustainable Multisector Accessible Affordable Reimbursable Tailored). It aims at guiding the development of tools and technologies that *integrate social determinants of health data with clinical data to enhance population health outcomes across individuals living in diverse geographic settings*. Further the study assesses the usability of a portable health information kiosk that utilizes SMAART^{TM} framework in addressing the burden of chronic non-communicable diseases (NCDs) in a community setting.

1.1 Conceptual Design of SMAART^{TM} Framework

Health does not occur in a vacuum. Instead, health status is embedded in larger living and working conditions. The larger social and economic policies and the economic resources available to the household can importantly affect health. Findings emphasize the need for policy makers, healthcare providers, and leaders from multiple sectors of society to use the currently available knowledge to improve living conditions and the health of populations (Williams, Costa, Odunlami, & Mohammed, 2008). Improvement in population health involves integration of complex, multidimensional data. It helps to identify patterns resulting in meaningful information (Stevenson,

Hogg, & Huston, 2007). The multidimensional analysis tends to be more in agreement with the end user's method of processing information. There is a growing need for methods and tools to support the construction of knowledge (Bhowmick, Griffin, MacEachren, Kluhsman, & Lengerich, 2008). The SMAART™ framework is designed and developed using the combined principles of Data, Information and Knowledge (DIK), Human Centered approach, Information processing theory and humanistic, behavioral and learning theories. This Population Health Informatics (PopHI) framework provides a platform to collect process and present population health data, in a meaningful and contextually relevant format that is easy to understand (Figure 1).

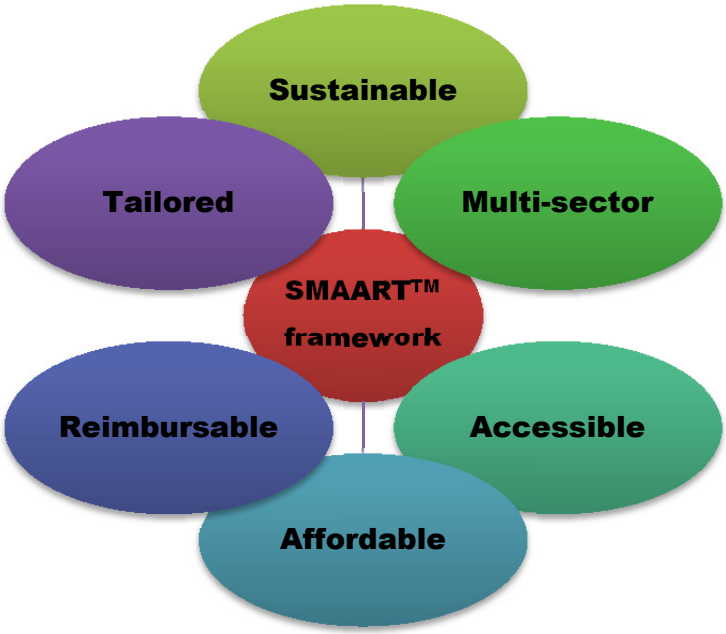

Figure 1. SMAART™ framework (Sustainable Multi-sector Accessible Affordable Reimbursable Tailored)

Data, Information, Knowledge Pathway: SMAART™ framework utilizes DIK pathway to make data more meaningful and consists of several components (Figure 2).

Data sources component: Social determinants of health data are typically organized at a geospatial unit and often has 3 dimensions: (a) attribute (i.e., context), (b) spatial (i.e., geographic) and (c) temporal (i.e., time). Attribute (context) component relates to issues of interest such as social and environmental data. Spatial (geographic) component includes data with location attributes (e.g. address, region, or country) and can provide insight into how and where to obtain important services. Temporal (time) component records time of the observation and enables users to learn from the past to predict, plan, and build the future. Data should be gathered on social determinants of health combined with clinical data across spatial and temporal dimensions to answer challenges related to how, who what, when and where.

Data Management component: This component includes data collection, validation, storage, data transformation, and making data available in a format that is ready to be analyzed.

Data Analysis component: This component includes arithmetic and comparison operators to compute means, medians, percentage distribution and 95% Confidence Intervals. The goal is to present data at both individual and aggregate levels.

Interactive visualization component: The goal is to display meaningful information in various formats including tables, charts, graphs and maps.

User Interface component: This component allows the individuals to interact with the data to conduct specific analysis and visualize the information based on their needs and the users perform.

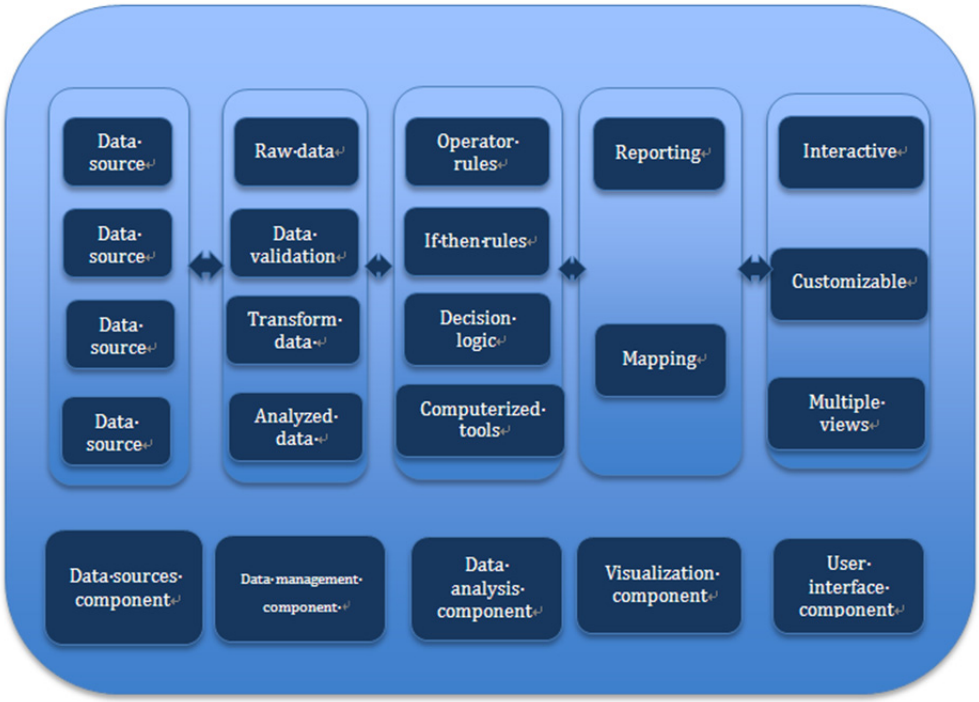

Figure 2. Proposed Data, Information and Knowledge pathway of SMAART™ framework

1.1.1 Theoretical framework of SMAART™

Human Centered and Cognitive Fit Theory Approach: The principles of Human Centered approach involve: (a) active involvement and understanding of users, (b) understanding task requirements, (c) appropriate allocation of function between user and system, (d) iteration of design solutions and (e) multidisciplinary design teams. Prior research has shown the need to have customized technology solutions to enhance population health outcomes. Human Centered approach incorporates the users' perspective in order to create a system that is useful and useable. Understanding users is an important aspect for creating SMAART™ applications. Tasks classification has shown to create useful applications (Wehrend, & Lewis, 1990). Interactions enable users to derive meaning and accomplish various analysis goals. Requirement analysis forms a basis towards development of the SMAART™ applications and tells what kind of functionality the SMAART™ applications should have or what it should be able to do. When the information presentation matches the task, it produces faster and more accurate results (Joshi, 2012). These benefits translate into system and task related performance factors. Cognitive fit theory (CFT) explains how graphical displays affect the decision processes (Chan, Goswami, & Kim, 2012). CFT depends upon fit between presentation of information and tasks used by the decision maker. Cognitive fit identifies an appropriate representation for a given task performed by users (Chan, Goswami, & Kim, 2012) (Figure 3).

SMAART™ intervention utilizing Information processing and Learning, behavioral and humanistic theories: It facilitates human centered SMAART™ interventions by facilitating health information and messages to be adapted depending on the psychosocial elements including attitude, self-efficacy, expectations, personal norms, and social cognitive theory. The principles of information processing theory are based on presenting information as a meaningful unit. By so doing, information is presented in a structured format and restricted to 5-9 pieces of text, making understanding easier. According to the learning behavioral and humanistic theories, information presented should be highly interconnected and relevant to the learner, multiple content formats and feedback given based on responses.

Usability and Health Technology Assessments: The evaluation component of the SMAART™ framework conducts health technology assessment, measures process outcomes and impact on cost, quality and access of healthcare services and change in both clinical and non-clinical outcomes.

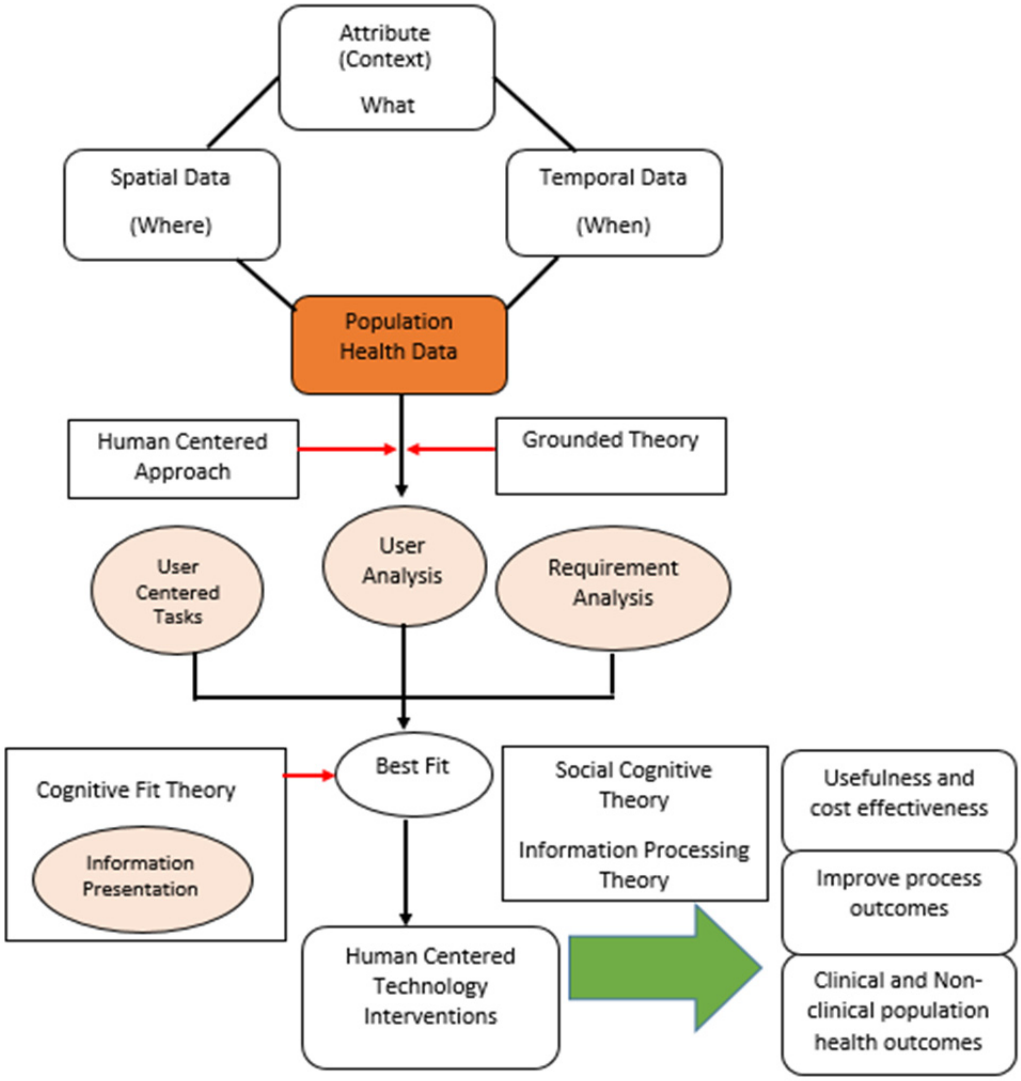

Figure 3. Theoretical framework of the SMAART^{TM}

1.1.2 Pilot Implementation of SMAART^{TM} Framework

The pilot study implemented presented here describes the usability evaluation of the Portable Health Information Kiosk using SMAART^{TM} framework. The details of the Portable Health Information Kiosk have been outlined in a previous paper (Joshi, A., Puricelli Perin, D. M., & Arora, M., 2013).

SMAART^{TM} framework is operationalized as an interactive, standalone, and an Internet enabled platform that facilitates (a) transmission of data and information regarding the health status of the consumer, (b) interprets data and information in an evidence-based manner (c) address the specific needs of the individual consumer, (d) timely feedback to the consumer addressing their requirements and (e) regular repetition of the feedback loop of information processing (Figure 3). There are different elements of SMAART^{TM} framework (a) multidimensional data assessment, (b) tailored risk profile, (c) personalized self-management strategies, (d) continuous progress monitoring, (e) interactive health education and shared decision-making (allowing users to obtain detailed information and recommendations on their low, moderate, and high risk parameters using a single click) (Figure 4).

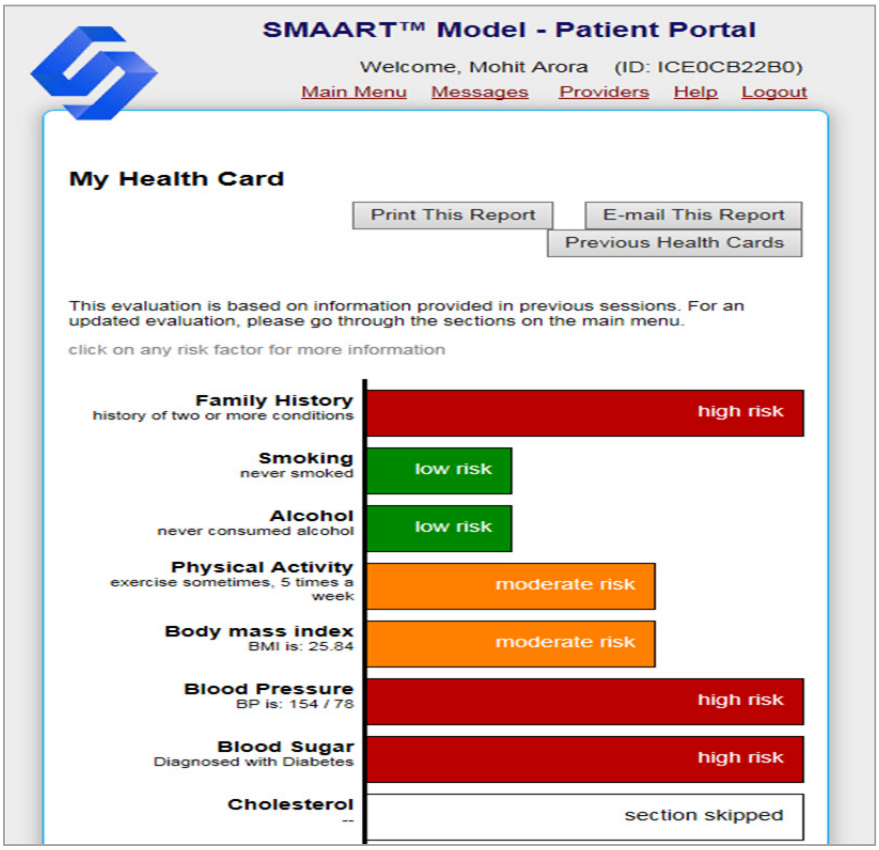

Figure 4. Snapshot of the SMAART health card

2. Methods

A convenient sample (recruitment based on accessibility to the researcher) of 149 individuals aged 18 years and above living in an urban slum setting of South Delhi, India were enrolled during the year 2013. Individuals recorded their health data using a touch screen, bilingual (English and local Indian Dialect Hindi), computer based program. Self-reported data was recorded using a series of multiple choice assessments. Objective data in this study was gathered using physiological sensors including weight scale and blood pressure levels. Individuals age 18 years and above, and those agreeing to participate, and living in an urban slum setting were enrolled into the study. Usability assessment was conducted with five response options for respondents using a 10-item System Usability Scale (SUS) and ranged from strongly agree to strongly disagree. The SUS a reliable, low-cost usability scale that can be used for global assessments of systems usability. Possible scores are 1, 2, 3, 4 or 5 for each question. The questions explain the complexity, functioning, ease of use, self-efficacy, and difficulty level associated with operating the system from the user's perspective (Bangor, Kortum, & Miller, 2008). None of the individuals enrolled in the study were asked for a follow up visit. The study was approved by the Institutional Review Board of the Foundation of Healthcare Technologies Society New Delhi IRB#FHTS/003/2013.

2.1 Variables Assessed

Subjective data assessments included self-report information about (a) Socio-demographics, (b) location of residence, (c) health behaviors, (d) clinical status and (e) Knowledge, Attitudes and Practices (KAP). Description of these variables has been outlined below.

- *Socio-demographics*: Age (years), Gender (males/female), Education attained (less than high school/some college/graduate and above/none),
- *Location of residence*: Data is gathered on the location of the individual residence including urban/slum/tribal settings
- *Health Behaviors:* smoking (presently/in the past/never) and alcohol history (presently/in the past/ never), drug, body mass index,
- *Clinical status*: ever been told by a doctor about high blood sugar (yes/no/I don't know), ever been

told by a doctor about high blood pressure (yes/no/I don't know), ever been told by a doctor about high blood cholesterol (yes/no/I don't know), and if yes are you currently being treated for your high blood cholesterol (yes/no/I don't know),

- *Knowledge, Attitudes and Practice (KAP):* Information was also gathered about the individual's level of understanding about the thresholds of being obese, hypertensive and at risk of being diabetic. Information was also gathered whether individuals were currently on treatment for any of the disease risks and the various approaches of treatment that were being utilized (e.g. medicine/diet/physical activity).

The objective data is gathered using multiple physiological sensors which capture individual weight, blood sugar and blood pressure readings. Algorithms ("if and then" rules applied to problem solving) are then applied to the collected data to generate an evidence-based report. This report is then displayed in an electronic format called a SMAART^{TM} health card (Figure 4). The SMAART^{TM} health card identifies risk factors of individuals across multiple variables and provides tailored recommendations and reinforcement (Figure 5).

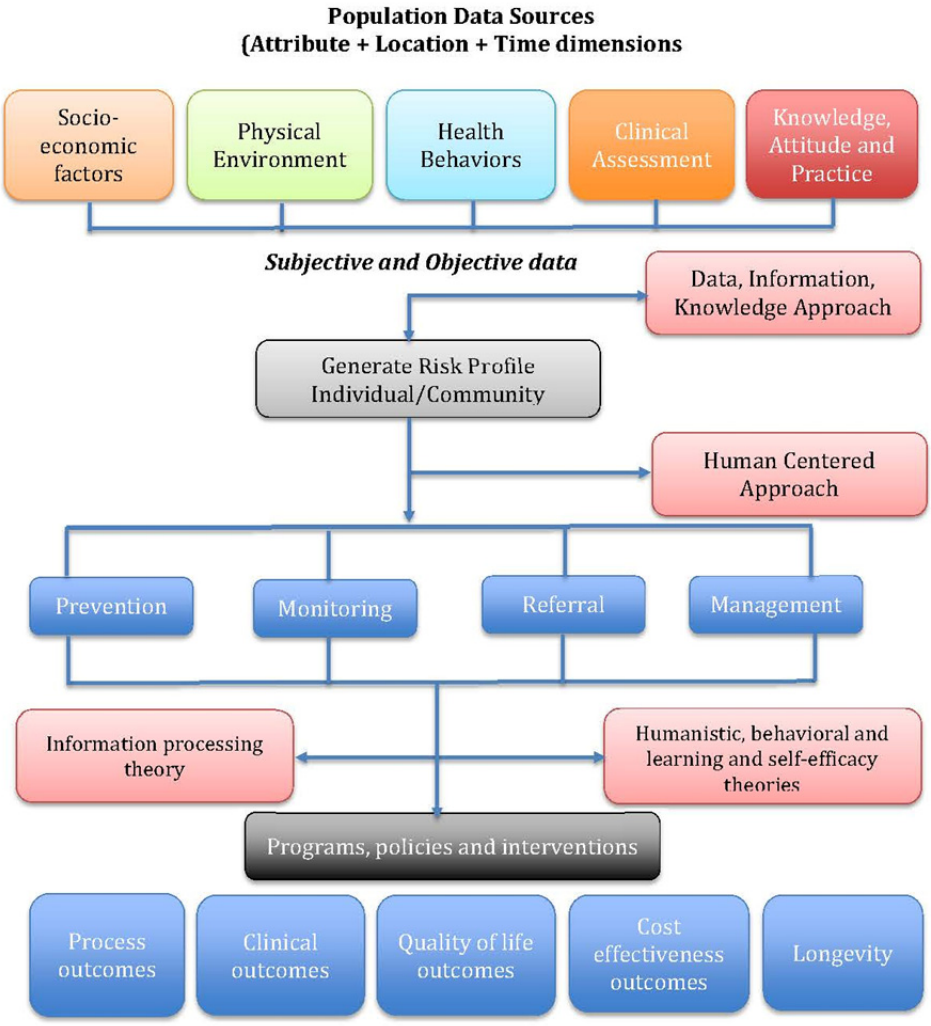

Figure 5. Implementation of SMAART^{TM} framework assessing burden of chronic, NCDs

3. Statistical Analysis

Descriptive analysis was performed to report means and standard deviations of the continuous variables and frequency distribution of the categorical variables. All quantitative analysis was performed using SAS version 9.1.

4. Results

4.1 Participant Characteristics

The average age of the study participants was 37 years (SD=15), and more than half of them were females (68%; n=98). Eighty nine percent of the study participants had almost none to less than high school education. More than half of them (71%; N=103) had no family history of diabetes, hypertension, high cholesterol and heart disease. About 21% (N=30) of them had history of current or previous smoking. Similarly 19% (N=27) had history of current or previous alcohol consumption (Table 1).

Table 1. Descriptive analysis of the study participants

Social determinants of Health	Variables Assessed	Characteristic attributes	Results
Socio-Demographics	**Age**	years	Mean=37; SD=13.88
	Gender	Males	32% (N=46)
		Females	68% (N=98)
	Education	Less than high school	46.5% (N=67)
		Some College	5.5% (N=8)
		Graduate	5.5% (N=8)
		Post Graduate	1% (N=1)
		Professional	
		None	41.5% (N=60)
Family History	**Did anyone in your family have the following? Select all that apply**	Diabetes	11% (N=16)
		High Blood Pressure	15% (N=22)
		High Blood Cholesterol	1% (N=1)
		Heart Disease	2% (N=4)
		None of them	71% (N=103)
Lifestyle behaviors	**Body Mass Index**		Mean=25.1; SD=5.25
	Smoking		
	Currently		14% (N=20)
	In the Past		7% (N=10)
	Never		79% (N=114)
	Alcohol		
	Presently		12% (N=17)
	In the Past		7% (N=10)
	Never		81% (N=117)
	Do you ever exercise?		
	Yes		28% (N=40)
	Sometimes		21% (N=30)
	No		51% (N=74)
	How many times a week do you exercise?		Mean=6; SD=3

Based on the BMI levels, individuals were classified into underweight (<18.5), normal (18.5-24.9), overweight (25-29.9) and obese (>=30) categories. Nearly 47% of the study participants were overweight to obese (Figure 6). More than half of the study participants (51%; N=74) reported that they never exercise. Results also showed that

nearly 45% of the study participants who never exercised were overweight to obese.

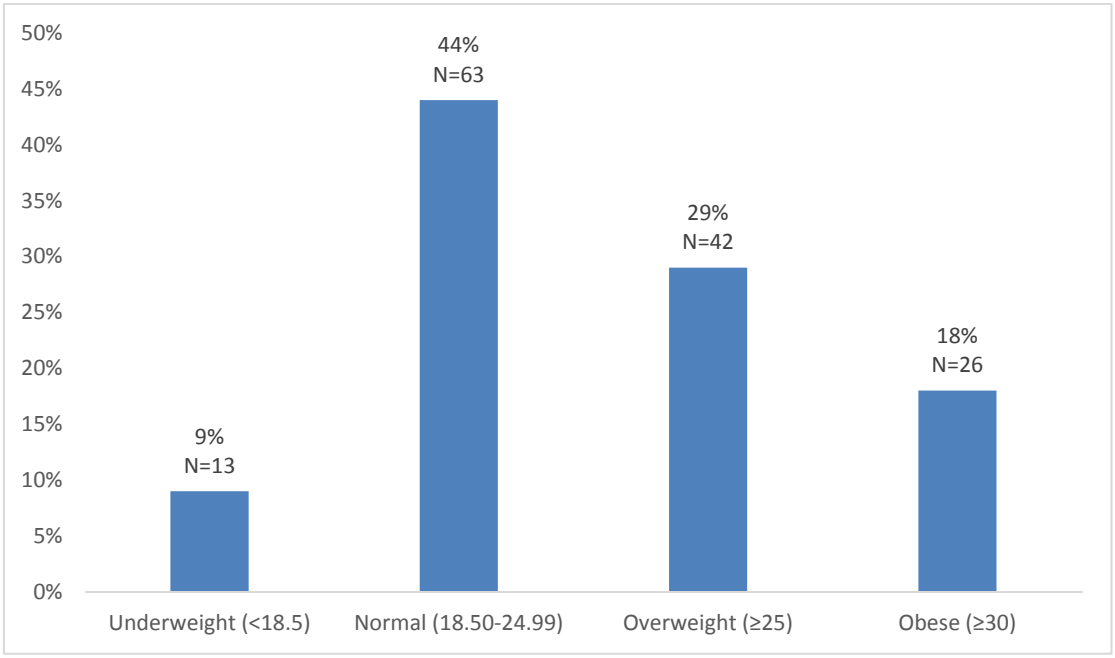

Figure 6. Percentage distribution of study participants across various BMI categories

4.2 Clinical Assessments

Self-reported data

Self-report information about individual diabetes, hypertension and high cholesterol status was recorded (Table 2). About 12% of the study participants had been told by their doctor that they have diabetes while 28% of them were told by their doctor of having high blood pressure. The average systolic and diastolic blood pressure levels was 123mm Hg (SD=20) and 75mm Hg (SD=12). Nearly 30% of the participants were not even aware about their cholesterol status.

Table 2. Percentage distribution of study participants for clinical assessments

Clinical variables assessment	**Yes**	**No**	**I don't know**
Have you ever been told by your doctor that you have Diabetes/High blood sugar?	12% (N=17)	72% (N=104)	16% (N=23)
Have you ever been told by your doctor that you have Hypertension/High blood pressure?	28% (N=41)	58% (N=84)	13% (N=19)
Have you ever been told by your doctor that you have Hypercholesterolemia/High blood cholesterol?	1% (N=2)	69% (N=99)	30% (N=43)

Of the 84 study participants who were never told by their doctor that they have hypertension or high blood pressure, 49% (N=41) of them had high blood pressure levels (Figure 7).

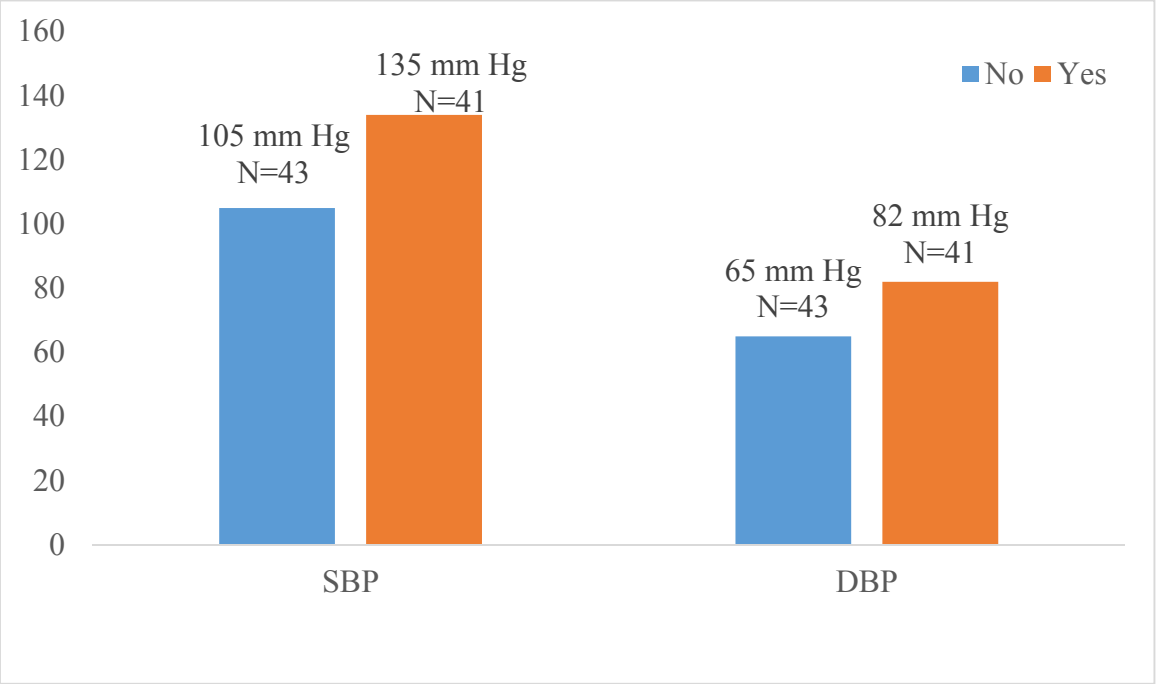

Figure 7. Comparing average Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) readings among those study participants who were never told by their doctor of having high blood pressure

4.3 Objective Data Assessments

Objective data assessments were recorded using physiological sensors such as blood pressure and weight scale measurements. Individuals based on their blood pressure readings recorded were classified using JNC7 guidelines to (a) Normal (<120 and <80mm Hg), (b) Prehypertension (120-139 or 80-89mm Hg), (c) Stage1 hypertension (140-159 or 90-99 mm Hg) and (d) Stage 2 hypertension (≥160 or ≥100 mm Hg) (James et al., 2014) (Table 3). Results showed that of the 41 individuals whose doctors had reported them of being hypertensive, 39% of them had their blood pressure levels within a normal range at the time of participation in the study, 27% had their blood pressure levels in the prehypertensive stage, 29% had their blood pressure levels in stage1 hypertension and remaining 5% in stage2 hypertension. However, those individuals who were never reported by their healthcare professional of being hypertensive, nearly 44% of them were either prehypertensive, or were in stage 1 or stage 2 of hypertension (Table 3). Based on blood pressure measurements and JNC7 guidelines, nearly 49% (n=71) of the individuals were either prehypertensive or were in stages1 or 2 of hypertension (Figure 8).

Table 3. Classification of study participants into hypertension based on the healthcare professionals who reported them to be hypertensive and those whose blood pressure levels were high during their blood pressure measurements

JNC 7 guidelines	Self-Report Hypertension		
	Yes	No	I don't know
	N=41	N=84	N=19
Normal (<120 and <80mm Hg)	16 (39%)	47 (56%)	10 (56%)
Prehypertension (120-139 or 80-89mm Hg)	11 (27%)	25 (30%)	3 (17%)
Stage1 hypertension (140-159 or 90-99 mm Hg)	12 (29%)	6 (7%)	2 (11%)
Stage2 hypertension (≥160 or ≥100 mm Hg)	2 (5%)	6 (7%)	3 (17%)

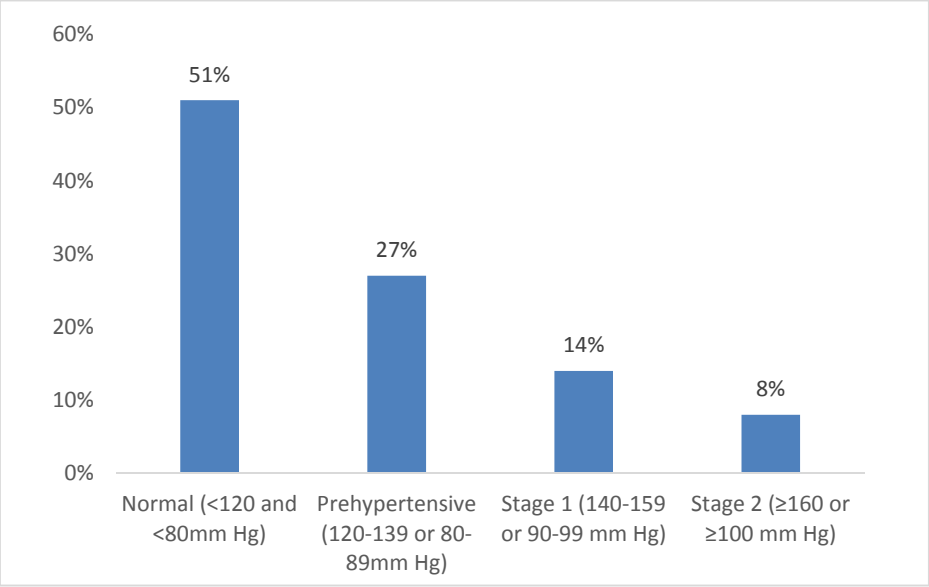

Figure 8. Classification of individuals into various hypertension categories based on their objective data measurements

Additional analysis was performed to determine the frequency distribution of study participants who were not doing regular exercise and their hypertension classification status based on JNC7 guidelines. Results showed that more than half of the individuals who were in the Pre Hypertensive stage were not exercising (51%), compared to the 35% who were in stage 1 and 45% who were in stage 2 of hypertension levels. These results clearly demonstrate an urgent need to develop lifestyle interventions especially among those who are already at a high risk of acquiring chronic, NCDs combined with poor socio-economic status.

4.4 Knowledge, Attitudes and Practice (KAP) Assessment of Blood Pressure and Obesity Levels

Individuals' Knowledge, attitude and practice (KAP) about their understanding of blood pressure levels was also assessed. Results showed that only 38% of the overall study participants were able to correctly report their hypertensive status based on their blood pressure measurements. (Table 4). Similarly, only 36% of the total study participants were able to correctly report their correct category based on their body mass index levels (Table 4).

Table 4. Individual's perception about knowledge related to hypertension classification based on their blood pressure measurements

JNC7 classification	**Self-report hypertensive assessment**			
	Normal	Pre-hypertension	Hypertension	I don't know
Normal	39 (53%)	26 (36%)	1 (1%)	7 (10%)
Pre-hypertension	22 (56%)	9 (23%)	1 (3%)	7 (18%)
Stage1 hypertension	7 (35%)	4 (20%)	5 (25%)	4 (20%)
Stage2 hypertension	6 (55%)	2 (18%)	1 (9%)	2 (18%)
Body Mass Index Levels Assessment				
Body Mass Index levels	Underweight	Normal	Overweight	Obese
Underweight	4 (31%)	16 (25%)	6 (14%)	5 (19%)
Normal	8 (61%)	39 (62%)	24 (57%)	3 (12%)
Overweight		4 (6%)	7 (17%)	9 (35%)
Obese			2 (5%)	2 (8%)
I don't know	1 (8%)	4 (6%)	3 (7%)	7 (27%)

4.5 Treatment Practices for Diabetes and Hypertension

Less than fifty percent of the individuals who self-reported of having diabetes were currently being treated (47%; N=8). Similarly only 39% (N=16) of the individuals who self-reported of having hypertension were currently being treated (Table 5).

Table 5. Treatment practices for diabetes and hypertension among individuals

Practice Assessment	**Response Options**		
	Yes	No	I don't know
Are you currently being treated for your high blood sugar?	47% (N=8)	47% (N=8)	6% (N=1)
Are you currently being treated for your Hypertension/ High blood pressure?	39% (N=16)	59% (N=24)	2% (N=1)

Of the people who were currently on treatment for Type 2 diabetes, 100% of them were receiving medications, but only 25% of them were adopting lifestyle changes such as diet and physical activity. Only 12% of the diabetic and 25% of the hypertensive individuals were following all 3 components of medication, diet and exercise to address their disease (Figure 9).

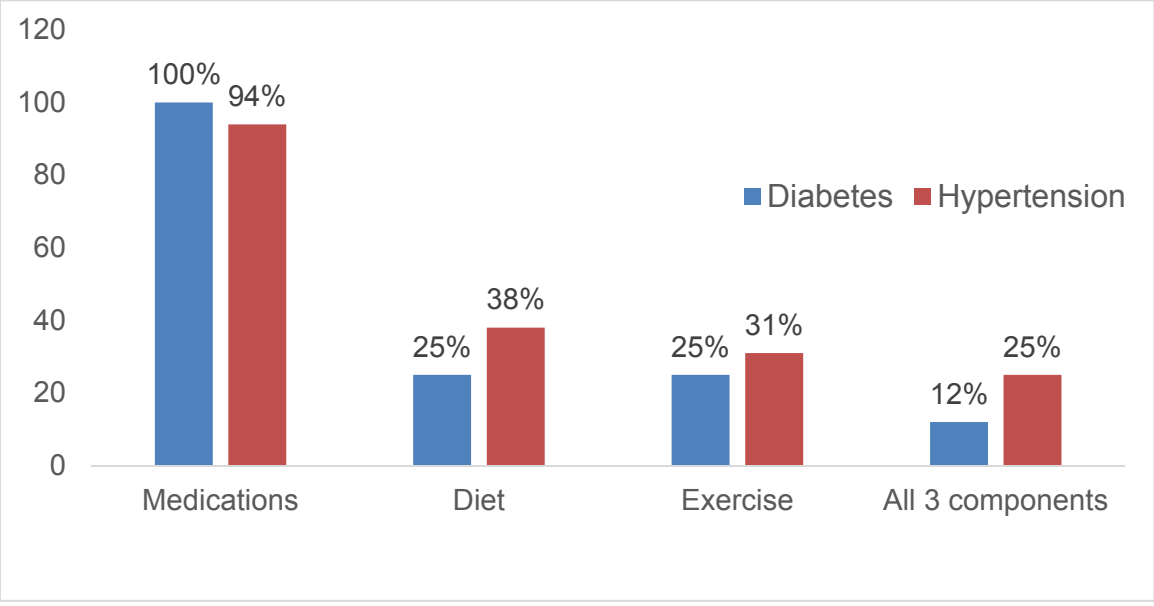

Figure 9. Percentage distribution of different treatments among individuals with diabetes and hypertension

4.6 Usability Assessment

Usability testing is a key component of product evaluation, and focuses on measuring a product's ability to meet its intended purpose by providing evidence on how real users interact with it. Results of our study showed high acceptance of portable health information kiosk by the 149 study participants living in urban slum settings. The study participants were able to navigate through the program with ease and found it useful to receive an electronic SMAART^{TM} health card that provided them personalized feedback based on their responses (Table 6).

Table 6. Usability of portable health information kiosk using SUS

System Usability Scale (SUS)	Strongly disagree				Strongly agree
	1	2	3	4	5
I think that I would like to use this system frequently	3% (N=5)	0% (N=0)	1% (N=2)	13% (N=19)	82% (N=122)
I found the system unnecessarily complex	83% (N=124)	3.5% (N=5)	3.5% (N=5)	1% (N=2)	9% (N=13)
I thought the system was easy to use	2% (N=3)	1% (N=2)	3% (N=5)	18% (N=26)	76% (N=113)
I think that I would need the support of a technical person to be able to use this system	10% (N=15)	1% (N=1)	21% (N=30)	12% (N=18)	56% (N=82)
I found the various functions in this system were well integrated	3% (N=5)	1% (N=1)	9% (N=13)	15% (N=22)	72% (N=108)
I thought there was too much inconsistency in this system	71% (N=105)	5% (N=8)	12% (N=18)	2% (N=3)	9% (N=14)
I would imagine that most people would learn to use this system very quickly	1% (N=2)	1% (N=1)	14% (N=20)	24% (N=36)	60% (N=89)
I found the system very cumbersome to use	79% (N=117)	6% (N=9)	11% (N=16)	1% (N=2)	3% (N=4)
I felt very confident using the system	5% (N=7)	3% (N=5)	3% (N=5)	7% (N=10)	82% (N=121)
I needed to learn a lot of things before I could get going with this system	42% (N=61)	3% (N=4)	20% (N=30)	11% (N=16)	24% (N=36)

5. Discussion

Results clearly show the need to develop lifestyle interventions that can supplement medication management to address the rising burden of chronic, NCDs especially among individuals living in under resourced settings. An interactive, bi-lingual program in a community setting can help assess the burden of risk factors of the study participants, and also examine their knowledge, attitudes and practices towards self-management of their disease. The results add to the growing literature demonstrating the use of computer technology for self-management in populations living in underserved settings. Delivering preventive and self-management tools by implementing SMAART^{TM} framework in a culturally relevant manner can help facilitate change in the knowledge, attitude, and practices related to chronic NCDs.

The current study describes the implementation of a Portable Health Information Kiosk using novel Population health Informatics SMAART^{TM} framework (Sustainability, Multi-sector, Accessible, Affordable, Reimbursable, and Tailored). The results of our study help us to identify individuals who could possibly be at risk of developing chronic, NCDs, or need more monitoring of their clinical and behavioral risk factor monitoring, or need institutional referral for targeted interventions and also need personalized lifestyle interventions to manage their disease. The platform serves a great purpose as it provides an opportunity to those individuals who might never be seeking care, or might be ignorant of their health condition. The whole purpose of this study was to evaluate the feasibility of a SMAART^{TM} framework to facilitate integration of social determinants of health data with clinical data for optimal interventions especially among populations living in underserved settings.

Some of the significant findings of our study show that nearly 47% of the individuals were in overweight to obesity category, 45% of them were not exercising, 49% of them were in prehypertensive, stage 1 and stage2 of hypertension, nearly half of them were not receiving any treatment for diabetes and hypertension. Even those who

were receiving treatment, they were receiving only medications with no diet or exercise management. Prior studies have shown an increased burden of non-communicable diseases (NCDs) in low-income and middle-income countries (World Health Organization, 2006). Cardiovascular disease (CVD) is a major contributor to the increasing burden of NCDs in these low-income and middle-income countries (Gaziano, 2005). There is a strong need to invest in the prevention of NCDs and of community screening in a cost effective manner (World Health Organization, 2005).

Results of the current study highlight the significance of conducting usability assessment of the health technology platforms among individuals with low to limited literacy levels. Further the results of the study show how the portable health information kiosk can be utilized in non-clinical settings to identify the burden of risk factors of various chronic disease related co-morbidities. In addition, combination of self-report data, knowledge attitude and practices, with objective measures of recording blood pressure and weight scale through physiological sensors provide an opportunity to assess the burden of chronic disease risk in a community setting. There were several limitations of the current study. The study had a small sample size and hence generalizability of the results is difficult to be determined. Second, additional research is needed across other diverse settings to determine if the findings of the student are replicable.

Population-based approaches can meet the needs of low-resource settings, which face human and fiscal resource shortages (World Health Organization, 2005). Community support and contribution to ensure improved health outcomes is needed (World Health Organization, 2005). It has been recommended that there is a need for task sharing of some of the prevention work with community health workers (Beaglehole et al., 2008). However, community health workers are often not well trained to manage NCDs (Fulton et al., 2011). New mobile information technologies are being developed, tested, and piloted with community health workers (Fulton et al., 2011).

6. Conclusion

There is a growing significance of using Information and Communication Technology (ICT) to improve healthcare services as it enables to provide health services far from the clinical setting, in remote areas, and among hard to reach communities. Health care can become more accessible to patients due to reduced time and expense of travel. Portable Health Information Kiosk based on the SMAART^{TM} framework is one of the innovative ways to bring ICT to the community setting to identify individuals who are already at high at risk of developing chronic, NCDs. Cost-effectiveness and sustainability of Portable Health Information Kiosk is ongoing to examine the delivery of preventive, monitoring, referral and lifestyle interventions among individuals living in diverse settings. .

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Competing Interests Statement

The authors declare that they have no competing or potential conflicts of interest regarding the publication of the paper.

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